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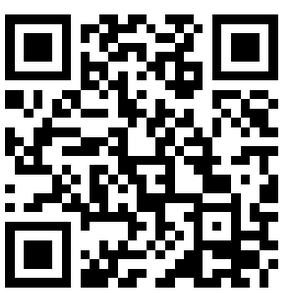

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INDUSTRIAL ORGANISATION.

As a nation we know a good deal more about German means and methods than we did a year and a half ago, and the voices of those who have cried for years in the wilderness anent the national importance of industrial reform are now listened to. The outstanding characteristic of the German is his thoroughness. It permeates his every walk of life—even his methods of "frightfulness." At times this characteristic, coupled with a good proportion of *Dummheit*, leads him into the most absurd and "impossible" of situations (as witness the majority of his diplomatic machinations)—at times, it leads him into a positive bewilderment of micro-detail (as witness many of his researches, which produce an amazing wealth of indigestible data but no conclusions). These, however, are the results of becoming obsessed by the system, and they do not alter the fact that Teutonic developments during the past fifty years have largely resulted from Teutonic thoroughness. Without any attempt to transplant a German quality to an uncongenial soil we shall do well to adapt any good features that we have observed in German industrialism and commercialism to our own circumstances before the German detects and tries to remedy the defects of his system.

As we have heard very frequently of late, the broad principles of prosperity are that as little as possible of manufactured products be imported, and that organised efficiency of equipment, processes and policy be found not only in individual firms and individual industries, but also in our national industry as a whole. A central body is needed which shall be qualified and equipped to collect information relating to markets and sources of supply and able to deal with the whole of our industry and commerce as one vast business enterprise. In a large industrial undertaking there are frequent conferences of departmental heads to ensure that the whole concern which may embrace works in half a dozen towns, is taking best joint advantage of markets and transit facilities. From time to time, fresh works or fresh departments are started to take advantage of the by-products of others or to supply the needs of others in the joint concern. Why should such organisation and such policy stop short at the largest private firms? Why not national conferences along similar lines? If Government lethargy and hopeless officialdom form the chief stumbling block, then that block should be cleared away, or else the manufacturers and commercial firms of this country must establish an organisation of their own. There seems nothing impossible in the suggestion that every firm should be given a number of votes proportional to its productive turnover, and invited to assist in electing a central body which should have the development of national industry and commerce as the beginning and end of its aims.

If there be a chance of such a body getting effectively to work, it is imperative that the first steps be taken by firms and individuals of high standing,

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so that no suspicion of private interest be aroused, and it is equally important that it be understood that the co-operation of every firm, large and small, is needed. There can thus be formed what may be called an Industrial Parliament, entirely free from the baneful influence of politicians. Its resources will be immense without placing any appreciable burden on individual "constituents." Provided that there is nothing of a hole-in-the-corner nature about the floating of such a scheme, there seems to be no reason why it should not at once assume national proportions. As a national organisation, embracing every industry, nothing could resist its activities, and we believe that on a proper elective basis it would command general confidence and energetic support.

A matter closely associated with the lessons in national industrial organisation and intensive organisation of individual works taught to us by the present war, is the value of national testing and approving. For years past the National Physical Laboratory has been gaining rapidly in reputation, and ever-increasing numbers of private firms have taken advantage of the services it offers in standardisation and testing work. Now that it has been made the final arbiter in so many matters connected with the production of munitions, its scope and qualifications should be brought home more clearly than ever to manufacturers all over the country, and its relations with British industry should be permanently improved thereby, to the benefit of all concerned.

It is no mean work which the National Physical Laboratory has accomplished in extending its staff and equipment to undertake the responsible work of testing wireless and all sorts of other electrical equipment—on top of an immense amount of research work and mechanical standardisation and testing, such as inspection of gauges (the final arbiter of accuracy in shell production), testing constructional materials, and so on. In due course publication of what has been done, and the means whereby the high standard of precision has been maintained, should inspire confidence and excite that interest which has unfortunately been rather lacking in the past. In short, its services in war work should place national testing and standardisation on a broader, firmer basis than heretofore. This, in conjunction with the revolutionary reorganisation which has taken place in our industry as a whole, will place us in a much better position to face the industrial struggle to come. And there is reason to believe that we shall need every advantage that can be given to us by circumstances and by our own efforts.

Telephony in 1915.

THE outbreak of the conflict now raging between civilisation and barbarism cut short experimental research in the Old World and compelled our investigators to turn their attention from peaceful progress to the arts of war; especially was research in wireless telegraphy and telephony forbidden ground except to the scientific staffs of the Army and Navy. Just before the commencement of the war sundry hints were thrown out by the Marconi Co. as to the approaching success of its efforts to place wireless telephony on a commercial footing, but whether sufficient progress had been made to enable our defenders to make use of it in the course of their operations we do not know, and if we did, we should not tell. But in the Western Hemisphere no such restrictions obtained, and our American friends made good use of the unique opportunities at their command, with the result that the year 1915 will for ever be distinguished by two great achievements—trans-Continental and trans-Atlantic telephony.

The former was inaugurated on January 25th, when the veteran inventor of the telephone, Dr. Alexander Graham Bell, conversed with his assistant of 1876, Mr. T. A. Watson, over 3,400 miles of line between New York and San Francisco, a line consisting of 1,480 tons of copper wire per circuit, carried on no fewer than 130,000 poles. That the human voice unaided should be capable of energising so great a mass of metal, of so attenuated dimensions, so effectually as to be recognisable at the far end of the line, is inconceivable; the feat, in fact, was only made possible by injecting into the circuit energy derived from external sources by the aid of relays, the development of which in itself was a striking achievement.

No such assistance *en route* was possible in the case of wireless telephony; once launched, the etherial vibrations must pursue their course on their own merits, and therefore we may perhaps regard the latter accomplishment as the more remarkable, although it represented only a tentative performance, and has not, like the former, become a commercial proposition. In this instance the human voice controlled at their source electric waves which traversed a distance of 4,900 miles, and still remained capable of being understood when reconverted into sound waves. As the longest distance covered in the former case was 4,750 miles, the palm for the greatest distance of transmission of speech must be awarded to wireless telephony. What will be accomplished in the future we cannot say, but we can safely predict that future achievements will put in the shade anything that we dare imagine now. And these two great feats in themselves suffice to mark the year as one of the most notable in the history of electrical methods of communication.

Copper.

THERE has been no holding back the copper market, the strength of which increased daily during the closing weeks of the old year, and which shows no signs whatever of relaxing. There has been an enormous business done in America, a large proportion of which was on behalf of the Allied Governments, and it was the buying in this connection which definitely pushed the market up to round 22 cents a lb. for electrolytic, the movement in America being followed by an upward rush in prices here which has carried refined material to about £111 a ton c.i.f. Liverpool. The position is one of the greatest gravity, for stocks have been reduced to entirely trifling proportions, and it seems hopeless to look for any substantial abatement in the material conditions ruling the market at the present juncture. It is all too apparent that the world's production has proved unequal to meeting the enormous demands for munitions. While production cannot well be extended, there seems no limit to the absorption of metal for war purposes. It is estimated by those in a position to speak with some authority, that the Allies are using up about 35,000 to 40,000 tons of copper a month, and the estimate seems to be pretty well based as far as can be ascertained from the broad indications available.

There are, of course, no approximate figures either of production or consumption now issued, but as the world's output of copper can be put down at about a million tons a year, the importance of the war can easily be gauged from a consideration of the facts set forth. So far as general consumption is concerned, each week sees a lessening in the business done. Labour scarcity is reported in all directions, while copper is practically too dear to be used for anything other than munition requirements, where expense is a factor which never enters into consideration. How far the upward movement may be carried is a mere matter of conjecture, but it may be said that there is not the slightest sign, so far, of any relief coming to the situation. No doubt, if there were any sign of peace there would be a sharp break in prices, but it is by no means a foregone conclusion that the termination of hostilities and the resumption of normal national conditions in Europe would produce a permanent lowering of prices, for the accumulated demands of the warring nations, to say nothing of the necessity of making good the hundreds of millions sterling of damage, might quite easily keep copper for an indefinite period upon a higher plane than has been seen within living memory.

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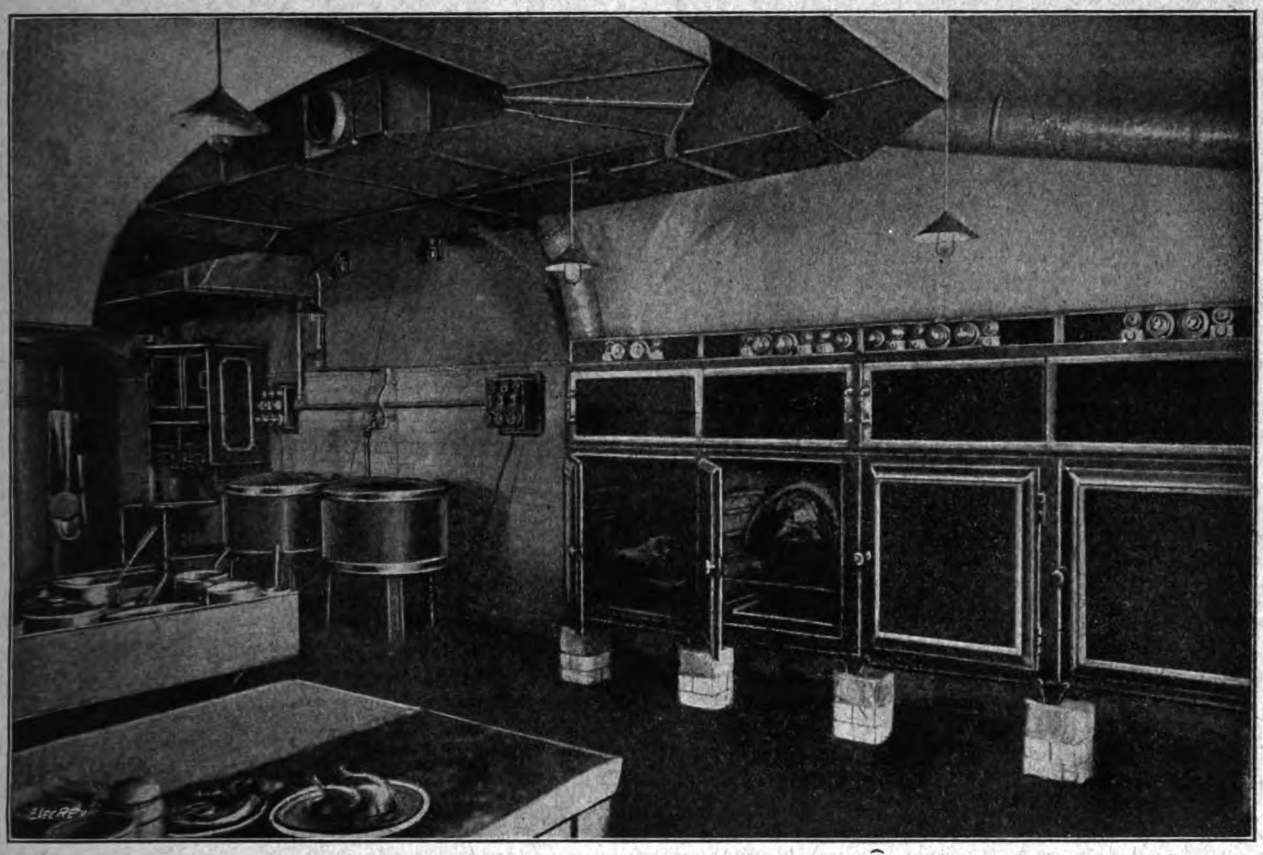
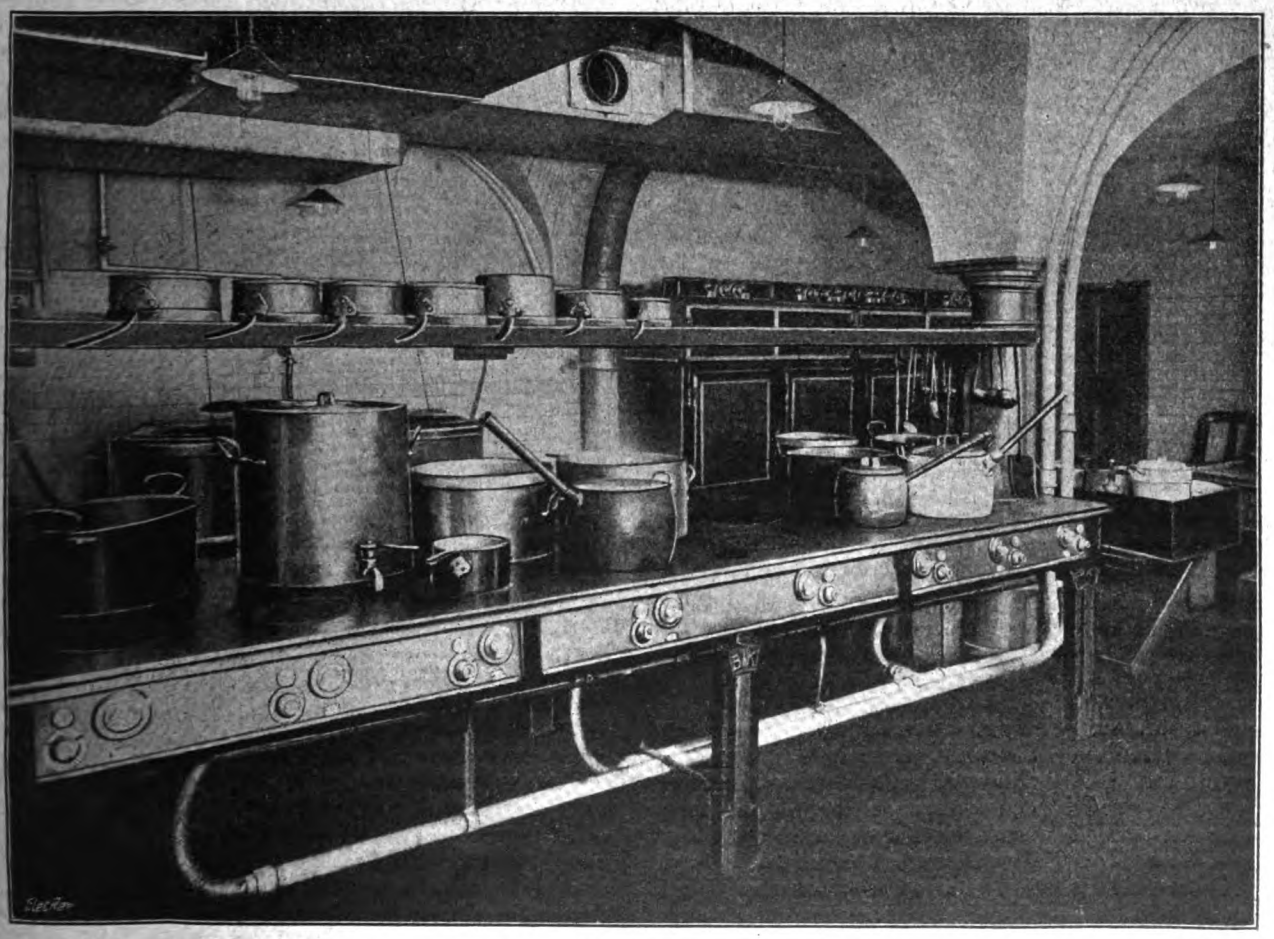
ELECTRIC COOKING AT EUSTON STATION.

In connection with the handsome new dining-room which has recently been opened by the London and North-Western Railway Co. at Euston Station, advantage has been taken of the opportunity to install a modern, and indeed model, system of electric cooking, in substitution for the previous cooking arrangements which involved the use of steam and gas-heated apparatus.

The complete electrical equipment has been supplied by the Brompton and Kensington Accessories Co., and is installed in a basement kitchen, and servery and grill adjoining the dining-room. The kitchen equipment comprises four ovens, each measuring internally 2 ft. by 2 ft. by 2 ft. 6 in. high, with the heating elements arranged



Interior of Electric Kitchen, Euston Station, showing Ovens, Ham Boilers, &c.



Large Boiling Table, Euston Station Electric Kitchen.

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around the sides and back. Seven different heats are provided, controlled through two three-way Diamond H switches, with pilot lights, in which the bulbs are enclosed in metal spinnings to safeguard against breakages, and Zed fuses—accessories of this type being used throughout the equipment. Above the oven range is a hot closet, with a maximum loading of 3 KW. controlled by two single-pole switches, and the total loading of the oven range is 23 KW.

Adjoining the oven range are two ham-boilers, each of 30 gallons capacity taking about eight average-size hams, together these have a loading of 7·5 KW., and adjoining this apparatus is a double grill for kitchen use, both apparatus being provided with heat regulation, and the latter—with 7 KW. loading—having four push-and-pull switches, with fuses and pilot lights. In the centre of the kitchen is what forms, in more senses than one, the technical *pièce de résistance* of the equipment—a large boiling table equipped with 23 hot plates of from 2,000 to 1,200 watts maximum loading, giving a total loading of 38·6 KW. Each plate is provided with a three-heat regulation switch, fuse and pilot light, these accessories being arranged round the frame of the top plate. A bain-marie, arranged in two sections with 1,500 watts, maximum loading, a hot closet for 1,000 plates with two-heat regulation and a loading of 3·7 KW., and a vegetable steamer with six nests, and a 4·5-KW. loading with three-heat regulation, are also installed; while adjacent to the service lifts in the entrance, which communicate with the servery above, is a small hot closet, of 2·3-KW. loading, for keeping the food warm while *en route* to the servery. The service lifts are of the Waygood automatic type, with push-button control.

In the servery—which is, of course, close to the dining-room—there is, adjacent to the lift, a vegetable server with a 4·2-KW. loading and two heats to each compartment; the top plate of this server is arranged for the reception of two nests or upper sections of the vegetable steamer, which are transferred direct with their cooked contents to it, preparatory to serving. Two soup tureens kept hot by means of water baths are also fitted; the heat regulation is controlled by six push-and-pull switches.

VIEW IN THE SERVERY, SHOWING CARVING TABLE AND VEGETABLE SERVER.

The servery also contains a large carving table with five cutting dishes for joints and other sundries; an electrically heated shelf behind enables plates and food to be kept hot while waiting delivery, and hot cupboards are also provided below the table for keeping food warm.

The total loading of this apparatus is 10 KW. and heat regulation by means of six single-pole switches is provided.

Yet another piece of apparatus has been installed—viz., the dining room electric grill, which, as usual, is adjacent to, and visible from, the dining room. This has two grilling compartments, with hot closets above and below, and has a 12·5-KW. loading. The switches in this case are of the push and pull type. It will be seen that the equipment is a very complete one in every way, and the kitchen is in many respects a model one, being provided with mechanical ventilation, fresh air being introduced and used air exhausted through special trunking, while the kitchen is tiled and finished in white, and electrically lighted throughout. In fact, one cannot help the reflection that such an excellent example of modern hygienic cooking methods should not be hidden from the public view, and that both the company and the public would be gainers were it allowed to advertise itself directly, as well as indirectly, by the excellent cooking results which, we understand, are being obtained. It may be mentioned that each apparatus is on a separate fused circuit and each circuit is led through a meter with a view to obtaining complete cost records.

The total number of meals served at present per day is about 400; the equipment has a total loading of 130 KW. The work has been carried out under the supervision of Lieut.-Colonel Cortez-Leigh, T.D., R.E., chief electrical engineer to the L. and N.-W. Rly. Co., to the requirements of the Hotel Department.

DIRECT-CURRENT MOTOR MAINTENANCE.

BY S. LEES.

(*Continued from Vol. 77, page 838.*)

The box type of brush-holder has now almost completely ousted the hinged-arm or the grip type which was so prevalent a few years ago. The grip-holder, when constructed properly, with due regard to its right application, makes a thoroughly good and satisfactory brush clip; the box type, however, possesses peculiar advantages which render this form more suitable for use on modern multipolar motors. The smaller amount of circumferential space occupied by the box-holder affords greater protection against the detrimental effects of "flash-over." And with a tendency ever towards economy, especially in the direction of cubical dimensions, the commutator end, particularly in the small-powered machines, becomes a detail of extremely restricted dimensions, and consequently, the short-pitched brush gear, practically unavoidable under such circumstances, gets uncomfortably crowded. Hence, faults which become manifest in "flashing-over" invariably play havoc with the brush-gear. It is possible, and moreover, by no means a rare occurrence, for a "flash-over" to maintain an arc sufficiently destructive in effect to wreck the brush-holders—the circuit fuses remaining intact, although not under-rated. The complication of detail so common in brush-holders of only a few years ago has gradually disappeared, and the absence of "knock-off" catches has rendered the present-day box-type holder a very simple affair by comparison with its earlier prototypes. The helical spring, too, has given way to some modification or other of volute spring of ribbon section; and by suitably shaping the free end of the spring to correspond to the brush head, auxiliary triggers are dispensed with. Given a sufficient number of convolutions in the spring, tension adjusting gear is unnecessary, as the pressure exerted at the free extremity of the spring is practically uniform throughout the comparatively small range of travel required for nearly all, if not all, commercial brushes.

Many manufacturers have adopted this construction as a standard type, using the same size of holder in multiple as required. Some little time back two well-known makers had turned out quite a number of big machines fitted with this type of brush-holder for tramway traction service. In both cases under review the brush-gear was of unusually massive build, but an unforseen weak point pretty nearly caused the condemnation of the whole brush-gear. This circumstance came about as follows: The position of the brush-spring normally stood out considerably proud of the body of the holder casting, as will be seen on reference to

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fig. 8. Obviously, under the abnormal conditions inseparable from traction operation, the effects of "flashing-over" would be more concentrated on the outside turns (*a*) of the spring than on any other part, and so it proved. Spring renewals became of rather too frequent occurrence, and there was always the added danger of a severed spring uncoiling and coming in contact with the commutator many bars behind

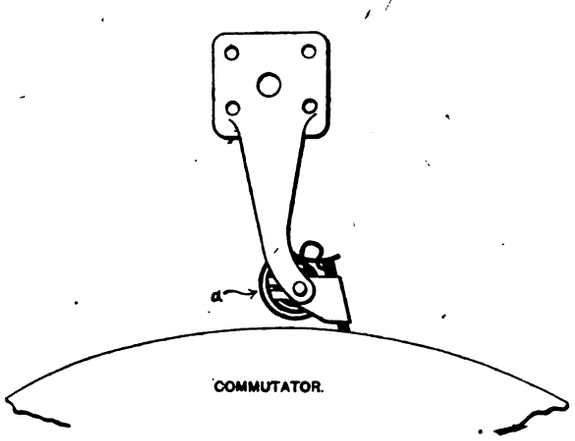

FIG. 8.

the same line of brushes. The writer has good reason for citing this case, as he had the "pleasure" of rehabilitating a number of installations of machines afflicted with the trouble described. An effective expedient for protecting brush-gear, especially the weaker and more exposed details thereof, is to shield the holder with a guard made of vulcanised fibre (sheet), one method of application being represented at *a* in fig. 9.

As an external protective agency the employment of vulcanised fibre finds many useful applications in the operation of electrical machinery. A prolific source of breakdown is

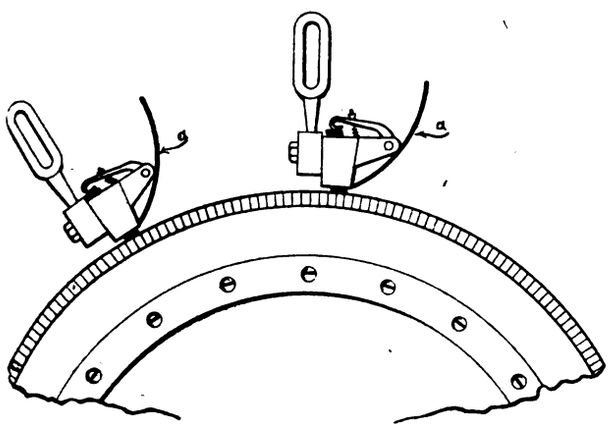

FIG. 9.

that arising from the failure of field-coil connecting wires. In practically all makes of machines, especially of motors, the conventional short tag of wire is used. Sometimes in the winding of the spool a finishing turn of heavier gauge wire is used for strength, but invariably the frail tag end issues at a point more or less inconvenient for connection with the adjacent coil. After the usual servings of spirit varnish the insulation becomes so brittle that great care is required in handling to avoid breaking off the said tag end of wire, which would, of course, necessitate unwrapping the coil covering before repair could be made. There are very few firms indeed that fit a really sound and mechanically safe

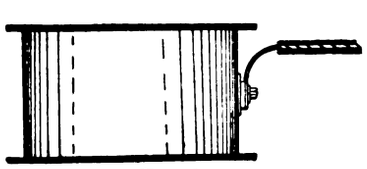

FIG. 10.

terminal attachment for field-coils. Two neat devices for this purpose are shown in figs. 10 and 11. As a safeguard against accidental breakage or damage to the connecting wires, a good plan is to protect the leads by a length of fibre tubing, as represented at *a* in fig. 11. Fibre tubing may also be used with advantage on the terminal ends of brush-leads and similar connections. This addition obviates

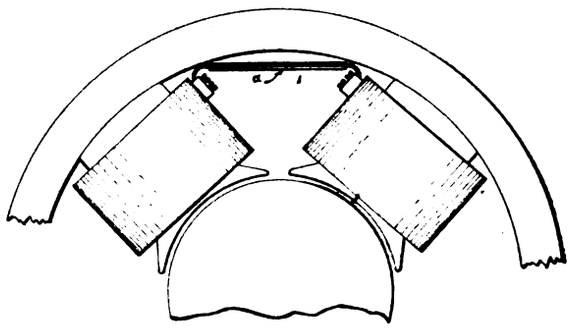

FIG. 11.

the unsightly mess of a matted bunch of greasy dishevelled braiding or flabby overgrown heap of decomposing rubber, and, moreover, makes for greater safety. The desirable neatness too of the finish given to such connections is obvious on reference to fig. 12.

Regarding carbon brushes, the writer asserts deliberately that practically all the troubles arising therefrom are caused either directly or indirectly through insufficient discrimination being made in their selection for the various classes of duty. There can be no excuse (except perhaps, economy) for using unsuitable brushes, as any reputable maker can supply carbon brushes graded to fit every known condition of working. What is commonly known as blackening of commutators is a condition which can be usually corrected by a suitable change of brushes. There is a growing tendency toward the wider use of plain or metal-capped brushes without bonding strips or cords, especially for low-powered motors. This cannot be looked upon as other than a retrograde step, as even if a number of brushes of the same design are used, the absence of any

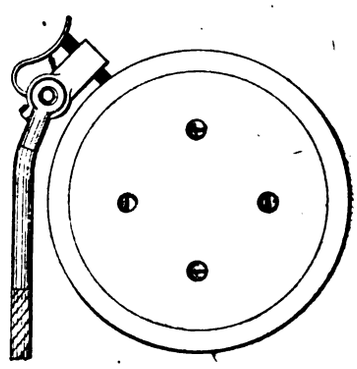

FIG. 12.

properly defined path for the brush current leads to all manner of trouble, and the inevitable heating which is set up destroys the tension spring, and insidiously weakens the holder at some slim part or other, such as rivet, pin, screw, &c. Greater tension, too, is required to ensure sufficient contact between the spring member and the brush; obviously, the life of the brush is considerably reduced thereby. For bonded brushes, probably the best method of amalgamating the flexible copper member with the carbon mass is to employ some binding medium which allows of the connection being made while the brush is in the plastic stage. The common method of soldering the bond to a metal cap or pin is unreliable, and the use of screw-clips and claws is equally bad, as, in addition, the practice renders a large proportion of the brush unusable. This detail is admittedly a weak point. There can be no excuse, however, for the existence of the many wretched devices which are to be seen at the other extremity of the brush-bond. For instance, the brushes of a certain standard 1,000-KW. machine were fitted with bonding cords which terminated in toy-like thimbles secured by $\frac{1}{8}$ in. Whitworth screws, the tapped hole in the thimble socket being insufficient in section to carry even a couple of full threads. The employment of separately attached terminals or thimbles

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is bad and quite unnecessary, as suitable eyelets may be formed easily on the flexible bond itself by pressing or welding. Of the various methods in vogue for securing the eyelet end of the bond to the brush-holder or its spindle very few can be described as good, some are indifferent, the majority distinctly bad. Naturally, the ordinary threaded screw is largely used, and if due regard be paid to proper proportions, this method of making the connection provides a secure and efficient fastening. But one might, not altogether unreasonably, wish for a more facile and dignified way of securing a refractory brush-bond on a bottom set of brushes of a 1,000-KW. generator, than by means of a No. 5 B.A. round-head screw, the operator lying face upward with spinal column at a most unnatural angle. For this purpose such ridiculously small screws are altogether out of place; nothing smaller than a $\frac{3}{16}$-in. Whitworth, or equivalent thread, should ever be used, and loose washers should be avoided always. A good form of screw is shown at fig. 13. The type of pin plug (fig. 14) is used on some makes of motors, various kinds of socket being available; in one form a spring clip is attached to the brush-holder by means of screws, in others an extension of the holder itself is made to form a socket into which the said pin is introduced. To be really efficient a pin-plug for this kind of duty should have a bifurcated shank and be brazed or

FIG. 13.

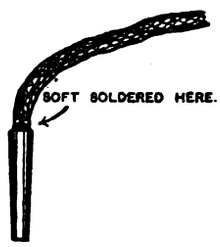

FIG. 14.

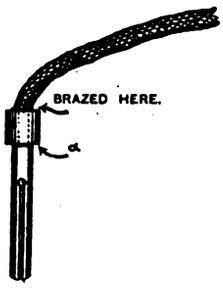

FIG. 15.

welded to the flexible tape or cord, and fit into a correctly-drilled socket, one form of this attachment being shown at fig. 15. The shoulder at *a* is to prevent the pin from touching the commutator, as it not infrequently happens that the careless replacing of a brush-bond results in a badly-grooved commutator, when the connecting pin is unshouldered. Some makes of brushes are fitted with bonds of inordinate length, especially for the smaller sized motors; great care should, therefore, be exercised in fitting so as to avoid making accidental contact with the motor case, or fouling the brush tension spring or trigger. The writer has experience of many cases where unnecessarily long brush-leads have become welded to the motor frame, causing considerable damage and inconvenience, through being disturbed during cleaning operations.

Another fruitful source of trouble is the failure of the external insulation at the commutator end clamp-ring, as indicated at *a*, fig. 16. Usually, the breakdown is not primarily due to inherent defects or flaws in the insulation

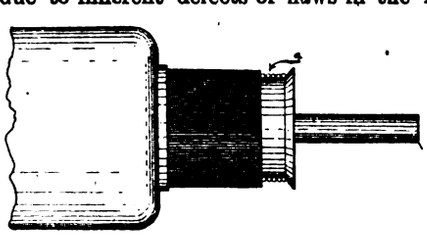

FIG. 16.

itself, but rather is the resultant effect of the time-honoured practice of binding with string or twine. The inconsistent practice of covering a fairly wide space of mica or micanite with cotton or hemp banding is really ridiculous. To argue that a serving of shellac solution is afterwards applied only aggravates matters, as the inevitable shrinkage that takes place renders the banding brittle and easily severed; moreover, the interstices between the several turns afford lodging places for dirt and grease. Further, to re-string an unwound band *in situ* is not an amateur's job, even were such a course recommendable, which it is not. This practice, still widely persisted in, is bad, mechanically and electrically, and it would seem, surely, that some better form of finish should not be beyond the resources of the progressive manufacturer. A satisfactory method was employed by one of the pioneer firms for a good many years, on fairly high-voltage machines.

The practice of "grooving" commutator bar insulation as a panacea for sparking troubles has enjoyed a very short-lived vogue, and perhaps rightly so. Doubtless, many cases of sparking have become amenable to some modification or other of this kind of treatment, but its application as a cure-all savours somewhat of the "tall order." Endless expedients have been devised and used with more or less success in the amelioration of sparking arising from *external* causes, and every plant attendant will have faith in his own particular pet palliative for administration in refractory cases. One might wish there were fewer proprietary nostrums on the market, as such so-called commutator compositions do more harm than good in ignorant hands, and it is by such that these substances are mostly used. Purely external sparking can be invariably traced to some well-defined cause or other, and when shorn of the profound mystification which usually surrounds the diagnosis of such affections, the disturbing factor oftener than not proves to be of an almost ridiculously simple character.

Given fair treatment a commutator will run for a surprisingly long time, even when it has become worn considerably out of truth. It is a mistake, however, unduly to

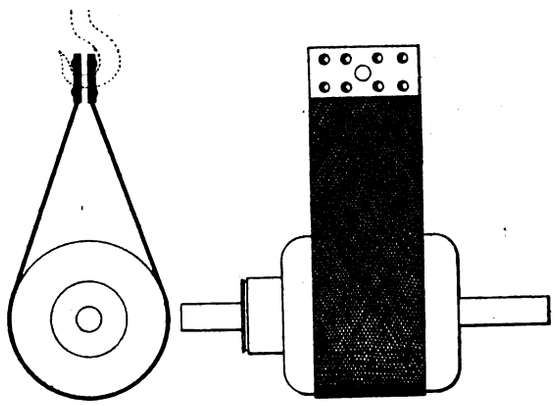

FIG. 17.

overrun a machine when in such a state. The best policy always in such circumstances is to have the commutator properly trued up before the inevitable mishap occurs. Of the two methods available—turning and grinding, it is pretty safe to say that neither has much, if any, advantage as regards the finished job over the other, all things else being equal. The turning of commutator metals demands the services of the skilled turner experienced on this particular class of work. On the other hand, a satisfactory job may be made by an unskilled hand (that is to say, one inexperienced at turning) with a good grinding machine. This is rendered possible by the employment of devices hitherto found only on the more expensive and fixed machine tools. Control of feeds and speeds is now obtained with micrometer-like precision, and the possibility of overrunning is eliminated by automatic reversing and stop-gear motion. One great advantage of the modern commutator grinder is that the commutator which is being operated upon also drives the grinder, usually by means of friction gear. With the older types of grinding machine the necessity for some external source of driving agent often added to the difficulties of overhauling a commutator. Of course, there are limits to the application of grinding *in situ*, especially in small sizes of motors—say, 20 H.P. and downwards. Improved methods of design and manufacture have rendered the withdrawal of an armature quite a simple matter, and no special appliances are necessary for its subsequent insertion between lathe centres. Once it is properly chucked, the actual work of turning up the commutator is performed with less expenditure of labour and time than if grinding were resorted to. When truing a commutator by turning, light cuts only should be taken, especially at the start, as the bulk of the cutting is on white stock, and mica quickly turns the edge of the tool. Heavy cuts, too,

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have a tendency to spring the commutator bars and open the mica, thus presenting openings for the entry of metal dust and chips. A good average cutting speed is 90 to 100 ft. per minute, using a sharp V tool having slight *top* rake and set at centre of work. A good finish is obtained with "medium" and "fine" carborundum cloth. To prevent the lodging of cuttings between the commutator connnections a stiff paper covering should be previously attached in a suitable manner. The practice of swathing the armature winding at this part in canvas wrapping has much to recommend it, and has, in fact, been adopted by a few makers. Instead of the conventional rope sling commonly used for lifting armatures, a form of cradle, as shown at fig. 17 is better, as, with the latter, risk of damage to winding, commutator, &c., is practically non-existent. The writer has had the pattern illustrated made up of a suitable size of Gandy belting with patch eyelets as shown, for handling armatures up to 6 tons in weight.

The fitting of new brushes is an operation far too casually treated; so also the re-bedding of the whole of the brushes after skimming up the commutator is often neglected. Obviously, owing to the reduced diameter of the commutator, the brush face and commutator surface will not coincide. The initial correct shaping of the brush face is of the utmost importance, and new brushes should never be left to shape on the commutator unassisted; neglect of this measure results in scorching and discoloration of the commutator surface, which then requires restoration.

(*To be continued.*)

SOUTH AFRICAN MUNICIPAL ELECTRICAL ENGINEERS IN CONGRESS.

THE first annual Congress of the Association of Municipal Electrical Engineers (Union of South Africa) was held in Johannesburg, commencing on Monday, November 15th, and terminating on Saturday, November 20th, 1915. There were present the undermentioned municipal electrical engineers :—

M. McDonough, Bethlehem.
W. F. Long, Cape Town.
G. H. Swingler, Cape Town.
J. Roberts, Durban.
E. Poole, Durban.
J. H. Blatchford, Greytown.
J. R. English, Heilbron.
T. Millar, Harrismith.
J. H. Dobson, Johannesburg.
F. T. Stokes, Johannesburg.
E. T. Price, Johannesburg.
T. Jagger, Ladysmith.
T. C. Wolley-Dod, Pretoria.
B. Sankey, Port Elizabeth.
A. S. Munro, Pietermaritzburg.
F. Castle, Oudtshoorn.
N. D. Ross, Potchefstroom.
W. Bellad-Ellis, Queenstown.
R. Mortimer, Roodepoort.
W. Leonard, Standerton.
— Ward, Newcastle.
L. L. Horroll, Pretoria.
L. B. Proctor, Boksburg.
W. S. Guildford, Boksburg.

On Monday the delegates were welcomed by the Mayor (Mr. Norman Anstey) and the chairman of the Tramway and Lighting Committee (Councillor T. F. Allen). Prof. J. H. Dobson, general manager, Gas, Electric Supply and Tramways Department, Johannesburg Municipality, was unanimously elected President for the year, and in the afternoon the members visited the Rosherville power station of the Victoria Falls and Transvaal Power Co., returning to Johannesburg at 6 p.m.

On Tuesday morning the delegates visited the Crown mines, and were received by the general manager, Mr. A. J. Brett, and the underground manager, Mr. Simpson. The party went down the mine, visited the large underground electric pumping plant, and afterwards inspected the surface plant. In the afternoon, the President, Prof. J. H. Dobson, delivered his inaugural address, and was accorded a hearty vote of thanks by Messrs. T. C. Wolley-Dod, of Pretoria, and B. Sankey, of Port Elizabeth. Mr. W. F. Long, city electrical engineer of Cape Town, read a short paper, entitled "Some Notes on the Prevention of Corrosion in Condenser Tubes," and a lengthy discussion followed.

On Wednesday the Congress met at 10 a.m. at the Town Hall, and after informal business, Mr. John Roberts, borough electrical engineer, Durban, read a paper on "Tariffs of Prices for Electricity," which was fully discussed. In the afternoon the delegates visited the power station of the Randfontein Estates and Gold Mining Co., being welcomed at the mine by Mr. T. P. E. Butt, the chief electrical engineer to the company.

Next morning a paper on "Diesel Engines" was read by Mr. W. Bellad-Ellis, borough electrical engineer, Queens-

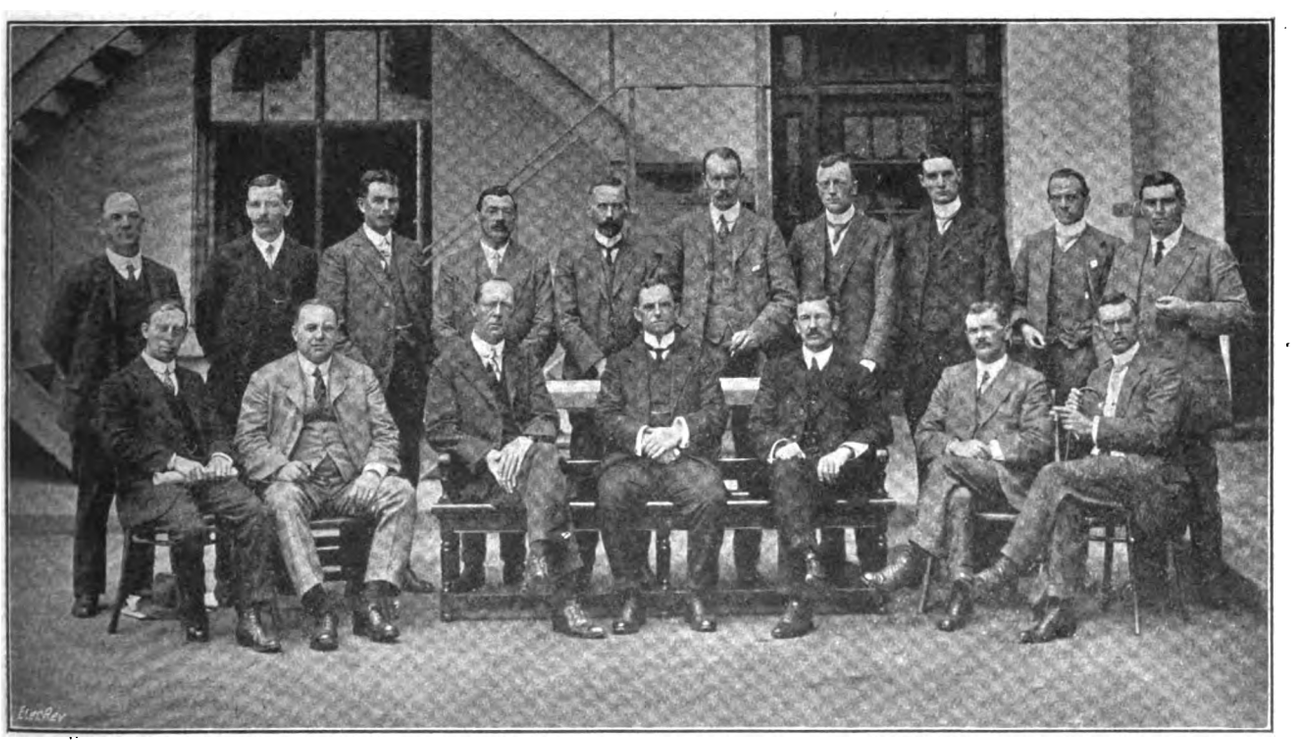

Photo.: Brittain, [*Johannesburg.*

A GROUP OF THE DELEGATES AT THE CONFERENCE OF THE MUNICIPAL ELECTRICAL ENGINEERS OF SOUTH AFRICA, Held at Johannesburg (S.A.).

BACK ROW.—M. McDonough, Bethlehem; J. R. English, Heilbron; T. Jagger, Ladysmith; T. Miller, Harrismith; J. Roberts, Durban (Member of Council); T. C. Wolley-Dod, Pretoria; B. Sankey, Port Elizabeth (Member of Council); E. T. Price, Johannesburg (Hon. Treasurer); F. Castle, Oudtshoorn; G. H. Swingler, Cape Town.

BOTTOM ROW.—W. Bellad-Ellis, Queenstown (Member of Council); F. T. Stokes, Johannesburg (Hon. Secretary); W. F. Long, Cape Town (Vice-President); J. H. Dobson, Johannesburg (President); A. S. Munro, Pietermaritzburg; W. H. Blatchford, Greytown; E. Poole, Durban. (*Names reading left to right.*)

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town, and after discussion the members visited the various places of interest in the town; in the evening they were the guests of the S.A. Institute of Electrical Engineers at the Transvaal School of Mines and Technology, when Prof. J. H. Dobson read a paper entitled "The Distribution Plant of the Johannesburg Municipal Electric Supply System," receiving a hearty vote of thanks from the Council of the Institution for his valuable paper.

On Friday, further discussions on the papers read during the week took place, and in the afternoon the Johannesburg municipal power station and distribution system were visited, also the large municipal abattoirs.

The Congress was brought to a conclusion on the following day, Saturday, when informal business was transacted, and the additional officers and Council were elected for the ensuing year, making the complete list as follows:—President, J. H. Dobson; vice-presidents, W. F. Long, B. Sankey, John Roberts, W. Bellad-Ellis; hon. secretary, F. T. Stokes; hon. treasurer, E. T. Price.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

An Expansible Boring Cutter.

MESSRS. VISLOK, LTD., of 2, St. Bride's House, Salisbury Square E.C., have recently placed on the market a new patented adjustable double-ended cutter for finishing holes in boring work, which is known as the "Gauge-all." The new cutter consists of two high-speed tool steel ends connected at the centre by special soft metal alloy. When, after the usual wear, it is necessary to increase the length of the cutter to its original dimensions, this is achieved by lightly hammering the alloy centre, which, being compressed,

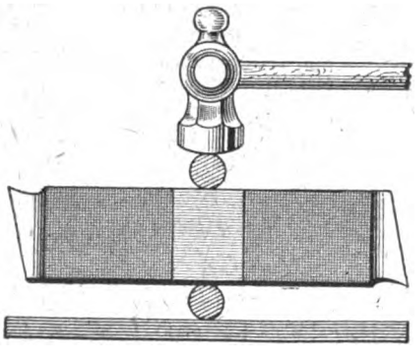

FIG. 1.—METHOD OF EXPANDING CUTTER.

forces out the steel ends. A U-shape iron or brass clip is placed round the alloy centre in order to facilitate the operation, and it will be noted that as the machine-man himself does this work, frequent visits to the tool room are dispensed with. A "Gauge-all" cutter with one centre has finished 200 holes, 3 in. by 10 in., in steel castings, and as new centres can be put in by the makers,

FIG. 2.—CUTTER, SHOWING ALLOY CENTRE.

its life can be still further prolonged. The ordinary cutter after about three visits to the toolsmith, has lost its nature, and therefore the new tool represents a great saving of tool steel—an indispensable commodity at the present time—and time, which is

FIG. 3.—"GAUGE-ALL" CUTTER EXPANDED.

always costly. We understand that the "Gauge-all" cutter has been thoroughly tested for a long time, mainly on steel castings, with most satisfactory results, and that in practice it has proved as stiff under a heavy cut as a solid steel cutter.

"Witton" Motor Starters and Controllers.

THE GENERAL ELECTRIC CO., LTD., of 67, Queen Victoria Street, E.C., has recently issued a new illustrated catalogue—"V section supplement"—dealing particularly with the numerous types of motor starters and controllers constructed by the company, which it is prepared to deliver either from stock or at short notice.

All kinds of "Witton" open, enclosed or semi-enclosed D.C. starters are stocked; this also applies to plain A.C. motor starters. These motor starters comprise adjustable three-phase resistances, without any automatic features, mounted somewhat similarly to those used in standard D.C. starters. The resistances are adjusted to pass approximately full load current on the first contact and thus to start motors against full load torque. "Off" contacts are provided. A spring return and "on" catch may be provided at a slightly increased price.

For starting three-phase squirrel-cage motors against loads not exceeding half full-load torque, "Witton" star-delta drum type

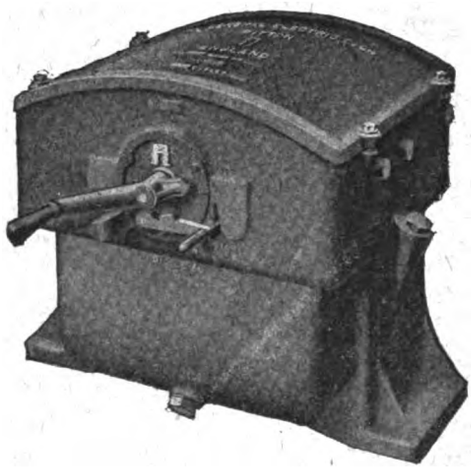

FIG. 4.—"WITTON" MISTAKE-PROOF AUTO-TRANSFORMER STARTER.

starters are to be recommended. These starters are suitable for motors taking a line current up to 50 amperes at 550 volts, three-phase. The "starting," "running" and "off" positions follow one another consecutively, so that it is impossible to go from the "off" to the "running" position without passing the "starting" stop.

Where squirrel-cage motors have to start against a greater torque than half full load torque, an auto-transformer starter should be employed; these starters comprise an auto-transformer with tappings giving a voltage of 40, 60, 70 and 80 per cent.

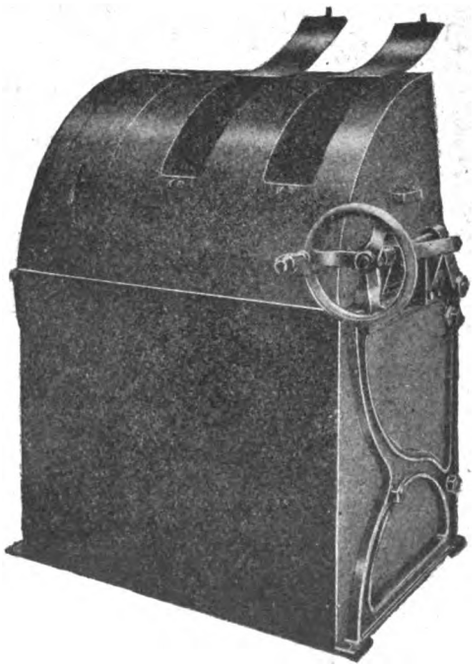

FIG. 5.—"WITTON" LIQUID STARTER FOR USE IN MINES, FLOUR MILLS, CEMENT WORKS OR DUST-LADEN ATMOSPHERES.

of the full line voltage, together with a change-over switch, operated by an external handle. The transformer can be oil-immersed if desired.

The well-known "Witton" liquid starter for continuous or alternating current motors is also listed, and we understand arrangements have been made to hold a large stock of finished parts to facilitate quick delivery.

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In the case of extensions to existing motor equipment or new motor equipment in improvised factories and workshops, the "dockyard" and "factory" types of motor-starting panels are especially suitable. These panels consist of a Salford switch and fuse (two-pole for D.C. and three-pole for A.C.), one ammeter, totally enclosed in the dockyard and open in the factory type, and one D.C. or star-delta starter, totally enclosed in the dockyard

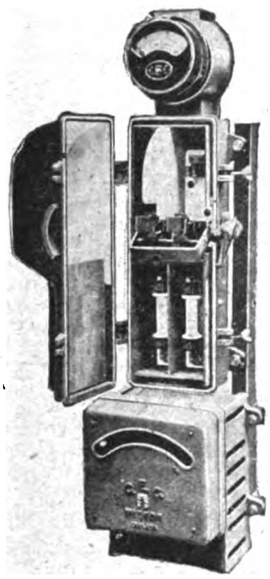

FIG. 6.—FACTORY TYPE MOTOR STARTING PANEL WITH DOOR OPEN, SHOWING FUSES.

and semi-enclosed in the factory type. The panel is simply bolted in position on site and connected to the motor by leads in the usual way.

For the control of small cranes and in other situations where space is limited, "Witton" 1 AR size controllers are suitable.

In addition to the foregoing, other controllers and controller resistances are listed, as are automatic motor starters, ironclad reversing switches, shunt regulators, main regulators, multiple switch starters, single-phase motor starters, &c.

Horn-Gap Fuses.

In the *Electrical World* for December 11th, Mr. E. A. Dillard describes methods which he has found satisfactory for the protection of small sub-stations against overload and breakdown of apparatus with high-pressure fuses. He prefers annealed copper wire for the fusible metal, though other metals would serve, and has found it easy to calculate the time in which a fuse will blow under given conditions, but not so easy to ensure the speedy clearing of the arc that follows.

The best shape of horn was found experimentally; straight horns like portions of the letter V were not so good as horns

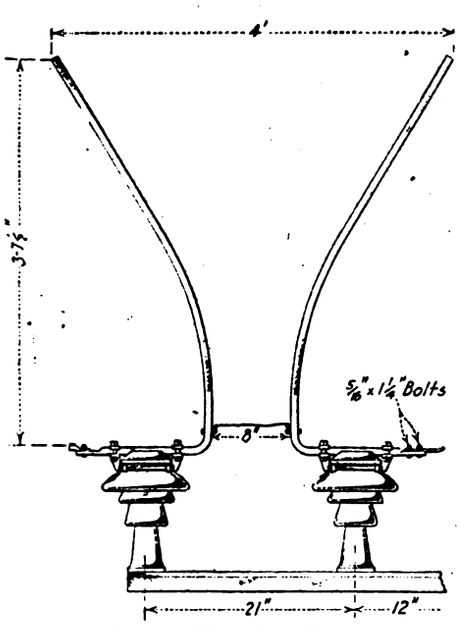

FIG. 7.—HORN-GAP FUSE.

curved as in the accompanying figure, which shows the horn-gap fuses used on overhead circuits at 22,000 volts; with these horns the arc was opened in half the time required with horns of other shapes.

The horns were made of galvanised-iron pipe, provided with clamping bolts at the base for the fuse wire, which was also wrapped round the horns, but enclosed fuses were found more satisfactory, the fuse-wire being enclosed in a fibre tube surrounded with a glass tube capped at one end with a heavy brass terminal. On fusion taking place, the arc vapours are violently expelled from the open end of the tube, and the arc is quickly broken without damage to the holder.

Electric Hot-Pad.

The HOTPOINT ELECTRIC HEATING CO., of 38, Poland Street, Oxford Street, W., have introduced a new flexible metal hot-pad—the "El Comfo"—constructed of nickel-plated metal with a removable eiderdown cover, and sufficiently flexible as a whole to bind round an arm or leg or fit to the shape of the body.

A special feature is the provision for temperature regulation. An even temperature can be maintained between 100° and 200° by

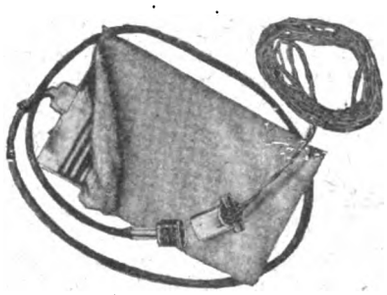

FIG. 8.—"EL COMFO" FLEXIBLE HOT-PAD.

means of a thermostatic cut-out arranged inside the apparatus, while the temperature limit is fixed by a small switch lever at one end of the device. It is claimed that owing to the automatic heat control, some five hours' service can be obtained for ½d. The

FIG. 9.—ALUMINIUM HOT-PAD.

apparatus is supplied with 4 ft. of specially reinforced flexible to connect to 6 ft. of ordinary cord and measures 10½ in. by 6½ in. by ½ in. thick.

A non-flexible aluminium hot-pad is also supplied of circular disk pattern, with one side convex and the other concave to suit body curves. The temperature arrangements and covering are similar to the preceding type; the apparatus is 8 in. in diameter and weighs 1 lb. The heating elements are guaranteed for two years for the flexible and for five years for the non-flexible type.

Japanese Electro-chemical Works.—H.M. Vice-Consul at Osaka reports that a company has been formed in Osaka, with a capital of 350,000 yen (about £35,700 at par), for the manufacture of caustic soda by the electrolytic process, and is going to erect a factory in Kyushiu, where hydro-electric power is fairly cheap. The machinery is to be Japanese. As a by-product bleaching powder will be obtained, and an output of 300,000 lb. of caustic soda per month is spoken of.

Renumbering of Patent Specifications. — The Patent Office announces that in order to give the public the advantage of having abridgments of specifications up to date while retaining their numerical sequence, applications for patents made subsequent to 1915 will be given new numbers when their complete specifications are accepted, or become open to public inspection before acceptance. The new numbers will start with No. 100,001 (without any indication of date), and will supersede the original application numbers in all proceedings after acceptance of the complete specifications. It is intended in future to issue abridgments of specifications in the illustrated official *Journal* a few weeks later than that in which their acceptance or publication is advertised, so that they will be available for search purposes soon after the printed copies of the specifications are on sale; but, until the system is fully in force, they will only be issued when there are sufficient to make up a full sheet of 16 pages. The present series of abridgments will run concurrently with the new series in the *Journal* until April, 1917, when it will be entirely superseded.

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THE IGNITION OF EXPLOSIVE GAS MIXTURES BY ELECTRIC SPARKS.

By J. D. MORGAN, A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS *at Birmingham, December 18th,* 1915.)

THE ignition of an explosive gas mixture by a spark is commonly considered to depend upon the communication of heat from the spark to the gas. When approaching the subject it is natural to suppose that the ability of the spark to ignite the gas can be expressed in terms of the heat energy of the spark. On examining the subject experimentally, however, a suspicion is soon created that ignition depends partly, if not entirely, upon some cause other than heat.

Assuming that heat alone when accompanied by sufficient temperature is capable of causing ignition, it would apparently be right to suppose that the mode of producing electric sparks containing sufficient heat could have no effect upon the igniting property of such sparks. This, however, is not found to be the case.

Prof. Thornton has shown that a greater amount of energy is required to produce an igniting spark by an alternating

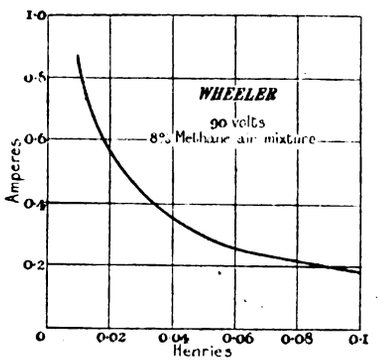

FIG. 1.

current than by a continuous current; and the relationship between the number of volts and amperes in the circuits immediately prior to the production of the sparks differs in character in the two cases. This fact is in itself sufficient to prompt the question: Does ignition depend upon some factor other than heat? A variety of experiments suggest a reply. If an iron wire heated by an electric current (continuous) be held over the disk of a charged electroscope, it will be found that when the wire first becomes visibly hot there is no effect upon the electroscope and gas cannot be ignited. On gradually increasing the current a condition of temperature is attained at which the electroscope steadily discharges. It is at this temperature that ignition occurs. Mr. J. R. Thompson has found that it is possible to ignite a cold explosive mixture by the incidence of X-rays on a platinum surface in it.

Where a hot wire or spark is the source, ignition only occurs when ionisation is produced, and ionisation alone without heat has been found to be capable of causing ignition.

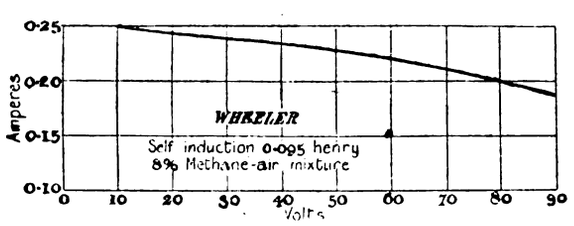

FIG. 2.

Ionisation accompanies the common electrical methods of ignition.

It is well known that gas mixtures are only combustible when the proportions lie within certain limits. These limits, for methane and air, have been carefully worked out by Dr. Wheeler, and the least single igniting spark for mixtures between these limits has been investigated by both Wheeler and Thornton. Mixtures of methane and air containing less than 5.6 per cent., and more than 14.8 per cent. of methane are incapable of ignition. The most sensitive mixtures lie between 7.5 per cent. and 9 per cent. of methane.

A common method of defining the least spark which will ignite a given gas mixture is by specifying the number of volts and amperes, or the number of amperes and the inductance in the circuit prior to the formation of the spark. On the assumption that this gives a measure of the ability of a spark to ignite a gas (or the "incendivity" of the spark), the validity of the method has been rightly questioned. For both inductive and non-inductive circuits there seems to be no sufficient reason, as will be explained later, for the assumption that the energy associated with a circuit prior to sparking can be regarded as a measure of the incendivity of the spark. Nevertheless, there is a practical value in curves showing the relationship between the number of volts and amperes or amperes and inductance in circuits which when broken give rise to sparks capable of igniting a given gas mixture, for they indicate conveniently the practical conditions under which dangerous sparking becomes possible.

The character of the alternating-current curves is different from those for continuous current, and for a given voltage the amount of the current is always higher. Fig. 1 shows how at a fixed voltage (90 volts) the least current capable of producing an igniting spark in an 8 per cent. mixture of methane and air varies with the inductance of the circuit. It is interesting to note that in an inductive circuit at relatively low voltages the current varies but little over a wide range of voltage variation. An example is shown in fig. 2. A similar condition is found in fig. 4. The curves given in figs. 1 and 2 show that the amounts of voltage and current, or current and inductance, capable of producing dangerous sparking are comparatively small, and emphasise the necessity, already well known, of adequately safeguarding electrical apparatus to which explosive gases are accessible.

The experiments upon which the curves in figs. 1 and 2 depend were performed with the aid of single sparks. The author finds that a single spark, which when repeated slowly will not ignite a gas, will after a more or less definite interval produce ignition when repeated rapidly. The element of time seems to him to be a factor of importance in ignition phenomena. If, instead of a single break device, a vibratory make-and-break device (such as the trembler of a bell) be employed, it is found that the ability of a given spark to ignite a gas mixture depends upon the duration of the sparking as well as upon the circuit conditions recorded in the investigations above described.

Fig. 3 shows a typical result following the use of a trembler spark in an explosive atmosphere consisting of a 10 per cent. mixture of coal-gas and air. The current was approximately 0.4 ampere throughout the range of the experiment. At 9 volts ignition was obtained instantly. On reducing the volt-

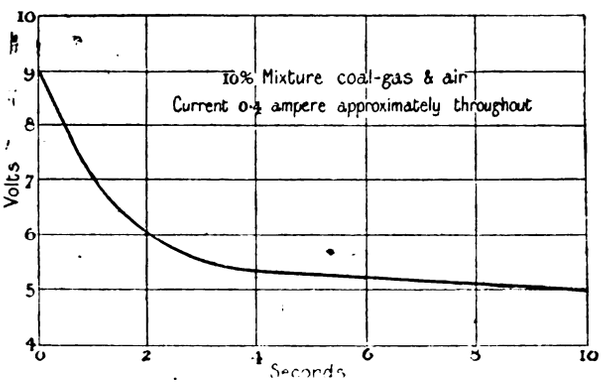

FIG. 3.

age to 7 a single break-spark would not ignite the gas, even when repeated as rapidly as hand-manipulation would permit; but when the trembler was allowed to vibrate normally, ignition due to the trembler spark occurred after one second. At 5 volts ignition occurred after ten seconds. This fact appears to be of practical importance in connection with that system of bell signalling commonly used in mines, in which the circuit is closed by the application of a piece of iron to a pair of bare wires. Sometimes an old file or a knife is used, and whatever be the implement employed the surface is usually rough. In drawing this implement across the wires there is not obtained the single spark of carefully maintained laboratory apparatus, but a rapid succession of sparks approximating to that of the trembler.

Reverting now to the question whether the measure of the circuit volts and amperes, or amperes and inductance, can be regarded as a measure of the incendivity of the spark, Prof. Thornton has stated that the energy of a break-flash (referred to sometimes in this paper as a single spark) is proportional to the power of the circuit and is equal to $\frac{1}{2} L i^2$, where i is the circuit current. In a recent leading article, the ELECTRICAL REVIEW* has gone a step further. Arguing from Prof. Thornton's work and basing its calculations specifically on certain curves by Dr. Wheeler (of which fig. 1 is one), it is stated that the igniting power of a break-flash depends on the $L i^{1.54}$, or approximately the $L i^{3/2}$, of the circuit. Finally, it is stated that for every gaseous mixture there is a constant value of the product $L i^{3/2}$ beyond which the break-flash will be capable of igniting the mixture. This is an interesting deduction, but the truth does not seem to be expressible in such a simple form. Igniting sparks can be produced in practically inductionless circuits carrying but a few amperes. These sparks, which may be termed "hot-point" sparks, are not included in an expression based on inductance.

* ELECTRICAL REVIEW, Vol. 77, p. 65, 1915.

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When a pair of contact points in a non-inductive circuit are separated so that an arc is maintained between them, it is true that the product $v\,i$ is a measure of the power of the arc. The value of $v\,i$ is not necessarily the same during arcing as when the contacts are together, and there is no reason for assuming them to be the same when the arc is only of momentary duration. Therefore $v\,i$ prior to sparking is not a measure of the power of a hot-point spark. Further, in non-inductive circuits carrying the same power, both igniting and non-igniting sparks can be produced by simply altering the shape or material of the contacts. Again, when the circuit is inductive and the above effect does not enter or is negligible, then the energy which produces the spark on separating the contacts is expressed by Li^2. With the same energy either igniting or non-igniting sparks may be produced according to the shape or material of the sparking points.

As already indicated, curves connecting volts and amperes, or amperes and inductance, in the circuit are useful as giving a general idea of the magnitudes involved in the production of igniting sparks, but caution must be exercised in using them, since (1) a variation of the size or material of the sparking points is attended by an alteration of the value of the circuit current required to produce an igniting spark, and (2) the incendivity of a spark depends to some extent upon its duration.

The general conclusion to which the author has been led by a variety of experiments on the electrical ignition of gases is that it is necessary to distinguish between the energy which produces a spark and that quality of the spark termed by him "incendivity," which enables the spark to cause ignition, and that the magnitude of the one is not a measure of the other, although there may be a more or less regular relation between them when certain physical conditions are kept constant. Ignition seems to depend on the ionisation caused by the spark. During the interval of sparking the ionisation may be rapidly dissipated or neutralised. If the neutralising action predominates there is no ignition of a gas mixture. If there is little or no neutralising action, ignition occurs immediately. Between these two limits there are a variety of intermediate conditions, which apparently account

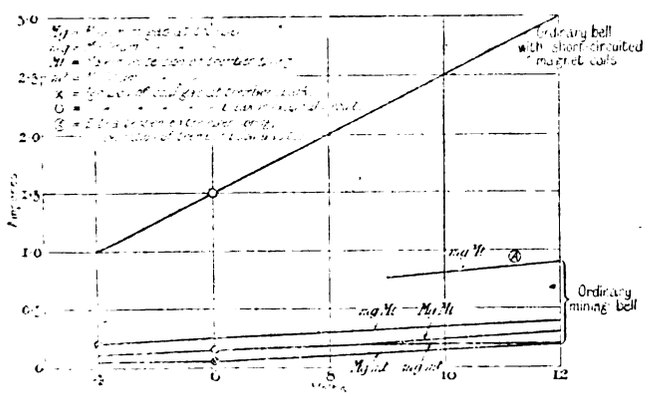

FIG. 4.

for the delay of ignition indicated by fig. 3, and much of the great irregularity that is often experienced in experimental work on this subject.

Enclosed Apparatus.—The effect on an explosion of the shape of the gas containing-chamber is not sufficient to be of any practical importance in the design of a case. However, if the shape is such that the case virtually comprises two or more communicating compartments, then an explosion initiated in one of them might spread to and produce destructive effects in the other; and a given gas mixture which explodes harmlessly in a motor case when the armature is at rest might explode with sufficient violence to wreck the case when the armature is in motion. These phenomena are quite well known in connection with the study of gas explosions. The increased pressure in the first is due to compression prior to ignition, and in the second is due to turbulence. In the design of protective cases for electrical apparatus it is necessary (1) to avoid intercommunicating chambers or chambers with partitions so arranged that it is possible for an explosion in one chamber to compress the gas in the other before igniting it, and (2) to construct the case so that it will withstand the increased explosion pressure due to turbulence. A motor which successfully resisted an internal gas explosion when at rest had its cover blown off by an explosion when the motor was in motion. At first sight this does not appear to agree with what is known of turbulence effects; but the explanation is probably that when an explosion occurs in a chamber in which the cooling surface is relatively large, turbulence may produce not only an increased rate of explosion but also an increased maximum pressure. A further fact which might have a practical bearing upon the design of covers is the character of the internal surface, if the configuration involves restricted passages. A rough surface has an accelerating effect both in dust and gas explosions, probably due to turbulence. Whether this effect is appreciable in closed chambers does not appear to be definitely known, but in tubes the effect is very marked.

Mine Bell-circuits.—The signal bell-circuits employed in mines commonly comprise a pair of bare wires connected to a trembler bell and battery. A signal is given by connecting the wires with the aid of a metal instrument. The bare-wire system has much to commend it on the score of simplicity and convenience, but latterly it has become the subject of much suspicion, especially since the Senghenydd disaster in 1913. Suggestions have been made to abolish bare-wire circuits and employ enclosed switches arranged at suitable intervals along insulated circuits, but the inconvenience of this is sufficiently evident to make it clear that miners will not abandon the bare-wire system unless it is shown to be irremediably dangerous. The facts appear to be that the system is not seriously risky and that what risk does exist can easily be removed.

The spark at the trembler of a bell is more dangerous than the single break-spark which occurs on the bare circuit when a signal is given. To avoid the use of a trembler it has been proposed to use single-stroke bells; but the trembler bell is apparently preferred by miners as the liability to mistake in the interpretation of a signal is less with the trembler than the single-stroke bell.

Danger of gas ignition at the trembler has been minimised by the use of an enclosing case, and the risk due to the spark in the external circuit has been tolerated partly for the reasons that such spark is supposed to be comparatively harmless and that the ventilation of the mine is sufficient to prevent the accumulation near the wires of an explosive mixture. Laboratory investigations show that, using a bell of the ordinary type, the break-spark can be not less dangerous than the trembler spark. If it is deemed necessary to enclose the trembler, there is no justification therefore for disregarding the break-spark. The first necessity is to abolish the break-spark or reduce it to a harmless dimension, and the second is to render impossible such a variation of the bell adjustment as would enable a dangerous break-spark to be produced.

The results of tests by the author on a mining bell in an atmosphere of coal-gas are shown in fig. 4. One object was to find the variation of current in the bell circuit with variation of voltage, and the manner in which these variations are affected by alterations of the bell adjustments. The other object was to find with what voltage and current ignition could be obtained both at the trembler and the break or contact in the external circuit. By adjusting the movable contact-screw at the trembler so as to produce the minimum spark-gap when the armature was vibrated by the magnet, and reducing the resistance of the armature controlling-spring to the minimum, the relation of volts and amperes indicated by mg.mt. was found. At 4 volts the current was 0.1 ampere, and at 12 volts the current was 0.2 ampere. Retaining the same tension at the spring and increasing the trembler gap to the maximum, the curve Mg.mt. was obtained. With this adjustment the current is 0.05 ampere at 4 volts, and 0.2 ampere at 12 volts. Keeping the gap at the maximum and increasing the spring tension to the maximum at which the bell could be actuated with a pressure of 4 volts, the relationship between volts and amperes is given by the curve Mg.Mt., in which the current rises from 0.1 ampere at 4 volts to 0.3 ampere at 12 volts. Still keeping the maximum tension, but adjusting the gap to the minimum, there was obtained the curve mg.Mt., which varies from 0.2 ampere at 4 volts to 0.4 ampere at 12 volts. A much higher current could be passed through the system by largely increasing the spring tension, but the bell could not then be actuated at a pressure below 9 volts. The result is shown in the short upper curve, which rises from 0.75 ampere at 9 volts to 0.9 ampere at 12 volts.

Repeating the above experiments in order to determine the conditions necessary for ignition of a coal-gas mixture, it was found that in the tests corresponding to the first three curves ignition could be obtained at 6 volts, but not lower; whereas when the spring tension was increased and the gap diminished as above stated, ignition could be obtained at 4 volts. When the gas could be ignited at the trembler spark it could also be ignited (although sometimes only after a number of trials) at the single break-spark. In these tests, therefore, both sparks were equally dangerous. The system which could be made to operate safely below 6 volts could be rendered dangerous by altering the trembler spring.

The above remarks are only true for coal-gas. It may be rather severe to test a mining installation in coal-gas, but if it can stand the coal-gas test it is abundantly safe in methane. An ignition test made by Dr. Wheeler on the above bell showed that with the armature fixed and the trembler contacts touching (a condition which gives the largest break-flash), the least current required to produce an igniting break-flash in an 8 per cent. mixture of methane and air was 0.26 ampere at 25 volts. An oscillogram of the current taken by the bell while ringing has been kindly supplied by Dr. Wheeler and is shown in fig. 5.

To ascertain whether a large reduction in the strength of the magnet coils would reduce the capability of the trembler and break-sparks to ignite coal-gas, a pair of weaker coils was arranged in conjunction with a vibrating armature contained within a small explosion chamber, the armature being controlled by a spiral spring instead of the flat or blade spring usually employed. In all cases the current values are higher and the sequence of the curves is slightly different from that of the bell tests. With minimum gap and minimum tension, ignition was first obtained both at the trembler and the

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break at 6 volts. With the other adjustments ignition was obtained at 4 volts. It follows, apparently, that it is useless to reduce the inductance of the circuit to avoid dangerous sparking unless the value attainable by the current is also reduced. In his report Dr. Wheeler remarks upon the desirability of making the resistance as high as possible, and the above experiments support this conclusion.

An obvious deduction from the foregoing is that for safe working the maximum voltage should be kept as low as possible. In the author's opinion, the value permitted by the Home Office regulations, namely, 25 volts, is much too high. Also the internal resistance of the batteries should be high in order to avoid a relatively large current in the event of an accidental short-circuit. Further, some additional precaution should be taken to abolish the spark or to reduce it to negligible dimensions.

A variety of expedients have been devised. One, well known to telegraphic engineers, consists in the arrangement of a non-inductive shunt of comparatively high resistance across the ends of the magnet windings. This diminishes the trembler spark and probably reduces the break-spark. A condenser across the trembler gap improves the conditions at the trembler, but does not remove the danger from the external circuit. Another device consists of a short-circuited winding or layers of tin-foil between the magnet windings for the purpose of reducing the energy available for sparking

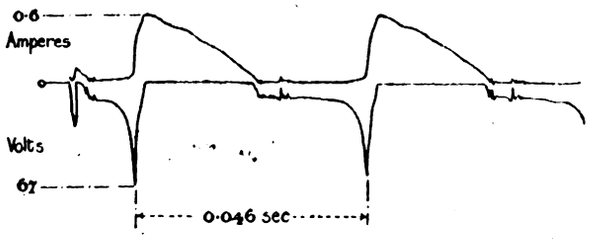

FIG. 5.

at the gap or break. Layers of tin-foil were wound in the magnet windings of the coils used for the tests recorded above, and it was found that whilst they increased the voltage required for ignition at the trembler from 4 to 6 in the Mg.mt. curve, no improvement was found at the break-spark of the external circuit.

An arrangement which has been found to give good results at both the trembler and the break is shown in fig. 6. The action at the trembler is the reverse of the ordinary action.

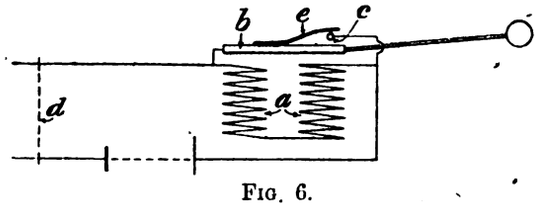

FIG. 6.

Instead of interrupting the circuit, the trembler short-circuits the magnet. The magnet windings are indicated by *a* and the spring-controlled armature by *b*. One end of the armature is connected to one end of the magnet coils, and the fixed contact *c* is connected to the other end. When the external circuit is closed as indicated diagrammatically at *d*, the magnet is excited and the armature is attracted by the same. Near the end of the movement a spring blade *e* on the armature touches the fixed contact *c* and short-circuits the magnet. By means of its spring the armature is returned, and the parts *c* and *e* are separated. The action is then repeated and a vibratory motion of the armature is obtained. Only a very minute spark is produced at the trembler, and this is entirely negligible. The intensity of the single break-spark at *d* is not reduced, however, to the same extent, and although it is much less active than when the ordinary trembler construction is used in the bell, it is possible to produce ignition of an explosive coal-gas mixture.

The mining bell above referred to was converted, without altering the magnet coils, to correspond to fig. 6, and the result of a test is shown by the top line in fig. 4. It will be observed that the current taken by the bell was very considerably larger than that by the normal bell. At 4 volts the current was 1 ampere, and at 12 volts it was 3 amperes. Notwithstanding the relatively large amount of current, no ignition of a coal-gas mixture could be obtained with any voltage at the trembler, but ignition could be obtained with 6 volts at the external break. By suitably proportioning the magnet windings and inserting a resistance between the battery and the bell, the current can be reduced to something of the same order as that required for an ordinary bell, and in that case the external circuit would be rendered quite safe.

Notwithstanding the improvements obtainable by devices such as those above described, the complete solution lies, in the author's opinion, in a suitable relay system. By using a small relay arranged to be actuated by a 4-volt battery, he obtained perfect operation of the bell with a current of 0.1 ampere in the relay circuit. Sparking in the external circuit of the relay was quite insignificant, and no ignition of coal-gas could be obtained. It was necessary to increase the relay current to 0.6 ampere before ignition could be produced. At the relay contact the condition was the same as in the external circuit of an ordinary bell; but it is obvious that this could be avoided by the use of a condenser or non-inductive resistance at the relay contact and the employment of a short-circuiting trembler at the bell. A similar experiment to the foregoing was performed by Mr. Watts* with similar results. Under laboratory conditions there is no difficulty in rendering a bell system safe on the lines above indicated, and there appears to be no reason why the same conditions cannot be realised in a practical apparatus suited for mining conditions.

Conclusion.—The opinion has already been expressed above that the Home Office regulations limiting the highest permissible voltage in bell signalling systems to 25 cannot secure safety, as the figure is obviously too high. If it is desirable to fix a limit, the figure should be reduced to 6. With the adoption of a relay system this lower figure is practicable. The fixing of a voltage limit is not, however, sufficient in itself to ensure safety. There should be added the condition that sparks produced in the system should not be capable of igniting a specified mixture of methane and air, as this result is easily obtained with a relay.

DISCUSSION.

Dr. KAPP said that the subject of the paper was of extreme practical importance, but also of considerable difficulty. The author said "the energy associated with a circuit prior to sparking can be regarded as a measure of the incendivity of the spark"; but he submitted that not the energy alone, but also the means employed to dissipate it should be regarded as essential factors of the problem. When the current was interrupted the stored energy $\frac{1}{2} L i^2$ must go somewhere; it was questionable whether a condenser was practicable, and the use of an inductionless shunt to the exciting circuit of the bell was objectionable, because it increased the line current and, therefore, the sparking at the bare mine wires when bridged. The author's device of working the bell on what might be called an inverted principle seemed much preferable, and, to judge from the results of tests given in the paper, this principle was quite successful. Thanks to the author's ingenious device, the problem might be considered solved at the bell; but what about the danger of incendivity of the spark when contact was made and broken at any point along the two bare wires? No doubt a relay system would be a solution, but was it robust enough for the rough usage of a mine? He suggested that perfect safety might be obtained in a simpler manner by distributing condensers along the signal wires, and especially putting one at the tail end. This expedient had the advantage that it could be applied to any existing installation, and at very little cost, by using Mansbridge condensers. To show what the effect of thus ballasting the line with condensers would be, he had calculated the sparking conditions of a particular line a mile long, and consisting of two wires spaced 10 cm. apart. Its inductance was 2.6 millihenries, and its capacity a little over one-hundredth of a microfarad; resistance 20 ohms. If a current of 1 ampere were broken at the tail end, there would be an oscillation with a periodic time of 34 microseconds, the damping effect of the resistance being very small. During the fraction of a second that it took to remove the iron bar by which the signal had been given, there might be some thousands of oscillatory sparks passing between wire and bar. The E.M.F. at the moment of zero current would be 440 volts, and the maximum power, which occurred at the time of 4 microseconds after the break, was 200 watts. It was true that the total energy stored in this so-called "non-inductive line" was only about 1,300 microjoules, but the frequency was extremely high, and the author had told them that high frequency increased the danger. It was, therefore, quite conceivable that an ampere broken anywhere on this line might produce a dangerous spark. Now let them ballast this line with only 10 mfd. in all, evenly distributed, say, in quarter-mile sections. The frequency of the spark now decreased to 1,000 per sec., the maximum voltage to 4.4, and the maximum power, which occurred 125 microseconds after breaking, had gone down to very little over 2 watts. These figures were well within the limits set by the author.

Dr. C. C. GARRARD said Mr. Morgan had thrown a very considerable amount of light upon a number of obscure points in the question of the ignition of firedamp in collieries. His own view was that all electric sparks in collieries should be regarded as dangerous and should be enclosed in suitable boxes. In his opinion, a switch-box for use in a colliery should be both explosion-proof and flametight, *i.e.*, capable of withstanding any internal explosion without emitting flames or sparks which would ignite an explosive mixture outside the box. There were two other points which Mr. Morgan had not touched on. The presence of ethane increased the liability of explosion of methane and air mixtures. The presence of coal dust was also of importance. It had been found that with sufficient coal dust an explosion could be caused by sparks in an atmosphere containing only ½ per cent. of gas.

* ELECTRICAL REVIEW, Vol. 76, p. 30, 1915.

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These facts strengthened the argument for the total abolition of open sparking in collieries. The remarks of Mr. Morgan as to how ignition depended on the ionisation caused by the spark were very illuminating; he was also much interested in the possibility of the violence of an internal explosion being increased by a portion of the explosive mixture within the box becoming compressed before ignition, due to an explosion in another part of the same box. He could confirm that by means of a relay combined with a condenser it was possible entirely to suppress the spark at the signalling wires. But if anything should go wrong with the adjustments of the relay, sparking might still occur at the signal wires. He was, therefore, inclined to think that a mechanical pull arrangement, with the contact-making device enclosed in an explosion-proof and flame-tight box, would eventually replace the bare signalling wires hitherto used.

Dr. RAILING, referring to the apparent disagreement between those authorities who asserted that the process of ignition was entirely electrical or entirely thermal in its origin, said that possibly both were right. It was possible that some sort of atomic turbulence was necessary to all chemical actions between atoms having an affinity for each other, and that this atomic turbulence could be set up either by electrical or thermal agencies.

Mr. E. A. WATSON wrote that the experiments quoted by the author seemed to show that the problem whether a given spark would or would not ignite an explosive mixture was not altogether a question of the total amount of energy available. On the thermal basis of ignition it was comparatively easy to see how it might be possible for there to be a limiting value to the energy below which ignition would not occur. If they considered a small quantity of hot burnt gas surrounded on all sides by a shell of cold unburnt explosive mixture, ignition would only occur if the heat liberated by the burnt core were sufficient to raise the surrounding shell to its ignition temperature. The smaller the volume of the hot core the less would be the ratio of the volume of core to the area in contact with the surrounding shell and the greater the cooling effect. They should therefore expect that before ignition of the whole charge could occur it would be necessary to raise a definite volume of gas to the ignition point, and this would, of course, require a definite amount of energy. They should, further, expect that the value of the minimum energy required would be affected by the pressure and temperature of the explosive mixture before ignition. The fact that although one spark would not ignite a given mixture yet a rapid succession of sparks would do so, might quite well be due to the heating of the mixture by the energy liberated. In this connection it was interesting to note the very large range of variation in the energy of the spark given by different makes of magnetos on the market, all of which might be said to give satisfactory ignition of the explosive charge. The output of a magneto varied considerably with the speed, but taking a standard speed of 500 R.P.M. it was found that the energy per spark given by various single-cylinder magnetos varied from 0.007 joule for a small American magneto to as much as 0.065 joule for a high-class English machine intended for very similar duty, *i.e.*, a range of output of very nearly 10 to 1. It would therefore seem that either the one machine must be unsatisfactory or the other must be needlessly powerful. The problem, however, was complicated, as much probably depended upon the speed of the engine, it being quite conceivable that an amount of energy which would be sufficient for a slow-speed engine might be inadequate for a high-speed one. It was well known that a substantial increase in B.H.P. might be obtained in most large high-speed engines by igniting the charge simultaneously at two points in the cylinder, but there appeared to be no data available to show whether an increase in B.H.P. might be obtained by increasing the energy at the sparking plug.

Mr. S. F. WALKER wrote that 25 years ago the question arose whether the spark on breaking circuit after ringing by pressing the naked iron wires together would ignite gas: he made some very exhaustive experiments, from which it appeared that there was very little chance indeed of ignition taking place. The signals which he fitted up in mines almost universally employed single-stroke bells, with which the danger of ignition of gas by sparks was considerably reduced. For complete immunity, he thought naked wires would have to be given up, and that connection for ringing would have to be made in explosion-proof cases. About 35 years ago he adopted the relay system at the Nunnery Colliery, Sheffield, but for a totally different reason. A signal was fixed on a very long engine plane, which was also very wet, and the leakage was so great that batteries would only keep up to their work for a very short time. He fixed a relay and put six cells only to work it, connecting the remainder in the local circuit with the bell. The arrangement was completely successful. The leakage was reduced within reasonable terms, and the signals remained loud and strong all the time.

Burnley.—A special meeting of Corporation employés, including tramway workers, has declined the offer of the Council of an increase of 5 per cent. for men earning 30s. and under, and an increase of 1s. per week for those earning over that amount. It was decided to press the original demand for a 3s. increase to the utmost limits.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The A.E.G. Meeting.

In closing this correspondence, I see another anonymous contributor, siding with "Anti-Humbug," accuses me of "obfuscation." Surely, the boot is on the other foot. I replied to the charge that it was as much as the existence of the E.C.A. was worth to tackle the problem of trading with enemy concerns such as the A.E.G. My contrary contention has now been fully conceded by "Anti-Humbug," and I am satisfied.

Allow me to repeat that the E.C.A. does represent the bulk of the capital invested in electrical contracting in this country, and its members are not guilty of the crime specified.

H. Marryat.

Chiswick, *January 3rd*, 1916.

Salaries in Power Stations.

In connection with the alleged shortage of power station assistants, it would appear that at last the Government are beginning to realise that electricity works, like railways and collieries, are of vital importance to the maintenance of industry, and in particular to the production of munitions of war. Now that the important fact has been brought home to the Ministry of Munitions, it is to be sincerely hoped that a businesslike policy will be adopted in regard to any matters connected with the supply of electricity and questions affecting electricity works employés, etc.

It will be agreed that electrical station men as a class have responded nobly to the call and offered their services for the Forces or as skilled engineers on munition work, although in many cases managers and committees have refused to sanction any temporary depletion of their staffs. The result has been, of course, that some of the more patriotic spirits have resigned in order to join the Forces, whilst others again have left to take up more attractive and better-paid positions in other stations or with firms engaged on Government work.

In order to stem the tide of affairs, chief engineers and managers have in many cases offered paltry war bonuses and an enamelled badge to the members of their technical staffs, with a view to compensation for the increased cost of living, and possibly to imbue the men with the importance of their position in the community. The bait has been swallowed in too many cases, but lately there appears to have been more real difficulty in getting men for charge engineer and switchboard duties, and whilst some engineers and managers have in a businesslike manner offered a living wage and secured competent men, others (judging by their advertisements) still try to continue the "penny wise and pound foolish" policy of employing underpaid technical assistants, and, to crown all, actually wonder why they can't get men!

In several instances the reprehensible practice of promoting comparatively untrained switchboard attendants to the position of "charge engineer" has been resorted to, no doubt, with a view to economising on the salaries item; but the results of such a policy are apt to be reflected in the shape of increased generating costs, particularly in regard to the steam side of the plant.

One hesitates to think that a power station in some fairly important industrial and munition area, containing some thousands of kilowatts of plant, may be placed under the charge of a comparatively inexperienced ex-switchboard attendant as "charge engineer," his salary perhaps being on a level with the wages paid to his engine driver or greaser; and yet there are no regulations in force as yet to prevent this being done.

Thanks to the Board of Trade regulations, our mercantile marine, which we depend upon so much at present, is in a far more enviable and safer position than some of our power stations with regard to its engineers, despite the fact that so many of them have been taken over for naval and transport duties by the Admiralty.

The Institution of Electrical Engineers never has evinced a genuine interest in electrical stations or their engineers; the Board of Trade and the Home Office may, of course, do so in the future, but at present let us hope that if the Ministry of Munitions takes the responsibility of controlling staff matters, it will not overlook the question of competent engineers and an adequate living wage.

Chief Assistant.

Domestic Electric Heating.

Referring to your issue of December 24th, there is one feature of electric heating which appears to have been completely overlooked by most writers. We have found, in Indian hill stations, that a ½-KW. radiator placed *under* a dining or office table provides all the warmth required when snow and ice are all round the house. The air temperature in these circumstances may not be above 45 deg., but this is a matter of no moment so long as warmed air is rising from under the table. As your leader points out, the normal temperature of

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60 deg. is no guide whatever to comfort. I am writing from personal experience in three successive winters, with a tariff well below point five, namely 13s. 4d. per KW. of maximum demand with unrestricted use.

J. W. Meares.

London, E.C., *December 30th*, 1915.

The Position of the Swedish General Electric, Ltd.

Questions raised in anonymous letters which have lately appeared in the electrical Press seem to indicate a desire on the part of some writers to ascertain the position of firms having connections with manufacturing companies in neutral countries.

We should, therefore, be glad if you would make it known in your columns, by publishing this letter, that we shall be very pleased to give full particulars of our company and of our parent concern, Allmanna Svenska Elektriska Aktiebolaget, Vesteras, Sweden, on application at our offices, Canada House, Kingsway, W.C., where the documentary evidence we have already had the pleasure of putting before you, and which has also been submitted to the authorities, will be available for inspection.

This evidence, we have no doubt, will be accepted as satisfactory proof that Allmanna Svenska Elektriska Aktiebolaget is a purely Swedish concern, not under the influence of any banks, firms, or persons in countries now at war with Great Britain, and that this company's business has been conducted in a manner in no way detrimental to the interests of the Allies.

None of the shareholders and none of the directors of the Swedish company are of enemy nationality.

The Swedish company has issued in all 150,000 shares, held by 1,530 shareholders. The largest number of shares held in one hand is 2 per cent. of the total.

The Swedish company has no working arrangements or understandings of any kind with enemy firms for the protection or control of each other's interests.

The Swedish General Electric, Ltd., has issued in all 5,000 shares, of which 4,996 are held by Allmanna Svenska Elektriska Aktiebolaget.

The Swedish General Electric, Ltd., has secured the services of various persons resident in England previously in the employ of companies controlled by German capital, but they have done so, following the example of prominent British firms, solely in their own interests, and without any arrangement whatever with the companies by whom such persons were formerly employed, or with the foreign firms controlling same. There is no agreement or understanding whatever with or regarding any such employés by which any such employés shall at any future time enter into their former employment, or into the employ of any other British or foreign firm.

The Swedish General Electric, Ltd., has not since the outbreak of war bought or sold any goods manufactured in countries now at war with Great Britain, or taken over or assisted in the disposal of stock owned at the outbreak of war by companies controlled by enemy capital.

Swedish General Electric, Ltd.
By order of the Board,
W. I. TURNER, *Secretary.*

London, W.C., *January 3rd*, 1916.

WAR ITEMS.

What the Germans Think of Russia's Future Trade.—An American Consular report draws attention to an interesting article on German trade with Russia, which appeared in a recent issue of the "Neue Zürcher Zeitung." Ridiculing any danger of a boycott of all German goods in Russia or of Germany being compelled to yield the Russian market to neutral or the Allied countries, this article lays emphasis on the conservative nature of the Russian merchant, who, it states, is not kindly disposed towards innovations, and could not easily be persuaded to purchase new brands of goods. It points out, as an instance, that the style of electrical apparatus has not changed for 10 years. Allusion is made to the careful "intensive cultivation" of Russian markets by Germany over a long period of years, and the causes of success are stated to be the long credits given by German traders—6, 9, 12 or even 14 months—and the low prices of German goods. It is affirmed that in electrical supplies Germany has no competitor in the Russian market. German influence is extensive; in business houses managers and foremen are almost invariably Germans, and buyers are either German or Russian. "As a result of long years of co-operation there has developed a sense of mutual confidence, and why should it disappear all of a sudden? . . . . A boycott of German goods is altogether out of the question, for the mere reason that the ties resulting from a community of interests extending for a long period of years will bind the two countries again after the conclusion of the war. In conclusion, it may be noted that there is hardly a German commercial house of any size that is not represented in Russia, and that there is a whole staff of German agents and other people who have for years been making their living through German houses, and it is hardly likely that they will suddenly take up with new ventures for the mere purpose of persuading the Russian peasant that French and English goods are better than German. After the war is over the Russian will know no more about France or England than he did before the war, for while he probably never heard English or French he knows something about German, and the Germans saw to it that in every small town there should be some German representative of their business."

Trading with the Enemy.—The Foreign Trade Department of the Foreign Office has been set up by the Foreign Office as a new Department in order to carry out the policy embodied in the Trading with the Enemy (Extension of Powers) Act, 1915. This Act gives power to prohibit trade by any person, firm or company in the United Kingdom with any enemy persons or association established in neutral countries. As the Foreign Trade Department will be concerned with preventing trade by British firms and companies with the enemy in neutral countries, it has been decided to merge with it the Trading with the Enemy Department of the Home Office, which has had the duty of enforcing the measures already taken to prevent trading with the enemy, and the staff of which will continue to perform the same duties as members of the new Department, in addition to taking part in the administration of the new Act. Questions of contraband or the hindrance of oversea trade between neutrals and the enemy and the licensing of exports from this country, and all questions of trading with the enemy other than those described above, will continue to be dealt with by the Government Departments which have hitherto been charged with these questions. In order to secure the full benefit for British interests of the policy of the Department, the advice and assistance of business men will be invited through the Chambers of Commerce and other trade organisations. It is recognised that the success of this policy will depend upon the active co-operation of the business community. It is hoped, therefore, that business men will be willing to aid the Department, and also that they will not hesitate to consult it in any matter in which it can be of assistance to them. Mr. L. Worthington Evans, M.P., has undertaken the direction of the new Department, with the title of Controller of the Foreign Trade Department of the Foreign Office. Offices have been obtained at Lancaster House, The Mall, S.W. (above the London Museum), which were opened on January 5th. All communications (including those relating to matters previously dealt with by the Trading with the Enemy Department of the Home Office) should be addressed to the Controller of the Foreign Trade Department, Lancaster House, The Mall, S.W.

An Australian Desire.—In the Fitzroy Council recently there was a discussion about the purchase of an electric motor. A British firm, which quoted £54, could not supply the motor for which it tendered, and the Works Committee wanted to buy one for £40 from America. It was moved that this be referred back, one councillor saying that they ought not to deal with any but British or Australian firms; another saying that the British firm could not fill the order; and a third suggesting that an Australian gas engine ought to be bought rather than an American electric motor. The matter was eventually referred back, on the understanding that only British or Australian motors be purchased. All of which shows how very strongly the wind is blowing in our favour in Australia at present. May British firms be prepared to grasp the opportunity.

After the War Trade: Government Promises.—The week before last we devoted considerable space to a discussion on after the war problems, which took place in the House of Lords. We welcomed that debate, because we regarded it as an indication that at last the time had arrived for the discussion of such matters in Parliament. While our pages were being run off the machines the House of Commons was holding its last sitting of a momentous year, and Mr. Runciman, the President of the Board of Trade, was giving an account of work which has been undertaken by his department, with the assistance of outside experts, for the purpose of safeguarding our national trade and commercial interests after the war. Many questions have been asked in the Commons on these matters, but the reply has generally been that the Government could not yet make a statement. The fact of Mr. Runciman's speech following so speedily upon the debate in the Lords, seems to us to show that our legislators having got over some of the very serious problems of other kinds, immediately connected with the conduct of hostilities and the production of munitions, that have arisen, are now able to give fuller attention to these other matters which were bound to become of predominant importance sooner or later. We are glad that these speeches were not longer delayed, for in absence of them, profitable discussion, either in the Press or in business circles, could not have continued. We can quite understand that in preparing the way for a Government trade and industrial course of action a large number of subjects have had to be exhaustively investigated, and we do not think any exception can be taken to the adoption of secret inquiry in this connection. Without proper data to go upon no sound, satisfactory, or permanent policy could be evolved which would bear the test of searching public examination when the right time came.

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Since Mr. Runciman made his speech the matter has taken on a somewhat altered aspect owing to the controversy in the Cabinet and in the country on the question of compulsion, the single men not having responded as duty called them to do under Lord Derby's scheme. Mr. Runciman, as President of the Board of Trade, has national trade affairs under his care, and if he and Mr. McKenna do not champion the cause of export trade, it is not likely that others will feel that their particular office in the Cabinet requires them to do so. The fact is that all along Cabinet Ministers have emphasised the maintenance of our export trade as far as possible during the war, and others have been agitating for far-reaching efforts at "capturing" German trade, but when these speeches were delivered apparently those who made them did not know how many men it would be necessary to call away from their ordinary callings in order to ensure victory. Perhaps they do not know now, but we may leave the members of the Cabinet, at this moment, to settle the supreme question, assured that industry will consistently and loyally follow them by making whatever sacrifices are shown to be necessary in order to hurry up the end of the war. But nobody will wish to deprive Mr. Runciman of the credit that is his due for work done at the Board of Trade during the last eighteen months. His speech on December 23rd showed how fully he had entered into the spirit of the trade problems of that period and the other problems that are anticipated. We observe that he has been described in the German Press as our "Minister of Commerce," and while we remember that there has been, and still is, a very wide appeal for the setting up of such an office, we also recognise that a great deal of the work that has been going on in his department is certainly preparatory and investigation work of a kind which can well form a basis for our future national action. Both he and Mr. Asquith have been careful to inform the House that such work has consisted largely of the collection of material, and that some committee or other, either from inside the House or from among Government officials, or from business and other experts outside, will require to analyse and report conclusions indicating what the future policy of the nation consequent upon all these investigations should be. Mr. Runciman showed that practically every item of our commercial life must come under review at such a time as this, for when the war was over not one of them would stand in the same position as before the war. In every case the relationship of Germany and Austria to what might be called the Central Power Zollverein was bound to conflict with our interest. There were some special subjects of a highly technical character which the Board of Trade were not prepared fully to investigate themselves, and these he had referred to a very small team of business men outside. These investigations covered a great variety of subjects. Among them were the use made by the Germans of the English financial system, the use made of British ports by German tonnage, and the position of German owners of British companies who claimed the advantage of our ports and flag, and the ownership of real property by aliens. The Board were sending to Italy an excellent representative to collect information on which they would be prepared to act, with the idea of capturing some of the trade done by Germans previously. As far as commerce was concerned, Germany was a beaten nation, and it was our business to take good care that she did not get her head up to the same extent after the war was over. The advantage of the investigations already made was that they had been made without arousing suspicions. Mr. Runciman said it must be the business of the Board of Trade to see that the commercial men of this country were given every advantage that the Government could place at their disposal, in order to secure for us our share of the commercial and industrial advantages that Germany enjoyed before the war.

Well done, Mr. Runciman! This is the position stated in a nutshell. If the Board of Trade really rises to the occasion in the thorough way that this speech indicates, and if British manufacturers take full advantage of the excellent opportunity that such an aggressive and enterprising policy should put in their way, we shall not have reason to be down-hearted—even the demand for a Ministry of Commerce would not be heard had we a Board of Trade that was really intelligently, and with a full and expert knowledge of our different industries, assisting us in all the ways that are practicable at home and abroad. But why send to Italy only? There are other and vaster countries—and we might say Colonies, too—where the need for "Special Representatives," or for additional ones, is very pressing indeed.

War Effects in New Zealand.—H.M. Trade Commissioner in New Zealand recently reported:—"The pinch of the war is being felt by those engaged in the electrical trade in Wellington. It is not nearly so easy now for an electrical firm to secure delivery of certain lines of goods as it was six months ago. There is a steady depletion of stocks of brass holders and plugs, hitherto supplied by Germany to a large extent, and if a source of supply of these and other small electrical goods is not soon found, some embarrassment will be experienced by the trade during the next twelve months."

Trade After the War.—With a view to focussing the opinion of the commercial community in all parts of the Empire, says the "Daily News," the British Imperial Council of Commerce, which is the representative body of the Chambers of Commerce and Boards of Trade throughout the United Kingdom and British Dominions, is convening a conference in London in June next. A provisional programme has recently been circulated to the members for their consideration. The programme is drafted under three main heads: Fiscal questions, legislative questions, and voluntary action by Chambers of Commerce and Boards of Trade. The items enumerated under each head include compulsory registration of aliens throughout the Empire, measures against the "dumping" of enemy goods, and the limitation of membership of Chambers of Commerce, etc., to British-born subjects.

It is announced that a joint committee of the London Chamber of Commerce and the National Patriotic Association has called a meeting on the subject of "Business after the War" for Monday, January 31st, at the Guildhall.

Controlled Works.—There are now 2,422 "controlled establishments" under the Ministry of Munitions.

Recruiting Notes.—It is reported to the Eastbourne T.C. that of the regular staff of 39 at the electricity works, 11 have joined the Forces, one has fallen in action, and another has returned medically unfit. Of the present staff, 18 have joined under Lord Derby's scheme, and the other 21 are ineligible.

A report to the York T.C. states that of the staff of 82 in the electricity department, 32 are with the Forces, and 43 in the reserve under Lord Derby's scheme; of the latter, 16 have official badges, and will not be called up. In the tramways department, 40 men are serving in the Forces, and 59 are enrolled in the reserve.

The whole of the eligible members of the staff of the Exeter electricity department have attested under Lord Derby's scheme.

LEGAL.

ELECTROLYTIC ZINC.

As reported in the ELECTRICAL REVIEW of December 17th, the Refractory Zinc Ore Treatment Co. applied in the Patents Court for a licence to use the German Patent No. 605 of 1909 for a process for the manufacture of anodes of massive manganese peroxide for use in the electrolysis of aqueous salt solutions, such as zinc sulphate solutions, to obtain commercially pure zinc.

The massive manganese peroxide anode, however, although it resists chemical action and maintains the electrolyte pure, has a comparatively small electrical conductivity, and the Refractory Zinc Ore Treatment Co. on Thursday, December 30th, applied in the Patents Court for a licence to use Patent No. 15,128 of 1911, belonging to Messrs. Siemens & Halske, of Berlin, for an anode in which pieces or rods of lead peroxide are embedded in pure manganese nitrate or in a mixture of crystalline peroxide and manganese nitrate. By this means is obtained an intimate union of the lead peroxide conductor with the manganese peroxide, so that the conductivity of the anode is increased to the desired degree. The application was heard by the Deputy Controller, Sir Cornelius Dalton.

Mr. Edward Evans appeared for the applicants: Mr. C. Barnard Burdon for the patentees.

MR. BURDON, before the new application was heard, said he desired to correct statements made at the last hearing to the effect that the main work in applying this electrolytic process to the production of pure zinc had been done by the applicants, and that some of Messrs. Siemens & Halske's patents were based on applicants' investigations. He had lately received a belated letter, which indicated that the foreign patentees took out patents about 1913, independent of the experiments of the Refractory Zinc Ore Treatment Co. The royalty offered was a microscopic one.

MR. EVANS said the difficulty was that they did not yet know what was the life commercially of an anode. Applicants were entirely deprived of the patentees' assistance in proving this process experimentally, and applying it economically to zinc. An elaborate and expensive plant would be required to produce the zinc, apart from that required to produce the anodes, and they would have to look to British manufacturers to help them. The patent now being asked for was highly important for the production of zinc. A price on the basis of the zinc produced was an unfair way of reckoning it. He would put it on the weight of the anode. The applicants had developed this thing on its commercial side entirely without the help of Siemens & Halske.

MR. BURDON recommended a double royalty—(1) On the basis of the electrode; and (2) a small royalty on the zinc produced. The small royalty paid to Messrs. Siemens & Halske was due to the fact that the patentees were told that prices were then so cut down in the zinc trade in this country by foreign competition that it would not be possible to pay more.

MR. EVANS suggested a royalty of 5 per cent. on the manufactured anodes. He explained that his difficulty with regard to a royalty on the selling price of zinc was that it would probably be necessary to float a separate company to make the zinc, and for that a great capital would be required. The patent covered both the making of the anodes and the getting of the zinc, and the licence would cover both these processes.

The DEPUTY-CONTROLLER said he gathered that the applicants would pay a royalty of 5 per cent. on the anodes they made for

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sale to a zinc-getting company, or 1s. per ton on any zinc they chose to manufacture themselves. The royalty would be on whatever they manufactured for sale.

MR. EVANS: And where we pay royalty on any anodes, there is to be no further royalty in respect of zinc.

MR. BURDON asked that the licence should specify that the power to use the anodes was not given for any other electrolytic purpose, and that all parties should pay a royalty to be estimated upon the basis of the zinc produced.

SIR CORNELIUS DALTON said he would communicate with the Board of Trade, and the applicants would hear from them at an early date.

ROSE BROS. *v.* BULL.

IN the City of London Court, on January 4th, before his Honour Judge Atherley-Jones, K.C., Rose Bros., 38, Beech Street, Barbican, E.C., electricians, sued a man named Bull, trading as W. J. Clarence, 42A, George Street, Richmond, for 10s. 8d. for dry batteries for electric flash lights supplied.

The plaintiff Rose said that the goods were supplied in January of last year. Defendant complained of them, and they told him that they knew they were not as good as they would be in a few weeks, when their batteries would be equal to any on the market. In starting a new factory there were difficulties to contend with. They were making the claim on principle, as defendant had behaved in a truculent fashion, shouting in their place: "You sell nothing but 'dud' batteries." They should have been returned within three months if there were any complaints. In cross-examination the witness said the batteries were made by the British Battery Co. Defendant: They were guaranteed for six months. Plaintiff: If returned unbroken within three months we would have taken them back. Defendant: I gave the order on the understanding that they were English batteries and guaranteed for six months. They were made abroad, probably in Germany. Plaintiff: You complained of the English batteries and we sent you Dutch. We could not get German ones if we wanted. If they were German they would have been good ones. We are now making our own. They are not yet quite as good as the Germans; but they will be as soon as we get the raw material.

Judge Atherley-Jones found for the plaintiff. Defendant: It is not fair. This is an absolute waste of money. The Judge: You should have returned them sooner. I cannot discuss it with you.

BUSINESS NOTES.

Consular Notes.—HOLLAND.—In a report from The Hague, an American Commercial Attaché states that, with the increase of the efficiency of machinery for generating, distributing and applying electricity, and making it less difficult to control, there has arisen an increased demand for small electric motors for work on farms in connection with threshing, feed cutting, churning, &c. The thickly-populated country, with its small and intensive farms, offers an inviting field for enterprise in the form of a central power station. The unlimited water supply from the navigation canals solves the problem of good feed water for boilers and cool condensation water for engines, and counterbalances to a large extent the high cost of fuel. Germany has hitherto furnished most of the electrical machinery, but this source of supply is now practically unavailable.

CHINA.—An unconfirmed report states that the board of directors of the China Eastern Railway has awarded the concession to the Russian firm of Barski & Co., at Harbin, Manchuria, to construct an electric tramway between Pristan and Old Harbin, *viâ* New Harbin, the total length of which is to be about seven miles.

In a comprehensive *résumé* of the effect of the war on South China trade, the American Consul-General at Hong-Kong points out that the chief result of the present state of affairs has been the shutting off of European markets for Chinese products, until prices for such products have fallen so low as to make production unprofitable even where the goods could be sold at all. This has, of course, depreciated the ability of China to buy for import. In most lines, therefore, the year's business has been confined to the liquidation of accumulated stocks. As a result of general business depression, there has been less demand for electrical machinery, and what demand has existed has, consequent upon high prices and uncertainty of delivery of British goods, reached the United States in unusual degree. A contributory cause to the falling off in trade in electrical lines is the cessation of German financing of electrical power and light projects. The Consul-General, whilst claiming an increased and increasing demand for American supplies, frankly admits that this is due more to the unique position of the United States as a great trading non-belligerent nation, than to any special activity on the part of American business men.

SPAIN.—From information supplied by the American Consul at Seville, a German electric company—the Compania Sevillana de Electricidad, of Seville—is having marked success. For the year 1914 the receipts, 2,267,436 pesetas (peseta = 9·6d.), and profits, 980,336 pesetas, show increases over the figures for the previous year of 190,000 and 94,000 pesetas respectively. Since 1911, this company has paid dividends of 8 per cent. annually, established a reserve of 405,000 pesetas, paid 3,348,000 pesetas for the redemption of bonds, and has now a capital of 12,800,000 pesetas. The company manufactures its own electricity in Seville, and has made an arrangement with the hydro-electric company, which takes its power from the Guadiaro, to have the exclusive right to sell its power in this city. It is, however, interesting to note that a new company—the Catalana de Gas y Electricidad S.A.—financed by Spanish and British interests, started business during 1914, and is having considerable success, although this does not appear as yet to have materially affected the receipts of the older Germany company.

SOUTH AMERICA.—The American Consul-General at Buenos Ayres, commenting on a meeting of the board of directors of the Camara Sindical de Comercio with reference to the causes restricting the development of commerce between Argentina and the United States, emphasises the importance of the opportunity which now offers itself to American manufacturers to compete for this valuable market. The causes of American failure in the Argentine have been the refusal to give long credits and neglect to consider the peculiar requirements of the country, resulting in the frequent dispatch of goods of quite a different character from those ordered, on the erroneous principle that the next closest thing will suit as well. Laying stress on the present abnormal conditions and the fact that the deviation of trade to the United States is mainly due to the temporary enforced withdrawal from this market of European countries, the Consul-General urges American traders to utilise the present opportunity to lay a solid foundation so that, at the end of the war, they may have become securely entrenched. Argentine newspapers, notably *La Prensa* and *La Nación*, also openly warn American manufacturers that the present situation must not be taken as a guarantee of the success of American goods when affairs have resumed a normal state. In this connection it is pointed out that the intermediaries and agents in the present accidental commerce are European houses and firms who have recourse to the United States only provisionally, and who logically will endeavour to resume their original relationship as soon as circumstances will allow.

An interesting and instructive table showing the total value of imports of incandescent and other lamps into South American countries from 1910-14 inclusive, is published in a recent American Consular report. The figures for 1913 and 1914 giving details of the imports from each manufacturing country, are not in some cases available, but some interesting comparisons are shown. In Brazil the relative figures from 1910 12 in respect of electric and electric lighting apparatus for Germany, the United Kingdom and the United States, were as follows:—

	Germany. Paper milreis.	United Kingdom. Papor milreis.	United States. Paper milreis.
1910 ...	2,401,121	1,788,954	4,625,363
1911 ...	3,695,937	2,635,266	5,079,112
1912 ...	4,251,435	1,760,080	6,368,801

The figures for the Netherlands and Austria-Hungary for the same period rose from 14,108 to 75 718 paper milreis, and from 20,628 to 109,147 paper milreis respectively. For incandescent lamps imported into Argentina, the figures for the United Kingdom show an increase from 1910 to 1913 from 38,000 to 67,000 pesos, for the Netherlands an increase from 96,000 to 108,000 pesos, for Austria-Hungary an increase from 8,000 to 23,000 pesos, whilst those for Germany and the United States show decreases from 324,000 to 241,000, and from 69,000 to 42,000 pesos respectively. The provisional figures for total imports of incandescent lamps for 1914 show a decrease for the year from 495,000 to 257,000 pesos. The figures for Mexico for 1910-12 are rather startling. The total imports for electric incandescent lamps decreased from 704,912 to 647,476 pesos, but the figures for the United Kingdom show a decrease from 26,417 to 550 pesos! The figures for Germany and Austria-Hungary decreased from 274,796 to 183,230 and 25,198 to 11,335 pesos respectively, but increases from 169 to 2,528 and 360,045 to 441,932 pesos are recorded in respect of the Netherlands and the United States. In Peru, out of a total for 1913 of £8,161 in respect of incandescent lamps, only £282 relates to the United Kingdom, the figures for Germany being £4,671 and for the United States £2,963.

Copper Stealing.—A fine of £20 was imposed by the Widnes Magistrates, on Thursday last week, on Victor Horace Osborne, foreman erecting electrical engineer, of Chatham Street, Stockport, who was charged with stealing 162 lb. of copper and 421 lb. of copper, the property of his employers, the B.T.H. Co. It was stated that the prisoner was supervising the erection of electrical plant at the Sullivan Chemical Works, Widnes, and Supt. Foster said that the police visited a local marine store and found that prisoner had disposed of a quantity of copper. For failing to enter in a book an account of all articles purchased, Charles Bond, marine store dealer, of Lugsdale Road, Widnes, was fined 40s.

RECEIVING STOLEN COPPER.—Thomas Wilson, coal and metal merchant, of Pendleton, was sentenced to six months' imprisonment in the second division by the Salford Recorder, on Monday, on a charge of receiving 1 cwt. of scrap copper, well knowing it to have been stolen. The copper was taken from the British Westinghouse works at Trafford Park.

Bankruptcy Proceedings.—WILLIAM CAREY WILD, electrical engineer, 57, Rhodes Street, Halifax.—At Halifax Bankruptcy Court, on December 30th, a receiving order was made on debtor's own petition. First meeting, January 12th; public examination, January 14th, both at Halifax.

AUGUSTINE GARBUTT, "electrical engineer, now weighing machine attendant," Leeds.—Receiving order made December 31st, on debtor's own petition.

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Trade in 1915.—The January issue of the *Chamber of Commerce Journal* contains a series of special reports by experts in the leading trades, regarding the trade and industry of the United Kingdom in 1915.

Trade Announcements.—THE LONDON COMMERCIAL ELECTRICAL STORES, LTD., have removed their offices and stores to 13, Farringdon Avenue, E.C. Telephone number: "Holborn 530"; telegrams: "Galvorite, London."

Owing to the increased business, MESSRS. CAVE & HIGGIN, LTD., have removed to more commodious premises at 265, Deansgate, Manchester (telephone number: "Central 1283").

Catalogues and Calendars.—THE VICTA ELECTRICAL CO., of 60, Queen's Road, Battersea, S.W., have issued a circular relating to their facilities for repairing electric meters during war-time; also a wall calendar for 1916, with monthly tear-off slips.

MR. W. H. JOHNSON, of 14, Panton Street, London, S.W., has in circulation a wall calendar, with small monthly slips for 1916, which in design effectively illustrates the fact that he is sole European representative for "Remy" electric apparatus.

THE DAVENPORT ENGINEERING CO., of Harris Street, Bradford, have prepared a wall calendar, with daily date slips, for the current year.

THE COUNTY OF LONDON ELECTRIC SUPPLY CO., LTD., of Moorgate Court, E.C., have prepared a telephone card for the convenience of consumers.

THE GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, London, E.C.—New catalogue of between 40 and 50 pages giving illustrated particulars of their various types of "Witton" starters, regulators, starting panels and controllers. Prices and other details are tabulated, and dimensioned drawings and diagrams of connections occupy the last few pages.

MESSRS. POPE'S ELECTRIC LAMP CO., LTD., Hythe Road, Willesden, N.W., have issued a wall calendar with plainly printed monthly tear-off slips.

MESSRS. THERMIT, LTD., of 27, Martin's Lane, London, E.C., have again issued one of their pocket memoranda books, the opening pages of which contain a good deal of illustrated information concerning Thermit welding, some useful tables, and calendars for 1916 and 1917.

MESSRS LANGDON-DAVIES MOTOR CO, of 110, Cannon Street, London, E.C, have sent us a handy-shaped pocket-notebook, the opening pages of which contain tables of information respecting some of their standard sizes and types of motors (single-phase, polyphase, and D.C.), while an insurance coupon lies in the front pocket.

THE L.P.S. ELECTRICAL CO., of 18, Adam Street, Strand, London, W.C.—Pocket pamphlet of 16 pages containing illustrated particulars of their current-carrying universal test clips.

MESSRS. W. BARNS & SON, Globe Works, Queensland Road, Holloway, London, N.—Illustrated circular showing various descriptions of perforated steel cable plates, metals and wire-work.

MESSRS. ALFRED HERBERT, LTD., of Coventry, have sent us one of their very acceptable wall calendars with monthly sheets for 1916, with bold figuring on good white paper.

MESSRS. PORTER PATENT SAFETY SEALS, LTD., 7 to 9, Belfast Road, London, N.—Prices and samples of their patent safety seals for electricity meters, &c.

Dissolutions and Liquidations. — POWER GAS ECONOMY, LTD.—This company is winding up voluntarily, with Mr. J. Duncan as liquidator. A meeting was called for yesterday at 149, West George Street, Glasgow.

NELSON'S COAL CONVEYOR, LTD.—A meeting of creditors is called for January 3rd, at 142, Park Road, Wallsend. Mr. T. Rose, liquidator.

BILBIE, HOBSON & CO., engineers, 106 Queen Victoria Street, E.C., and Daverell Street, Great Dover Street, S.E.—Mr. H. G. Hall has retired from the partnership, and Messrs. J. Bilbie and J. S. Wylde will continue the business under the same title, &c.

CEDES ELECTRIC TRACTION, LTD.—A petition presented by the Tudor Accumulator Co., Ltd., for the winding up of this company, is to be heard on January 18th, in London.

SALSBURY LAMPS, LTD.—A meeting is to be held on February 7th, at 15, Eastcheap, E.C., to hear an account of the winding up from the liquidator.

Book Notices.—"The *Mechanical World* Electrical Pocket Book for 1916" (Emmott & Co.; price 6d. net) contains new sections on switchgear and switchboards, earthing, "reductors" for half-watt lighting, and the efficiency of dynamos and motors, and the accumulator notes and sections on lighting circuits and switching, and electric lighting, have been revised and extended. The book gives a remarkable amount of condensed information for the small price charged, and has the great advantage that it opens like other books.

"The *Mechanical World* Pocket Diary and Year Book for 1916" (Emmott & Co.; price 6d. net), now in its 29th issue, contains several new tables, while much additional information regarding steam boilers has been inserted. A separate section is devoted to the Diesel engine, and notes on brazing and soldering have been added.

Measurements for the Household (Circular No. 55 of the Bureau of Standards, U.S.A.) is a remarkable departure from precedent, in that although the product of a Government Department, it takes cognisance of the existence, requirements and implements of the domestic household and aims to instruct the householder as to units and methods of measurement generally, methods of checking the quantities of goods bought by weight and measure, and the methods in vogue for cheating him—or rather, her. In this country, we fear, the average housekeeper would actively resent such an incursion into her sphere, which she believes she alone understands, and she would certainly decline to be taught anything about the efficient management of her domain; but perhaps our trans-Atlantic cousins are less dogmatic in such matters and are willing to learn something of scientific method. We have examined the circular—which comprises nearly 150 pages—with interest, and unreservedly congratulate the authors on the manner in which they have carried out their work, and on the admirable matter, both text and illustrations, which the volume contains. True and false weighing and measuring instruments (some of the fraudulent ones showing marvellous though misguided ingenuity), thermometry, fuels, combustion, lighting, electricity, gas and water supplies, with the corresponding meters, humidity, barometric pressure, hydrometry, and time are amongst the subjects dealt with; the treatment is extremely clear and simple, yet accurate, and the information given undoubtedly should go far to reduce the waste and increase the comfort obtaining in the domestic household. Although the first edition is only a few months old, a second is already in preparation, and the newcomer merits the warmest welcome and approval.

"Science Abstracts," Sections A and B. Vol. XVIII, Part 12, December 28th, 1915. London: E. & F. N. Spon. Price 1s. 6d. each.

The December number of the "*Journal* of the Tramways and Light Railways Association" contains a full list of members of the Association and their addresses.

"*Journal* of the Institution of Electrical Engineers." Vol. 54. No. 253. January 1st, 1916. London: E. and F. N. Spon, Ltd. Price 3s. 6d.—This issue contains the following papers:—"Design of High-Pressure Distribution Systems," by Mr. J. R. Beard; "Mathematical Design of Transformers," by Prof. D. Robertson; "Electric Generating Stations in China," by Prof. C. A. Middleton Smith; "Pole-Face Losses," by Mr. F. W. Carter.

"The Principles of Dynamo-Electric Machinery." By B. F. Bailey. London: Hill Publishing Co. Price 12s. 6d. net.

"The Electrical Engineers' Diary for 1916." London: S. Davis and Co. Price (stiff boards or limp cloth) 3s. 6d. net.

We have received a copy of a new monthly paper, *Russia*, which is published in London at 6d. It is a commercial, financial and literary review, and contains the official bulletin of the Russian Chamber of Commerce in London. One of the articles discusses engineering prospects in Russia; others deal with Russian traffic routes and Russian credit.

LIGHTING AND POWER NOTES.

Aberdeen.—The Electricity Committee has renewed the contracts for the supply of electricity to the Harbour Commissioners and the Great North of Scotland Railway Co. The number of units generated in November was 1,301,800, as compared with 1,138,140 units in the previous year, an increase of 163,660 units.—*Evening Gazette.*

Birmingham.—PLANT EXTENSIONS. — The Electric Supply Committee recommends the City Council to approve a scheme for extending the temporary generating station just completed at Nechells. This recommendation is the outcome of certain negotiations, and the decision of the Committee, in view of the fact that the temporary station would only be sufficient to meet the demand of existing consumers, not to accept any further applications for supplies. Manufacturers who had accepted orders for urgent work thereupon took steps to compel the undertaking to supply. The alternatives of proceeding with the permanent station, or erecting an extension to the existing temporary station, were considered, but it was found that new plant could not be installed in the permanent station before the winter of 1917, whereas the temporary extension will, it is hoped, be ready for use during the winter of 1916. The cost of the buildings and plant is shown in the following table:—Foundations, engine and boiler house, J. J. Shardlow, £3,500; structural steel work, E. C. & J. Keay, Ltd., £5,800; corrugated asbestos sheeting for roof and walls, glazing, &c., £2,200; 6,000-KW. turbo-alternator, with condensing plant, £27,000; three boilers with superheaters, chain-grate stokers, chimneys, induced draught fans, &c., Babcock and Wilcox, Ltd., £17,000; coal-handling plant, overhead telpherage system, Herbert Morris, Ltd, £3,500; ash-handling plant, £50; overhead crane for engine house, £600; steam, feed and water pipe work, including valves, £5,300; cooling towers, including foundations, Davenport Engineering Co., £5,550; fire appliances, £60; lagging for steam and feed pipes, £160; hotwell feed water tank and connections, £500; engine-room platforms, £200; railway siding, £3,000; high-tension switchgear and cable connections, £5,000; wharf extension, £3,000; contingencies, 10 per cent., £8,240. Total, £90,660. The cost of the underground trunk and distributing mains that will be necessary is estimated at approximately £50,000. If it should be necessary to install economisers there will be an additional expense for economisers and foundations of £8,000. The items of plant against which makers' names are given are those for which tenders have been obtained and submitted to the controlling authority.

Carlisle.—Owing to the heavy rains, the Corporation electric light station was flooded on Friday last, causing a temporary cessation of the electric lighting.—*Times.*

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Canada.—The Hydro-Electric Power Commission of Ontario has extended the power plant at South Falls, Muskoka River, by the addition of a 750-K.V.A. unit; the extension will supply the towns of Gravenhurst, Bracebridge and Huntsville.—*Canadian Engineer.*

According to an American Consular report, the plant capacity of the Calgary municipal electrical undertaking is 15,000 KW., the plant consisting of turbine and reciprocating sets with gas fired boilers. At the present time, however, the Calgary Power Co., is supplying the city under a bulk contract, from its hydro-electric plants on the Bow River, 58 miles away, and using the city's power plant as a stand-by unit. The city distribution is at 2,300 volts, three-phase, by means of 233 miles of pole line; the consumers' secondary feeders are single-phase, three-wire, at 110 and 220 volts and three-phase, 220 volts, for power. Some 14,000 meters are in service and 200 miles of streets are electrically lighted. The department is in a prosperous financial position.

Chelmsford.—E.L. PURCHASE.—The T.C. has decided to apply for an order under the Special Acts (Extension of Time) Act, 1915, extending for one year the time within which the Corporation may exercise its option to purchase the local electric light undertaking. In 1894 the B. of T. granted Messrs. Crompton and Co. a provisional order, and the present undertakers are the Electric Supply Corporation, Ltd.

Dublin.—When the chairman of the Lighting Committee recently moved the adoption of a report recommending the Committee's amalgamation with the Electricity Supply Committee, an amendment was moved by Mr. P. T. Daly for deferring the report pending the report of a Special Committee investigating the affairs of the electricity undertaking, and this was agreed to. By 37 votes to 14, the Corporation adopted a report of the Electricity Committee on the charges for electrical energy supplied to theatres.

Erith.—The U.D.C. on December 29th decided to grant a supply of current to the West Kent Electric Co. for a further 200 houses in Colyer's Lane. The electrical engineer has been authorised to install, at a cost of £60, a new centrifugal pump.

Finchley.—E.L. FAILURE.—The electrical engineer, reporting upon the recent breakdown of the mains, said that this was the first occasion on which the supply of current had been completely disorganised since 1903. Each of the three main areas of supply was affected, and there were numerous minor faults on consumers' premises. The breakdown had partially damaged the large generating set. The major fault was due to a pick hole in one of the distributing mains, and the engineer is of opinion that all street openings should be under supervision, as similar damage had been done on several occasions. The engineer spoke highly of the manner in which the staff and men worked to clear the breakdown. The suggestion with regard to the supervision of future excavations was adopted by the Council.

Halifax.—PROPOSED LOAN.—The Corporation proposes to apply to the L.G.B. for power to borrow £5,558, the additional cost in connection with the purchase of plant required at the electricity works.

The General Purposes Cammittee has referred to the Electricity Committee a request for an advance of wages by the employés of the electricity department.

Hereford.—LOAN REFUSED.—The L.G.B. has refused the application of the T.C. for sanction to a loan for additional plant at the electricity works on the ground that the matter is not one of pressing necessity. The Council, in consequence, will not entertain for the time being any applications for new supplies, nor any extension of any existing supply.

Heston and Isleworth.—ELECTRICITY PRICES.—The Electricity Committee has again decided to retain the present price of current, as in view of the probable falling off in the quality of gas, owing to the extraction of constituents for manufacturing purposes, the undertaking would be likely to reap the benefit of an increased demand.

Leamington.—A sum of £300 is to be spent on X-ray apparatus and an electrical installation at the Warneford and South Warwickshire Hospital.

Leicester.—PLANT EXTENSIONS.—Having received numerous applications for increased power supply from manufacturers, the Electricity Committee recommends the Council to sanction an expenditure of £14,000 for the immediate provision of cables and for anticipated requirements, for which official approval will be given.

Lincoln.—PRICE INCREASE.—The T.C. has decided to increase the accounts of all ordinary consumers for lighting and power by 20 per cent. from the completion of the meter readings for the Christmas quarter's accounts.

London.—BETHNAL GREEN.—The Electricity Committee of the B.C. has had under consideration the question of the method to be adopted in dealing with the mains and services laid by the Shoreditch B.C. in the Bethnal Green area. The Shoreditch Council has from time to time during the past 12 years laid mains and services, some of the work being undertaken on the understanding that the Bethnal Green authority would, when in a position to supply current, purchase the mains of the Shoreditch Council, whilst other works have been carried out by the latter authority in the absence of objection on the part of the Bethnal Green authority. The Committee recommends the Council to authorise it to negotiate further with the Shoreditch Council for the purchase of the mains and apparatus in order that the matter can be settled promptly.

Manchester.—LOAN SANCTION.—Sanction has been received for the borrowing of £8,250, repayable within 60 years, for the purchase of certain lands required in connection with the scheme for the establishment of an electricity generating station at Barton.

Paisley.—YEAR'S WORKING.—For the year ended May 15st last, the Corporation electricity undertaking earned a gross revenue of £25,908 and a gross profit of £11,072, and after meeting the usual financial charges and taxes, a surplus remained of £446, as compared with £395 in the previous year. The units sold during the year amounted to 4,036,611, which included 1,703,128 units supplied to the Paisley District Tramways Co., and 1,428,000 units supplied for power purposes. The output sold compares with 3,839,857 units for 1914.

Salford.—PROPOSED LOAN.—The Electricity Committee has decided to recommend the Council to apply to the L.G.B., for sanction to borrow £1,600 for a 500-KW. rotary converter set, together with the requisite switchgear and low-tension cable.

Southend.—L.G.B. SANCTION.—The L.G.B. has sanctioned the loan for the provision of engines at the Leigh and Thorpe Bay sub-stations, on the understanding that the Corporation will endeavour to dispose of the machinery and will not fix the same without the Board's consent. A further communication is to be made to the Board on this matter.

Stalybridge.—LOAN APPLICATION.—The Joint Board has decided to apply for sanction to the borrowing of a sum not exceeding £20,000 for an extension scheme at the generating station to meet the increasing demands for energy. It is proposed to install another turbine set.

West Bromwich.—LOAN SANCTION.—The Electricity Committee of the T.C. has obtained sanction to borrow £8,850 for the extension of generating plant as follows:—£1,759 for economiser, steel chimney, motor for stoker and water softener; £4,517 for boiler machinery, &c.; and £2,574 for engine house extension and for foundations for boilers, chimneys, &c. The Committee recommends the entering into of an agreement with the Oriental Tube Co. for the supply of current of a minimum quantity of 80,000 units per annum.

Wharfedale.—E.L. SCHEME.—In regard to the scheme of various Wharfedale District Councils, with a view to the establishment of a joint electricity supply undertaking, it appears that the Otley and Burley Councils have suddenly withdrawn without attending a meeting of the joint committee to intimate their intention. In a report from the Wharfedale Electricity Sub-Committee, presented to the Guiseley Council, it was suggested that providing there was a unanimous desire on the part of the Councils concerned to allow a private company to come into the district it would be advantageous if each Council had a similar agreement with such company. Dr. Muschamp, the originator of the joint scheme, said a tentative scheme had been drawn up, with a recommendation that each Council should take a census with the object of ascertaining what demand there would be for electricity. The scheme must remain in abeyance at present because the Board of Trade had clearly intimated that it would not grant any order to any company during the period of the war.

Whitstable.—At a special meeting of the U.D.C. on December 28th, it was reported that the debenture-holders of the local Electric Supply Co. had appointed a receiver. A resolution was passed to the effect that the Council should only continue generating current in the usual manner until January 7th, unless on or before that date the debenture-holders stated their willingness to recoup the Council for all expenses incurred.

York.—DEFERRED EXTENSIONS.—The Electricity Committee has recommended the T.C. to apply for an extension of time for the laying of mains in the Bishopthorpe and Acomb districts under the 1914 order.

TRAMWAY and RAILWAY NOTES.

Aberdeen.—TRACK MAINTENANCE.—Some discussion is likely to arise in the T.C. regarding a proposal emanating from the Tramways Committee that the maintenance of the tramway track should be handed over to that department.

Belfast.—FEMALE LABOUR.—At the meeting of the Corporation, on Monday last, Alderman Tyrell, of the Electrical Committee, in reply to a Labour protest against the employment of women as conductors on the trams, said that, if it was necessary to employ women, it would be done. Some discussion followed on the age of conductors, which had been reduced from 19 to 17 years, and also on a recent electrical explosion in one of the streets.

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Blackpool.—CONTRACT TICKETS.—The T.C. on Tuesday last had another long debate on the question of tramway contract prices. The tramways manager recently reported that the existing charge of £3 per annum for the entire system was resulting in a loss of about £2,000 a year to the department, but the General Purposes Committee last week supported a recommendation that any change should be deferred until after the war.

Ald. Grime submitted that the Council should settle the matter at once by raising the price to £5. The amendment was defeated, so that the existing charges will remain in force.

Bradford.—FEMALE LABOUR.—Over 300 applications have been received for the 20 posts of women car conductors which have been decided upon by the Tramways Committee as an experiment.

During the storm of Saturday last a double-decked tramcar was blown over in Idle Road, the two passengers receiving slight injuries.

Canada.—Thirty Ontario municipalities have endorsed the proposal to construct an electric railway from Toronto to London (Ontario), at a cost of £2,800,000.—*Morning Post.*

Colne.—The T.C. has refused to accede to a request by the Tramway Workers' Union that the advance of 5 per cent. which the Council made at its last meeting, should be regarded as permanent, and not as a war bonus.

Erith.—The U.D.C. has decided to apply for a prov. order to alter or amend the Tramways Improvement Act, so as to enable the Council to run motor-'buses in certain districts.

Glasgow.—TRAMWAY ACCIDENT.—On Saturday last an accident occurred to one of the Corporation electric cars, which left the rails at a sharp curve, and crashed into the wall of the Forth and Clyde Canal. The force of the collision caused the upper portion of the car to become separated from the lower, and to hang sideways against the wall. Over 40 passengers were on the car, and several were badly injured, including the woman conductor, the most serious cases being removed to the Western Infirmary.

Leeds.—NEW TRAMWAY OFFICES.—The Corporation tramway department moved during several days last week from its old premises in City Square to a new building at the corner of Lower Briggate and Swinegate. The new headquarters are to be shared by the Highways department, and the estimated cost of the place is £30,000. A new headquarters has long been urgently needed, the growth of the tramway system having been very rapid in the last 15 years.

Preston.—The Tramway Committee, after considering a statement of receipts, has declined to discontinue the Sunday morning car service. Girls are to be employed for the tramway parcel delivery service.

Manchester.—The B. of T. has extended for one year the time limited by the Manchester Corporation Act, 1911, for the construction of certain authorised tramways within and beyond the city.

Radcliffe.—ACCIDENT.—Nine persons were slightly injured on Monday in a tramway accident. Harry Pusey, the driver of the car, was driving down Radcliffe New Road, at about eight miles per hour, and when he tried to apply the brakes, about 200 yards from the bottom of the decline, the wheels began to skid. He applied other brakes, but the car gained speed, collided with a lorry, and ran off the track into a shop-front.

U.S.A.—CHICAGO ELECTRIFICATION REPORT.—The long-waited report of the "Chicago Association of Commerce Committee of Investigation on Smoke Abatement and Electrification of Railway Terminals" has at last been made public. It contains some 1,200 pages, and apparently comes to the conclusion that railway electrification would have a negligible effect in reducing smoke polution, and that if carried out, the railways would have to meet an estimated annual loss of over 14 million dollars on the undertaking. The electrification of every mile of track in the city would involve 3,476 miles, 1,476 miles being main line, and affect 38 railroads.

The Committee in estimating the cost of electrification considered several systems, and found comparatively little difference in cost. The least costly scheme was an 11,000-volt single-phase trolley system ($178,000,000); a 2,400-volt direct-current trolley system was estimated to cost $191,000,000; and a 600-volt D.C. third-rail system $198,000,000, but this system was regarded as impracticable on account of the number of gaps in the third rail, while the overhead trolley system would be hampered by the number of structures across the track. The estimated annual deficit arises from the burden of annual charges to be met, electric working being in itself cheaper than steam operation. Steam locomotives were found to be responsible for only 10 per cent. of the gaseous polution of the air, and it was considered that electrification would reduce the visible smoke in the city by only 20 per cent. As pointed out by an American contemporary, the extent of this smoke nuisance to the city at large may be of minor importance, but its concentrated nature in certain localities may have an important bearing on the matter.

One result of the publication of the report has been a unanimous decision of the Chicago City Council instructing the Council's Committee on railway terminals to consider immediately the electrification of the steam railways within the city, and report as to the necessary ordinances to bring this about—the Council thus ignoring the findings of the Chicago Association of Commerce.

The engineers to the Boston Elevated Railway Co. have recommended the addition of a 35,000-KW. turbine set to the South Boston station, which contains three 15,000-KW. turbo-generators. The engineers point out that while a 20,000-KW. set would provide sufficient power to meet reasonable demands temporarily, the larger unit would cost considerably less per KW. and be more efficient. It is estimated that the additional cost ($200,000) would be repaid within five years by these savings. With an estimated five years' output of 1,180,000,000 units, the manufacturing costs are estimated at $3,200,000 with the larger set, and at $200,000 more for the smaller set; the use of the larger machine with its less steam consumption would also defer the necessity for additional boilers for one year beyond the time if a 20,000-KW. set were installed. The engineers also mention the tendency towards higher boiler pressures, it being considered practicable to build equipment for 400 lb. per sq. in. or more. The Boston Co. is rearranging its sub-station plant and substituting 4,000-KW. rotary converters for smaller units.

TELEGRAPH and TELEPHONE NOTES.

Ceylon.—According to *Indian Engineering*, the wireless equipment of Ceylon has been so much improved that the Island can now receive messages from Paris and Cornwall.

Postal Telegraphists.—It has been arranged with the War Office that no Post Office servant who has been attested shall be called up until the Postmaster-General has intimated that arrangements can be made for his release. Telegraphists and skilled workmen included in the revised waiting list for the Royal Engineers will not be called up with the groups into which they fall, but will be retained in their civil positions until they are required for enlistment in the Signal Service.

Russia.—"Urgent" telegrams to Russia at the rate of 1s. 1½d. per word were instituted on January 1st. These telegrams have priority over other private messages.

Switzerland.—According to official reports, the Swiss telegraph and telephone network had, at the end of 1913, an extent of 10,389 km. The telegraphic traffic during 1913 increased to 6,140,526 telegrams (an increase of 182,512 messages). Telephone subscribers totalled 80,517, the wire serving them being 336,419 km. in extent. The interurban circuits and international circuits had a total length of wire of 65,099·8 km. The number of conversations was 73,733,935. The aggregate of receipts totalled 21,182,715 fr.; expenses were 20,016,955 fr. The profit was, consequently, 1,165,760 fr.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—January 19th. P.M.G. Carbon and manganese powder, manganese chloride, chloride of ammonia, porous pots, outer jars and carbon blocks. See "Official Notices" to-day.

February 18th. Melbourne, Brunswick and Coburg Tramways Trust. Six radial trucks.*

BRISBANE.—January 23rd. P.M.G. Wheatstone apparatus. See "Official Notices" Dec. 17th.

April 15th. P.M.G. Common-battery multiple switchboard, or automatic or semi-automatic switchboard, and associated apparatus. See "Official Notices" December 31st.

MELBOURNE.—February 16th: 51 electric staff instruments. February 23rd: Two commutator slotting machines, for the Victorian Railway Commissioners.*

SYDNEY.—January 31st. Three electrically-operated railway freight-car transferers, for Jones Bay wharfage, Pyrmont. Particulars from Engineer-in-Chief of the Harbour Trust, Circular Quay.

January 20th. Silk-covered wire, for P.M.G.*

February 7th. Metropolitan Board of Water Supply and Sewerage. For No. 1 pumping station at Ultimo. Two centrifugal pumps and electric motors (4,000 gallons per minute each), switchboards, starters, &c. Contract No. 1,301.*

February 28th. Municipal Council. Tenders for induction regulators. Specifications (11s. 6d.) from the Electric Light Department, Town Hall, Sydney.

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-KW. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.

Darlington.—January 12th. Corporation. Coal bunkers, elevators, &c., for the electricity works. Specifications from the Borough Electrical Engineer, Haughton Road.

Dublin.—January 12th. Port and Docks Board. Twelve months' supply of electrical supplies. Forms from Mr. N. Proud, Secretary, Port and Docks Office, Westmoreland Street.

Leeds.—January 15th. Electricity Department. Steam coal (small slack, smudge or similar material) during the period ending July 31st or December 31st, 1916. Mr. C. N. Hefford, City Electrical Engineer, 1, Whitehall Road.

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London.—ISLINGTON.—January 21st. B.C. Twelve months' supply of engine-room stores, electrical fittings, meters, cables, &c. See "Official Notices" Dec. 31st.

New Zealand.—AUCKLAND.—February 23rd. City Council. Centrifugal pumping electric motors, and automatic starting and controlling apparatus, for the four city pumping stations. Specifications from the office of the Water Board, Town Hall, Auckland.

DUNEDIN.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.

RAETIHI.—March 14th. Town Board. 40-H.P. hydro-electric generating set, switchboard, &c. Plans and particulars from Messrs. H. W. Climie & Son, Raetihi.*

South Africa.—January 17th. S A. Railways Administration, Johannesburg. 74,966 drawn-wire tungsten lamps.*

Spain.—Tenders have just been invited by the municipal authorities of Puerto de Bejar (Province of Salamanca) for the concession for the electric lighting of the town during a period of 20 years.

The municipal authorities of Bodon (Province of Salamanca) have lately invited tenders for the concession for the electric lighting of the town during a period of three years.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Aberdeen.—The Corporation Tramways Committee has accepted tenders for ironwork and supplies of wood from Messrs. Cruickshank & McIntyre, Ltd., and Messrs. John Fleming & Co.

Australia.—The Brisbane Hospital Committee has accepted the tender of the Brisbane Electrical Co., at £3,852, for the installation of electric light and power.

The Sydney Harbour Trust has accepted the tender of Messrs. Gibson, Beattie & Co. for six electric wharf capstans, for Pyrmont. —*Tenders.*

Bristol.—The Corporation Electrical Committee has accepted the tender of the East Bristol Collieries, Ltd., for a six months' supply of coal to the Avonbank works. The estimated amount is £11,540.

Grimsby.—The Electricity Sub-committee recommends the purchase of the following coals from Messrs. Ed. Bannister and Co., Ltd.:—

250 tons of Brodsworth nutty slack, at 15s. 6d. per ton, to be delivered during January.
5,000 tons of Sherwood slack, at 12s. 4d. per ton, to be delivered during the next 12 months.

Keighley.—The Tramways Committee has recommended the acceptance of the tender of Messrs Clough, Smith & Co., Ltd., to construct the overhead equipment for railless trolley vehicles from the present terminus at Hebden Road, Haworth, to Lower Town, Oxenhope, the capital payment to be suspended until after the war.

Leicester.—The Electricity Committee recommends the Council to seal the following contracts:—

Siemens Bros. Dynamo Works, Ltd.—An additional 1,000-KW. rotary converter and switchgear cables, &c., at £2,450.
British Electric Transformer Co., Ltd.—One set of 100-KW. transformers, one spare transformer, one 75-KW. single-phase transformer, and one 50-KW. single-phase transformer, at £312.
G. Fletcher & Co., Ltd.—Additional coal-handling plant, at £1,952.

London.—L.C.C.—The following tenders have been accepted by the L C C. for the supply of electric lamps:—

Corona Lamp Works, Ltd.—Items 8-18, 18-21, and 26 (metallic-filament lamps, with filaments of drawn wire).
Crysteo, Ltd.—Items 2-27 (metallic-filament lamps, with filaments not of drawn wire).
Edison & Swan U.E.L. Co., Ltd.—Items 1-7 (carbon-filament lamps).

Manchester.—The Electricity Committee has accepted the following tenders:—

One set of induced-draught plant.—Musgrave & Co., Ltd.
One steam-turbine-driven boiler feed pump.—Worthington Pump Co., Ltd.
Two electrically-driven circulating water pumps.—Mather & Platt, Ltd.
Coal-conveying plant.—Babcock & Wilcox, Ltd.
Water cooler.—Klein Engineering Co., Ltd.
Railway track and crossing.—Marple & Gillott, Ltd.
Steelwork required in boiler house No. 2.—Francis Morton & Co., Ltd.
Fountains for new cooling towers and boiler house No. 3.—F. Mitchell and Co, Ltd.
Periodical inspection and insurance of two boilers and economisers.—National Boiler & General Insurance Co., Ltd.
Length of ozone-proof cable.—Pirelli-General Cable Works, Ltd.

Salford.—The Electrical Committee has accepted the following tenders:—

500-KW. rotary converter set.—British Westinghouse Co., £1,450.
4-ton Albion motor petrol wagon.—Albion Motor Car Co., Ltd., £775.

The Tramways Committee has accepted the tender of Messrs. Hadfields, Ltd., for 14 manganese-steel crossings, at £292; and the offer of Messrs. Brown, Bayley's Steel Works, Ltd., for 300 steel tramcar tires, at £4 10s. 9d. per tire.

West Bromwich.—The following tenders for the supply of plant have been recommended by the Electricity Committee for acceptance:—

Gwynnes, Ltd.—Motor-driven centrifugal pump.
Kennicott Water Softener Co.—Water softener.
Cochrane & Co., Ltd.—C.I. pipes.
Babcock & Wilcox, Ltd.—High-pressure steam pipes.

FORTHCOMING EVENTS.

Greenock Electrical Society.—Friday, January 7th. At 7.45 p.m. At the Temperance Institute, 19, West Stewart Street. Paper on "The Economy of Electricity in a Small Household," by Mr. W. B. Smith.

Electro-Harmonic Society.—Friday, January 7th. At 8 p.m. At Holborn Restaurant. Smoking concert.

Manchester Association of Engineers.—Saturday, January 8th. At Grand Hotel, Aytoun Street. Paper on "The Importance of Uniform Conditions for Engineering Operations and Industrial Work," by Mr. A. Etchells.

Institution of Civil Engineers.—Tuesday, January 11th. At 5.30 p.m. At Great George Street, Westminster. Paper on "The Electric Locomotive," by Mr. F. W. Carter.

Illuminating Engineering Society.—Tuesday, January 11th. At 8 p.m. At the Royal Society of Arts, John Street, Adelphi. Discussion on "Some Principles in Industrial Lighting (with special reference to the first Report of the Departmental Committee on Lighting in Factories and Workshops)" to be opened by Mr. J. S. Dow.

Institute of Marine Engineers.—Tuesday, January 11th. At 7 p.m. At Tower Hill, E.C. Paper on "Power-driven Tools on board Ship," by Mr. J. Hamilton Thomson.

Liverpool Engineering Society.—Wednesday, January 12th. At the Royal Institution, Colquitt Street. Paper on "Marine Refrigeration," by Mr. J. Wemyss Anderson.

Association of Engineers-in-Charge.—Wednesday, January 12th. At 8 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Limit Gauges and their Application," by Mr. W. H. Booth.

Institution of Electrical Engineers.—Thursday, January 13th. At 8 p.m. At Victoria Embankment, W.C. Paper on "The Predetermination of the Performance of Dynamo-electric Machinery," by Prof. Miles Walker.

(**Newcastle Local Section**).—Monday, January 10th. At 7.30 p.m. At the Mining Institute. Paper on "The Design of High-pressure Distribution Systems," by Mr. J. R. Beard.

(**Scottish Local Section**).—Tuesday, January 11th. At 8 p.m. At 207, Bath Street, Glasgow. Paper on "Distribution and Rise of Temperature in Field Coils" (part II), by Prof. M. Maclean and Mr. D. J. Mackellar.

(**Manchester Local Section**).—Tuesday, January 11th. At 7.30 p.m. At the Engineers' Club, 17, Albert Square. Paper on "The Predetermination of the Performance of Dynamo-electric Machinery," by Prof. Miles Walker.

(**Birmingham Local Section**).—Wednesday, January 12th. At 7 p.m. At the University, Edmund Street. Paper on "The Predetermination of the Performance of Dynamo-electric Machinery," by Prof. Miles Walker.

(**Yorkshire Local Section**).—Wednesday, January 12th. At 7 p.m. At the Philosophical Hall, Leeds. Paper on "The Design of High-pressure Distribution Systems," by Mr. J. R. Beard.

Chemical Society.—Thursday, January 13th. At 8 p.m. At Burlington House, Piccadilly, W. Ordinary meeting.

NOTES.

Bristol Corporation and Enemy Goods.—At a meeting of Bristol City Council on Saturday a resolution was passed requesting the Corporation Committees to avoid as far as possible trading with firms containing Germans or German capital. It was suggested that Sir W. H. Davies, M.P., who was present, should draw the attention of Parliament to such trading by Government departments.—*Times.*

The City Council had a lengthy discussion on the matter a few days ago, the question being raised with reference to a contract for main cable for the Royal Edward Dock, placed with Messrs. Siemens Bros., Ltd. Alderman Pearson, who was the principal speaker, said that whether the works were under Government control or not it did not affect where the profit went. If the profit went into the hands of the public trustee he was of opinion that it would largely go to Germans when the war was over, and at the end of the war it would be used to bargain with Germany, and Germany would get it directly, or as a set-off. Alderman Pearson went on to give illustrations of the way in which relatives and friends of his own, Englishmen, who had been in control of businesses in Germany up to the outbreak of war, were being treated in Germany—living either in gaol or in horse boxes. He proposed:—"That all Committees of the Council be instructed, when placing orders, to avoid any business which is enemy-owned or is managed or worked directly or indirectly by or under the influence of enemy subjects, or is carried on wholly or mainly for the benefit of or on behalf of enemy subjects, notwithstanding that the firm or company may be registered or incorporated within the King's Dominions." After discussion, in the course of which it was shown that the firm had supplied machines, and unless they were to be allowed to replace parts in case of breakdown it might be very awkward, also that they were patronised by the Government, and had supplied war materials to the Government, Alderman Pearson wished to add the words "as far as possible." He said that it was his idea that they should go to Messrs. Siemens when it was absolutely necessary. The resolution as amended was agreed to. A report of the discussion will be found in the *Bristol Times and Mirror* for January 3rd.

Institution and Lecture Notes.—Institution of Electrical Engineers.—The Council has decided that during the war any candidate for admission as Associate Member who is engaged on naval or military service, or employed (whole time) in an engineering capacity on munitions or other war work, shall be exempted from complying with the examination regulations, and any such service may be accepted in part fulfilment of the conditions laid down with regard to experience, provided that in other respects the candidate satisfies the requirements as to age and training.

The Council has asked the National Service Committee of the Institution to formulate a scheme for giving to disabled sailors and soldiers a preliminary training as switchboard attendants, &c., and for obtaining means to carry on this work and arranging for the selection and distribution of applicants for positions.

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The following local hon. secretaries and treasurers have been appointed:—Mr. H. Hastings, for Spain; Mr. A. C. Kelly, for Argentina; Mr. W. M. L'Estrange, for Queensland.

The following arrangements are announced for meetings to be held in London between now and May:—

January 18th.—Prof. Miles Walker, "The Predetermination of the Performance of Dynamo-electric Machinery."
January 20th.—H. H. Harrison, "The Principles of Modern Printing Telegraphy."
February 10th.—O. L. Record, "The Testing of Underground Cables with Continuous Current."
February 17th.—C. Chree, D.Sc., F.R.S., "Terrestrial Magnetism." (The seventh Kelvin Lecture.)
March 9th.—E. V. Pannell, "Continuous-current Railway Motors."
March 16th.—N. W. Storer, "The Possibilities in the Design of Continuous-Current Traction Motors."
April 13th.—(To be announced later.)
May 11th.—Annual General Meeting.

Fatalities.—At Manchester on Tuesday an inquest was held on Henry Wharton, aged 17 years, who had been employed at a Manchester munition works. Deceased was being instructed in the work of driving an overhead crane. On December 31st he appeared to have left the cabin of the crane (although he had no need to do so), and he was seen with his hand on a "live" wire well above the cabin. He fell to the ground and died later. "Accidental Death" was the verdict.

At the adjourned inquest at Eastbourne in connection with the death from electric shock of two men who attempted to render assistance to a motor-car which collided with and smashed a 2,500-volt switch pillar on December 26th last, the jury returned a verdict of "Death from Misadventure," adding a suggestion that such boxes should be further from the side of the road. Mr. A. P. Trotter, electrical adviser to the Board of Trade, represented the Board at the inquiry.

On Tuesday last, Arthur Walker, an electrician at Skinningrove Ironworks, slipped into some gearing, receiving injuries which necessitated the amputation of a leg.

For Sale.—Messrs. Percy Huddleston & Co. will sell by auction without reserve, at 158, Falcon Road, Clapham Junction, S.W., on January 13th, a 230-volt motor, motor fans, arc lamps, cables, wires, &c., of which some particulars are given in our advertisement pages to-day.

Appointments Vacant.—Shift engineer (£130), for the City of Birmingham Electric Supply Department; electrician (50s.), for the Abertillery U.D.C.; assistant electrical engineer (£130), for the Government of Malta Electric Lighting Department. See our advertisement pages to-day.

Volunteer Notes.—ENGINEERING INSTITUTIONS' VOLUNTEER ENGINEER CORPS.—Orders for week commencing January 10th, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commandant.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, January 10th.—Sections 1 and 2, Technical; Sections 3 and 4, Squad, Signalling Section and Recruits.

Tuesday, January 11th.—School of Arms, 6 to 7 p.m.

Thursday, January 13th.—Shooting for Sections 1 and 2, and Signalling Section.

Friday, January 14th.—Sections 3 and 4, Technical; Sections 1 and 2. Squad, Signalling Section and Recruits.

Saturday, January 15th.—Uniform Parade. Time and place will be posted at Headquarters later.

E. G. FLEMING,
Company Commander and Acting Adjutant.

3RD BATT. (OLD BOYS) CENTRAL LONDON REGIMENT (VOLUNTEERS).—Battalion Orders by Captain R. J. C. Eastwood (Sub-Commandant), Thursday, January 6th, 1916:—

Captain of the Week.—Mr. C. F. Holland.

Orderly Officer.—Mr. F. Owen.

Week-end Parades.—Saturday.—A, B and D Companies will parade at Baker Street Station at 2.30 p.m. and proceed by train to Willesden, where they will detrain, and proceed by march route to Wembley Park. C Company will parade at the same time at Baker Street Station, and proceed direct to Wembley Park by train.

Sunday.—Field Day.

The Battalion will parade at King's Cross (G.N.R.), at 9.30 a.m. sharp, and proceed by train to Potter's Bar. Members will make their own arrangements for lunch. Hot tea (without food) will be provided at 3.30 p.m., and members are advised to bring their own drinking cups. The Battalion will entrain at Potter's Bar for the return journey at 4.40 p.m. A sketch of the ground, by Mr. Marples, will be issued to all Company Commanders.

Musketry.—Inter-Platoon Competition.—Acton Range will be open on Saturday next, the 8th inst., for practice for above competition, only for those men who have sent their names in to the Musketry Staff. Parade in Uniform, at Acton Range, at 2 p.m. punctually.

A. G. JOINER, *Major and Adjutant*, O.B.C.

British Trade in China.—A Reuter dispatch from Shanghai says that a Chamber of Commerce has been formed embracing the whole of China. It is issuing journals in English and Chinese, and is receiving most valuable co-operation from the Consular officials. The *Chamber of Commerce Journal* announces the formation of a school to teach the Chinese language to Englishmen. Shanghai is at present in the throes of a rubber boom.

Inquiry.—Makers of electrical conduit bearing the mark of a thistle are asked for.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—Mr. PERCY LANE, mains assistant at the Finchley electricity works, has tendered his resignation.

The Leeds Electricity Committee has recommended the City Council to advance the salary of Mr. C. N. HEFFORD, engineer and manager of the undertaking, from £600 to £800 per year.

Mr. J. B. FELTHAM, chief assistant at the Gloucester Corporation electricity works, has been appointed electrical engineer to the Mexborough U.D.C.

The Manchester Electricity Committee has decided to recommend that Mr. A. E. MCKENZIE, chief assistant engineer, be appointed deputy chief engineer at a salary of £700 per annum, rising by annual increases of £50 to £800 per annum as the maximum.

The National Electric Construction Co. have appointed Mr. H. C. BABB to be engineer and manager of their electricity works at Bo'ness, in succession to Mr. Rogers. Mr. Babb went to Bo'ness from Hawick, where he acted as chief technical assistant to the Edmundson's Electricity Works. On leaving Hawick recently he was presented with a case of pipes.

Mr. J. E. M. STEWART, chief assistant engineer in the Leicester electricity department, has resigned his appointment in consequence of ill-health. The engineer has been authorised to obtain the services of an assistant at a salary of £300 per annum.

Mr. T. S. WARTERS has resigned his position as shift engineer at the Regent's Park station of the St. Pancras Borough Council.

General.—Mr. A. VINES (formerly Schneider), a British-born subject, a managing director of Messrs. Evershed & Vignoles, Ltd., has by deed poll, dated December 31st, 1915, abandoned his former surname of Schneider and adopted and will use henceforth his mother's maiden name of Vines.

Mr. H. G. W. HASLETT, of Messrs. Haylock & Haslett, joined the London Electrical Engineers early in October last, and is now engaged in coast defence work with that corps. A dissolution of partnership has been deemed advisable, which will date from January 1st, 1916. The business will be continued under the original title of Ralph H. Haylock & Son.

Mr. WALTER TOWERS, lately mechanical engineer at Stirling Corporation electricity station, has obtained an important appointment at Rosyth Naval Base. Mr. Towers, who left Stirling about two months ago, offered his services to the Admiralty, who gave him a position at the Base, and he has since been promoted supervisor of the main power station. Mr. Towers was employed by the Stirling Corporation for 13 years.

Dr. WM. GARNETT, the well-known education authority, mathematician and physicist, retired from his position as Educational Adviser to the L.C.C., on reaching his 65th year, on December 31st.

In the *London Gazette* appointments there appear the following announcements:—December 15th, 1915. Admiralty; Electrical Engineer in H.M. Naval Establishments, Ernest Thomas Williams; December 17th, Richard Wightman.

The marriage took place at Hollingworth Congregational Church, on December 27th, of Mr. WALTER AGUTTER, of the electrical staff of the D.P. Battery Co., Bakewell, and Miss M. Marshall, of Woolley Lane, Hollingworth.

The *Morning Post* states that Mr. E. MANVILLE, of London and Coventry, president of the Associated British Motor Manufacturers and ex-president of the Society of Motor Manufacturers and Traders, has consented to serve as a member of the Board of Referees in connection with the excess profits duty.

It was announced in the *Times* last week that a marriage would shortly take place between Mr. HORACE FIELD PARSHALL, of Penbury Grove, Penn, Bucks, and Miss Ellen Dunlap Payne, daughter of Mrs. Gertrude Dunlap Payne and the late Frederick William Payne, of Boston, Massachusetts.

Mr. F. W. MOZLEY, eldest son of Mr. H. Mozley, the Burnley tramways manager, has enlisted in the Engineering Company of the London Regiment of Artists' Rifles. He is chief engineering assistant to the Burnley Corporation.

The daily Press states that Mr. G. W. J. PRAAT, traffic superintendent, Bournemouth Telephone District, has been appointed superintendent of telegraph and telephone traffic in the Ceylon Post Office.

Major C. W. JORDAN, electrical engineer, of Cardiff, has just taken over the duties of Commandant of the No. 7 Area of the Western Command. In this area there are Lancashire, Cheshire and Manchester, as well as Glamorgan companies.

Roll of Honour.—Second-Lieutenant WILFRID C. HUNTER, R.G.A., who was killed in action on December 30th in Flanders, was, prior to the war, secretary of the Rugby Lamp Co., Ltd. It is only a few weeks since he took leave of his parents and friends in Rugby to proceed to the Front.

Warrant Telegraphist HARRY NOBLE, of the R.N.R., has received the Serbian gold medal for zealous service in the

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war, the conferment having been made at the instance of King Peter.

Sapper ARTHUR E. PHILLIPS, signaller in the Royal Engineers, formerly an electrical engineer at Bradford, is on sick furlough at his home suffering from diabetes.

Private HAMER, of the 16th Lancashire Fusiliers, formally employed at the Westinghouse Works, Trafford Park, has been killed by the explosion of a mine under a trench in France.

Private J. L. HORNE, of the 1/6th Battalion Manchester Regiment, who prior to the war was an apprentice electrical engineer at the Westinghouse Works, Manchester, and previously reported missing, is now reported to have been killed at the Dardanelles.

Sapper HARRY ASHCROFT, of the County Palatine Engineers, who has died in hospital at Rouen, France, from pneumonia, contracted whilst engaged on trench work, was until last March engaged as an electrician at Southport.

Sapper TOM GRANTHAM, who has been wounded on three occasions, and is now home on leave from France, was prior to the war an electrician at Blackpool Tower.

Private ALBERT T. SCOTT, 3rd Buffs (East Kent Regiment), who is reported wounded and a prisoner of war, was on the staff at the power house of the Associated Portland Cement Manufacturers, Ltd., at Burham, near Maidstone.

Lance-Corporal CLAUD BANCROFT, of the 4th Battalion West Riding Regiment, who is in hospital at Sheffield suffering from serious injury to his ears through the bursting of a trench mortar, was engaged prior to the war as electrical engineer on board Mr. George Jay Gould's yacht *Atalanta*, which is now doing patrol duty in connection with the Navy.

The Salford Tramways Committee has passed a resolution congratulating Sergeant SMETHURST, an employé of the Committee, on being awarded the D.C.M., and has given instructions for the resolution to be engrossed on vellum and presented to Sergeant Smethurst.

Will.—The late Dr. F. S. PEARSON, who was drowned in the *Lusitania*, left estate valued at £328,970 in the United Kingdom.

New Year Honours List.—In the New Year Honours list the following appear:—

MR. D. A. THOMAS, of South Wales Colliery fame, who has lately rendered valuable assistance to the Ministry of Munitions by his visits to America, has the dignity of a Barony of the United Kingdom conferred upon him.

MR. G. N. BARNES, M.P., formerly Secretary of the Amalgamated Society of Engineers, is to be sworn a member of the Privy Council.

SIR GEORGE BULLOUGH, of Messrs. Howard & Bullough, engineers, and MR. A. F. YARROW, the shipbuilder, are made Baronets.

MR. GEORGE FRANKLIN, who was formerly chairman and managing director of the National Telephone Co., Ltd., is made a Knight, as are also Mr. H. F. LE BAS, of the Caxton Publishing Co., and Mr. R. A. ROBINSON, a former chairman of the L.C.C.

In the Colonial Honours list, COLLINGWOOD SCHREIBER, Esq., C.M.G., general consulting engineer to the Government of Canada, becomes a K.C.M.G.

MR. J. R. BOOSE, travelling commissioner for the Royal Colonial Institute, is made a C.M.G.

Mr. W. W. HOY, general manager of Railways and Harbours, Union of South Africa, and Mr. JOHN KENNEDY, consulting engineer to the Montreal Harbour Commission, each receive the honour of Knight Bachelor.

The Kaisar-i-Hind Gold Medal awarded for public services in India is given to Mr. W. S. SHARPE, Indian Telegraph Department, Superintendent of Telegraph Engineering, Bombay Division, and to Mr. H. J. H. GLENN, executive engineer, Province of Delhi.

NEW COMPANIES REGISTERED.

Temple Brothers, Ltd. (142,541).—This company was registered on December 24th, with a capital of £1,000 in £1 shares, to carry on the business of electricians, electrical, mechanical, motor, telephone, heating, ventilating, and general engineers, makers and repairers of and dealers in electrical and other fittings, telephones, indicators, fire alarms, lightning conductors, automatic time recorders, clocks, time switches, electrical, scientific, surgical, nautical, optical, and mathematical instruments, manufacturers of and dealers in engines, aeroplanes, airships, motor cycles and cars, etc. The subscribers (with one share each) are: J. Hamilton, London House, New London Street, E.C., mechanical engineer; A. J. Seward, London House, New London Street, E.C., superintendent engineer. Private company. The first directors (to number not more than five) are W. J. Stewart (chairman) and J. Hamilton. Qualification, £50. Remuneration, as fixed by the company. Solicitor: C. Crowther, 23, Abingdon Street, Westminster. Registered by Jordan & Sons, Ltd., 116/17, Chancery Lane, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Dick, Kerr & Co., Ltd.—Capital, £650,000 in £1 shares (350,000 pref.). Return dated November 4th, 1915. 305,000 pref. and 260,000 ord. shares taken up, £565,000 paid. Mortgages and charges: £331,665

Bankfoot Power Co., Ltd.—A memorandum of satisfaction to the extent of £5,000 on September 30th, 1915, of debentures dated May 12th, 1911, securing £50,000, has been filed.

James Keith and Blackman Co., Ltd.—Issue, on December 20th, 1915, of £1,500 debentures, part of a series of which particulars have already been filed.

A memorandum of satisfaction in full on November 11th, 1915, of debentures dated February 9th, 1914, securing £1,500, has also been notified.

Northampton Electric Light and Power Co., Ltd.—Issue, on December 3rd, 1915, of £500 debentures, part of a series of which particulars have already been filed.

Buenos Aires City and Suburban Tramways, Ltd.—A memorandum of satisfaction in full on December 9th, 1913, of charges dated March 29th, 1911, and supplemental agreement dated September 4th, 1912, securing £64,000 and further advances up to £20,000, has been filed.

CITY NOTES.

British Columbia Electric Railway Co., Ltd.

THE annual meeting was held on December 30th at the Great Eastern Hotel, E.C., under the presidency of Mr. G. P. NORTON. In the unavoidable absence of the Chairman (Mr. R. M. Horne-Payne) Mr. HAROLD BROWN, a director, read a speech which that gentleman had prepared. In this the CHAIRMAN said that British Columbia had unquestionably suffered from the effects of the war very much more acutely than any other part of Canada. A commercial paralysis had resulted which had produced so great a falling-off in the receipts of the company that it was probable it would not earn in the current year much more than sufficient to pay its debenture interest. Fortunately the war did not find the company in a weak position as regards cash resources, and by immediately cutting down capital expenditure to the utmost possible extent and enforcing the most rigid economy, the position had been still further strengthened, and the company was now in a position to withstand even the present acutely bad times although they should continue for several years. Unfortunately, as events had turned out, they had extended the tramway system and increased their equipment and power plants largely beyond the requirements of the business at present available, and had, therefore, for the time being, large amounts of capital unremuneratively employed. For instance, their systems of power plants on the mainland and Vancouver Island had cost $13,475,000, and they were capable of producing about twice as much power as was required during the past year. The ordinary effects of the commercial depression had been greatly accentuated by the advent of an extraordinary form of competition in the jitney 'bus. With regard to the future of this competition, since the commencement of the winter rains there had been a considerable and continuous reduction in the number of jitneys operating, particularly in Vancouver. It was expected that this reduction would at least continue during the remaining winter months. What, however would happen in the spring, when the fine weather returned, it was difficult to forecast. The general manager held the opinion that they would not be troubled next summer with the jitney 'bus to the same extent as during the past summer. They had hitherto struggled to maintain a thoroughly efficient service throughout all the districts served by their cars, but should this jitney competition continue on an extensive scale, the company must cease to operate some of the outlying lines. At present the jitneys took the cream of the paying traffic in the more thickly populated centres, leaving the company to provide for the whole of the unremunerative business. It was impossible for the jitneys to supply the needs of the outlying districts at anything like the fares which the company charged, but if the people insisted upon supporting this unfair competition in the more thickly populated areas the company would have no alternative but to leave some of the outlying districts without travelling facilities. During the year every effort had been made to strengthen the company's friendly relations with the municipalities, and although the board had been compelled to refuse many requests involving expenditure of money, it was hoped that the municipal authorities were beginning to some extent to appreciate the company's difficulties, and that the interest and prosperity of the company and of the community were identical and inseparable, and this would undoubtedly be realised more and more after the war. The company's present position was extremely disappointing, but it was one that would right itself with the return of normal conditions. As the result of the wonderful crop, which was reliably estimated to produce to the farmers in the three prairie provinces alone no less than 400 million dollars, and of the stimulus given to every branch of manufacture by the increased spending power derived from it, and also from the large munition orders placed in Canada, a great revival of trade had taken place in the Eastern and Central Provinces, and would undoubtedly slowly extend to British Columbia. He might sum up the situation by saying that the company was suffering from what could only be described as tragically bad times, which had caused much suffering and had driven a quarter of the population out of the cities and had, incidentally, caused a greatly restricted use of the cars and of electric light, a reduction in the consumption of power by industrial enterprises, and had produced jitneys. He thought there was no

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doubt that the worst was past. There was already a considerable improvement in the lumber trade, some increase in activity in mining, and the restoration of the Canadian Pacific steamship service to Japan and China was definitely announced, which afforded grounds of hopes of a more marked improvement when the winter was over. The Panama Canal and the Canadian Northern Railway across the continent to Atlantic tide water, both of which were completed in the last year, would prove most powerful factors in hastening the development of British Columbia on the return of normal conditions, and there was nothing in the situation which caused him to abate in the least degree his absolute confidence in the splendid future of the province, which could be hastened or retarded chiefly by the disposition shown by the people to treat capital with honesty and consideration or otherwise.

The CHAIRMAN formally proposed the adoption of the report, which was seconded by Mr. EVAN-THOMAS.

Replying to a shareholder, the CHAIRMAN said that with regard to the jitney competition, the board were of opinion that an ordinary motor-car could not possibly subsist for any length of time on the fares they were getting. It was, of course, possible that some form of vehicle would develop which would be a serious competitor with the trams, but up to the present the competition had come very largely from private owners who drove their own car and who were prepared to work inordinately long hours. The board had striven to get fair regulations for these cars, and he hoped they would succeed, but they had not been able to do anything up till now. As to the provision of £167,888 for renewals maintenance, the board thought it was in the best interests of the company that that provision should be continued as hitherto, and he might point out that it was only because they had put by such large sums in the past that the company was in its present very strong financial position.

The report was adopted.

Tata Hydro-Electric Co., Ltd.

THE directors, in their report to June 30th, 1915, state that in addition to the cotton and flour mills which have contracted to take supply from the company for a period of ten years, the company has entered into a contract with the Bombay Electric Supply and Tramways Co., Ltd., for energy required by them for two of their sub-stations, and the necessary plant for one of these has been ordered. The directors have authorised the investigation of new areas on the ghauts for the extension of the present scheme to meet any prospective demand for energy. Suitable sites have been chosen, and the result of the investigations shows that considerable power will be made available on a highly satisfactory basis. The general manager reports as follows:—

The Walwhan dam was raised last season to a sufficient height to store water at full supply level. The work of completion is in progress. The water in this lake reached full supply level on September 10th, 1915. Water for power supply is being drawn from Lonavla lake since the commencement, and the lake now stands at only 4½ ft. below full supply level. The duct is nearing completion throughout. The Lonavla to Foreday section is in use, and the Walwhan section is being dressed, and is practically ready for service. The foreday work is practically completed. The sluice house, sluices, and all machinery are erected, and only a little finishing work remains. One upper pipe line and five small lower pipe lines are completed for the original installation. The valve house at junction point 9 is under construction. The tunnel between Walwhan and Shirawata is complete except for a little trimming, and a quantity of excavation has still to be done in widening the approach cut. Work is proceeding on the Shirawata Dam, and a small quantity of water is stored which will be utilised for construction purposes. A temporary weir is constructed for a small additional storage for power purposes next year. The power house work for the four units is practically completed. With the satisfactory conclusion of the necessary revision work on the generators the whole apparatus of the original installation will be soon in full service. The transformers, switchgear, etc., are all in regular use and giving satisfactory service. The transmission line is in working order, and both circuits are available to their full capacity. The question of insulators for maintenance is receiving attention.

The receiving station plant is all installed for the four units and working satisfactorily. For improving the power factor of the system two synchronous condensers have been erected during the year. The workshop building is completed and brought into use. The underground cables so far put into service are giving satisfaction. The major portion of the erection work is completed. Mill equipments for all the mills of the original installation are received. Ten mills are completely equipped and receiving power. Seventeen mills are receiving power for partial requirements. Load is being added continuously with due regard to the convenience of the customers. Arrangements are now being made for night supply of energy. At present there are 27 mills with motors of the aggregate B.H.P. of 27,400 in service.—*Indian Textile Journal.*

Western Canada Power Co.—It is announced, says the *Times*, that this company will default in payment of the coupon payable on January 1st on its five per cent. first mortgage bonds. A committee has been formed in Canada to protect the interests of the bondholders.

South Wales Electrical Power Distribution Co., Ltd.—The directors, in forwarding warrants for the current half-year's interest on the original debenture stock, state that, although at the present time there is in hand a sum sufficient to pay the now current half-year's interest, the whole of that sum was not earned in the half-year, a part having been previously accumulated.—*Financier.*

Calcutta Electric Supply Corporation, Ltd.—The number of units sold to consumers during the four weeks ended November 26th, 1915, amounted to 1,709,366, compared with 1,075,864 in the corresponding four weeks of 1914.

Kaministiquia Power Co.—The directors have declared a dividend of 1½ per cent. for the quarter to January 31st, or at the rate of 6 per cent. per annum.

STOCKS AND SHARES.

TUESDAY EVENING.

The first week of the new year has witnessed a good deal of firmness through the Stock Exchange. Prices all round are good, notwithstanding the fact that the public are buying comparatively little. The strength of the Consol market is a noticeable feature. Home Railway stocks are decidedly better. The industral sections are more or less overshadowed by further robust developments in rubber shares, prices in that particular section going ahead with daily persistence, in consequence of a steady advance in the price of the raw stuff.

The turn of the old year released money, as usual, in the way of dividends, and also from the banking accounts of those who still indulge in the practice of window-dressing. Several Colonial new issues are in the air, and one of them has already made its appearance, but without exerting any effect upon investment prices, though in more normal times they would probably have depressed the gilt-edged securities to some extent. There is so much money awaiting investment that prices are well maintained, and it would be a simpler task to write out the names of fifty first-class stocks of which there is no supply, than to catalogue a list of similar length giving the names of those which can be bought at the present time.

The Home Railway market is enjoying one of its periodical spasms of firmness. Most of the popular stocks are better and a decided feature of the market is the buoyancy of Underground Electric Railway issues. The £10 shares, in particular, are strong; but the 6 per cent. income bonds have also advanced, and show a rise of 2¼ on the week. The improvement is due to inquiry on behalf of investors, of whom a large number are buying quite small amounts of the stock. Metropolitans and Districts are both harder, and Central London stocks—out of favour for some time past—are now wanted.

Hundreds of ex-dividend markings have been made within the past ten days throughout the Stock Exchange lists. Anglo-Argentine Tramways preference shares, and one or two of the debenture stocks are now ex dividend, and the company's first preference shares, at 4, look tempting to the speculative investor. British Columbia Electric preference moved up a point to 61.

The Mexican group is weaker. A few thousand dollars of Mexico Tramway and Mexican Light & Power bonds are on offer, although definite news from the country is as scanty as ever. Brazilian Tractions show a slight recovery, hardening to 51½, while other foreign Tramway descriptions are fairly steady.

The Telegraph market is very firm. Anglo deferred moved up to 23. Western Telegraph debenture stock has recovered a point of the interest deducted from the price. Globe preference are a trifle easier at 10¼. Marconis, now ex dividend, are quoted at 35s., and there is rather more disposition to deal in them again. The Heavy telegraph shares are all good, buyers predominating, and with very little floating supply on offer.

Home Electricity shares are no better. Illumination issues of all kinds are dull, gas stocks being weak equally with electricity supply shares. Westminsters have further receded. St. James' ordinary are back to 6. The market is stagnant; and although occasional bargains take place in the leading shares, this section ranks amongst those which have been unfortunate enough to fail in securing any portion of popular support since the war broke out nearly eighteen months ago.

British Westinghouse preference are strong at 2, in consequence of favourable rumours with reference to the big profits which the company is making out of war work. Babcock and Wilcox have also advanced further. Callenders are a good market at 11¼, showing a rise of 15s. on the week. India-Rubbers, at 8¼, are ex their dividend, and once more look cheap.

The rubber market is the name to conjure with for the moment. That there is a temporary shortage of the raw material seems to be generally recognised, but without affecting the rush for rubber shares. Those engaged in the business are pressed to the uttermost in order to keep up with the activity, which one of them declared only the other day to be anomalous and contradictory, what time the country is at war. Nevertheless, the public insist upon buying shares, the support coming from all parts of the country. By every canon of tradition and precedent, there should be abatement of the fever before long, and not a few Stock Exchange men look for a halt to be called. Still, as long as the strength of the raw rubber market is so pronounced, the public are hardly likely to want to part with their rubber shares.

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SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Jan. 4, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.				
Brompton Ordinary	10	7½	—	£6 18 4
do. 7 per cent. Pref.	7	7	—	5 0 0
Charing Cross Ordinary	5	8½	—	7 2 10
do. do. do. 4½ Pref.	4½	8½	—	6 0 0
do. do. City Pref.	4½	3 xd	—	7 10 0
do. 4 Deb.	4	78	—	5 2 7
Chelsea	5	4½	—	5 17 8
do. 4½ Deb.	4½	87	—	5 3 6
City of London	9	12½	—	7 7 8
do. do. 6 per cent. Pref.	6	11	—	5 9 1
do. do. 5 Deb.	5	96 xd	—	5 2 0
do. do. 4½ Deb.	4½	85 xd	—	5 6 0
County of London	7	10	—	7 0 0
do. do. 6 per cent. Pref.	6	10½	—	5 17 8
do. do. 1st Deb.	4½	85 xd	—	5 5 0
do. do. 2nd Deb.	4½	88	—	5 8 0
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	1⅞	—	8 8 4
do. do. 6 per cent. Pref.	6	4½	—	7 1 2
do. do. 4 Deb.	4	75	—	5 4 0
Metropolitan	8½	2⅜	—	7 7 4
do. 4½ per cent. Pref.	4½	2½ xd	—	6 18 6
do. 4½ Deb.	4½	85	—	5 6 0
do. 3½ Deb.	3½	70	—	5 0 0
St. James' and Pall Mall	10	6	— ¼	8 6 8
do. do. do. 7 per cent. Pref.	7	6	—	5 16 8
do. do. do. 3½ Deb.	3½	70 xd	—	5 0 0
South London	5	2⅜	—	7 5 6
South Metropolitan Pref.	7	1⅛	—	6 14 0
Westminster Ordinary	9	6	— ¼	7 10 0
do. 4½ Pref.	4½	4	— ⅛	5 12 6
Telegraphs and Telephones.				
Anglo-Am. Tel. Pref.	6	100½	—	5 19 6
do. Def.	1½	28	+ ⅛	6 10 5
Chile Telephone	8	6¾	—	6 8 0
Cuba Sub. Ord.	5	8	—	6 5 0
do. Pref.	10	15	—	6 13 4
Eastern Extension	7	12½	—	£6 8 0
do. 4 Deb.	4	80	—	5 0 0
Eastern Tel. Ord.	7	128	—	£6 4 0
do. 3½ Pref.	3½	66	—	5 6 0
do. 4 Deb.	4	81	—	4 19 0
Globe Tel. and T. Ord.	6	10⅜	—	£6 12 2
do. Pref.	6	10½	— ⅛	5 17 1
Gt. Northern Tel.	22	33½	—	6 11 4
Indo-European	13	48 xd	—	6 15 4
Marconi	10	1⅝ xd	—	5 14 3
New York Tel. 4½	4½	101	—	4 9 1
Oriental Telephone Ord.	10	1⅝	—	5 6 8
do. Pref.	6	3	—	6 17 2
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	8	6	—	£7 12 5
do. Pref.	5	4⅜	—	5 8 1
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	12⅜	—	£6 7 0
do. 4 Deb.	4	79 xd	+1	5 1 0
Home Rails.				
Central London, Ord. Assented	4	72½	—	5 10 6
Metropolitan	1½	25	+ ½	5 8 0
do. District	Nil	16½	+ ½	Nil
Underground Electric Ordinary	Nil	1 5/16	+ 3/16	Nil
do. do. "A"	Nil	6/-	+6d.	Nil
do. do. Income	6	79½	+2½	£8 12 0
Foreign Trams, &c.				
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
do. 5 Deb.	5	96 xd	—	5 5 0
Anglo-Arg. Trams, First Pref.	5½	4 xd	—	6 17 6
do. 2nd Pref.	5½	6⅜ xd	—	8 3 0
do. 4 Deb.	4	72½ xd	—	5 6 8
do. 4½ Deb.	4½	77 xd	—	5 17 0
do. 5 Deb.	5	81	—	6 4 0
Brazil Tractions	5½	5⅛	+ ⅛	6 16 0
Bombay Electric Pref.	6	10½	—	5 17 1
do. 4½ Deb.	4½	85	—	5 3 0
British Columbia Elec. Rly. Pfce.	5	61	+1	8 4 0
do. do. Preferred	—	40	—	Nil
do. do. Deferred	—	40	—	Nil
do. do. Deb.	4½	64	—	6 12 10
Mexico Trams	Nil	40	− 2	Nil
do. 5 per cent. Bonds	—	49	—	Nil
do. 6 per cent. Bonds	—	48	—	Nil
Mexican Light Common	Nil	99	−1	Nil
do. Pref.	Nil	40	−2	Nil
do. 1st Bonds	—	47	—	—
Manufacturing Companies.				
Babcock & Wilcox	14	2 7/16	+ 1/16	5 15 0
British Aluminium Ord.	5	22/6	—	4 9 0
do. Pref.	6	18/-	—	6 13 4
British Insulated Ord.	15	10½	—	7 2 10
do. Pref.	6	5⅜	—	5 11 7
British Westinghouse Pref.	7½	40/-	+1/6	7 10 0
do. 4 Deb.	4	69	—	5 14 10
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	11½	+ ½	6 1 4
do. 5 Pref.	5	6⅛	—	5 17 8
do. 4½ Deb.	4½	90	—	5 0 0
Castner-Kellner	20	8	—	6 18 4
Edison & Swan, £8 pd.	Nil	9/-	—	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	60 xd	—	6 13 4
do. do. 5 % Deb.	5	60	—	8 6 8
Electric Construction	6	14/-	—	8 11 6
do. do. Pref.	7	19/9	—	7 1 4
Gen. Elec. Pref.	6	9½ xd	—	6 8 1
Henley	20	18½	—	£8 12 6
do. 4½ Pref.	4½	4½	—	5 6 0
do. 4½ Deb.	4½	92	—	4 17 9
India-Rubber	10	8¾ xd	+ ¼	£18 1 2
Telegraph Con.	20	8½	—	£8 1 0

* Allowance made for dividends being paid free of income-tax.

Kent Collieries Closed.—The *Times* states that, owing to scarcity of labour and transport difficulties, the directors of the Kent Collieries have decided to suspend operations until after the war.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, January 5th.

CHEMICALS, &c.		Latest Price.	Fortnight's inc. or Dec.
a Acid, Hydrochloric	per cwt.	..	..
a " Nitric	"	..	..
a " Oxalic	per lb.	1/2	..
a " Sulphuric	per cwt.	..	..
a Ammoniac Sal	"	..	..
a Ammonia, Muriate (large crystal)	per ton	£50	..
a Bleaching powder	"	..	..
a Bisulphide of Carbon	"	£23	..
a Borax	"	£25	..
a Copper Sulphate	"	£45	30/- inc.
a Lead, Nitrate	"	..	..
a " White Sugar	"	..	..
a " Peroxide	"	..	..
a Methylated Spirit	per gal.	..	..
a Potassium, Bichromate, in casks	per lb.	..	..
a Potash, Caustic (88/90 %)	per ton	..	..
a " Chlorate	per lb.	1/5	..
a " Perchlorate	"	1/6	..
a Potassium, Cyanide (98/100 %) (for mining purposes only)	"	Nom.	..
a Shellac	per cwt.	65/-	..
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	"	£11 10	..
a " Recovered	"	..	..
a " Lump	"	£8 10	..
a Soda, Caustic (white 76/77 %)	"	..	..
a " Chlorate	per lb.	1/4½	..
a " Crystals	per ton	60/-	15/- inc.
a Sodium Bichromate, casks	per lb.	8½d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	..	..
b " Wire, in ton lots (1 to 14 S.W.G.)	"	..	..
b " Sheet, in ton lots	"	..	..
g Babbitt's metal ingots	"	..	..
c Brass (rolled metal 2" to 12" basis)	per lb.	1/2½ to 1/3⅜	¾d. inc.
c " Tubes (solid drawn)	"	1/3 to 1/3½	¼d. inc.
c " Wire, basis	"	1/2⅝ to 1/2¾	¾d. inc.
c Copper Tubes (solid drawn)	"	1/3½ to 1/3¾	¾d. inc.
g " Bars (best selected)	per ton	£119	£7 inc.
g " Sheet	"	£119	£7 inc.
g " Rod	"	£119	£7 inc.
d " (Electrolytic) Bars	"	£105 10	£7 10 inc.
d " " Sheets	"	£126 10	£7 10 inc.
d " " Rods	"	£115 10	£7 10 inc.
d " " H.C. Wire	per lb.	1/2	¼d. inc.
f Ebonite Rod	"	8/-	..
f " Sheet	"	2/6	..
a German Silver Wire	"	1 10	..
h Gutta-percha, fine	"	6/10	..
h India-rubber, Para fine	"	4/1	9½d. inc.
f Iron Pig (Cleveland warrants)	per ton	79/-	1/- inc.
f " Wire, galv. No. 8, P.O. qual.	"	£28	..
g Lead, English Pig	"	£31 15	35/- inc.
g Mercury	per bot.	£16 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e " " " medium	"	8/6 to 6/-	..
e " " " large	"	7/6 to 14/- & up.	..
c Nickel, sheet, wire, &c.	"	Nom.	..
g Phosphor Bronze, plain castings	"	..	..
g " " rolled bars & rods	"	..	..
g " " rolled strip & sheet	"	..	..
c Platinum	per oz.	210/-	..
d Silicium Bronze Wire	per lb.	1/3	..
r Steel, Magnet, in bars	per ton	£85	..
g Tin, Block (English)	"	£174 to £175	£7 to £8 inc.
a " Wire, Nos. 1 to 16	per lb.	2/8	..
g White Anti-friction Metals	per ton	..	..
k Zinc, Sh'ts (Vieille Montagne bnd.)	"	Nom.	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
j Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

Electro-Harmonic Society.—Mr. C. B. Clay will preside at the smoking concert which is to be held to-night at the Holborn Restaurant (King's Hall), at 8 p.m. The artistes are announced as follows:—Mr. Philip Ritte, tenor; Mr. George Baker, baritone; Mr. W. H. Squire, violoncello; Mr. Alan Stainer, ventriloquist; Mr. Leslie Harris, sketches at the piano; Mr. Harry May Helmsley, cartoonist and imitations of children; Mr. Bernard Flanders, A.R.A.M., solo pianoforte and accompanist.

Cobalt and its Uses.—Extensive deposits of cobalt exist in Canada, but the metal, which resembles nickel, is more expensive than the latter; nevertheless, it possesses advantages for electro-plating purposes, and recently it has been found that an alloy with iron, containing cobalt to the amount of one-third, has a very high magnetic permeability, much higher than that of pure iron or transformer steels, while the hysteresis loss is as low as that of commercial steels. The alloy, however, is brittle and costly.

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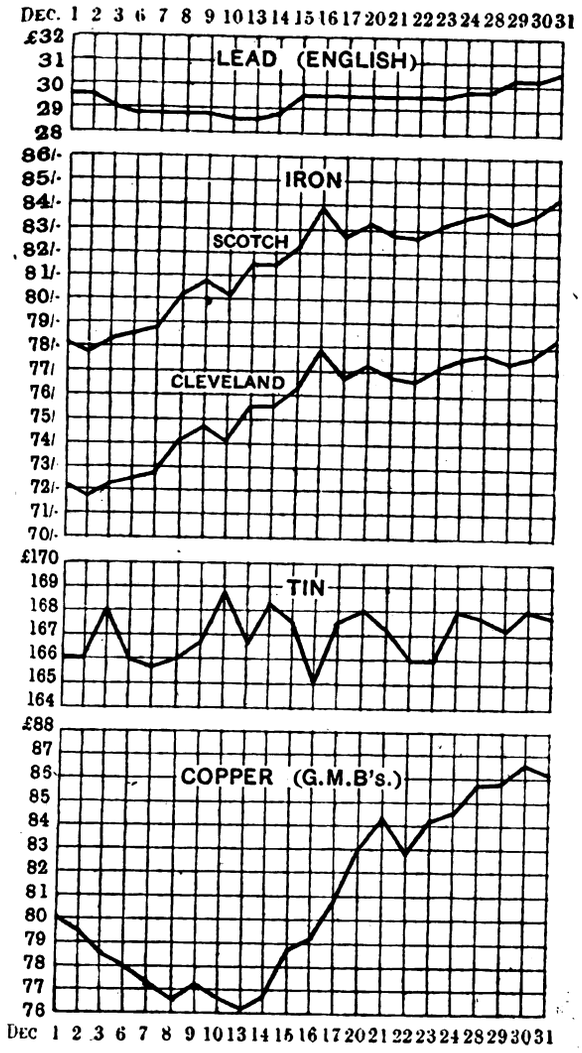
METAL MARKET.

Fluctuations in December.



Electrical Work in British India.—The following information regarding openings for trade in British India is extracted from the review of the trade of India in the past year. The Director of Statistics to the Indian Government recently reported:—"Electrical machinery for use in connection with water-power plant has great capabilities of expansion. The total number of electrical installations in India is already large, and is increasing. All the larger towns and chief ports possess electric light and electric tramways, or are about to use power for these purposes. A gradually increasing market for electrical machinery is anticipated. In recent years the collieries of India have largely adopted electrical equipment, and here German goods have found an opening. The Calcutta market has in late years been flooded with cheap German materials for electric wiring, such as cables, switches, ceiling roses and cut-outs. Since the outbreak of hostilities this source of supply has ceased, and the United Kingdom is likely to capture the German trade in these goods, provided the requirements of the market are carefully studied."—*Board of Trade Journal.*

Australian Electrical Contract Conditions.—A beneficial effect directly attributable to the amalgamation of the New South Wales and Victorian Electrical Engineers' Associations was reported to the Victorian Branch, last week, by Mr. W. J. Newbigin, who represented that Branch at a conference with the Federal Council of the Electrical Association of Australia. As a result of that conference, model contract conditions have been evolved, which, although differing in several respects from those now made by Government and municipal engineers, will almost certainly be adopted by those officials. They have already been approved by representatives of the electrical contractors. The conditions were drawn up a few days ago in Sydney by a committee, including the chief engineer of the Sydney tramways, the city electrical engineers of Sydney and Melbourne, a New South Wales Government assistant electrical engineer, an electrical contractor, and a consulting engineer, all of whom are on the Electrical Association's Federal Council. No such arrangement could have been arrived at, Mr. Newbigin said, but for the amalgamation.—*Australian Mining Standard.*

MUNITIONS AND LABOUR.

(COMMUNICATED.)

THE year 1914 will ever be remembered as the year of the outbreak of the great war; the year 1915 will be remembered as the year of muddle by the Government and "squabbles" among the "powers that be," but the capital error that stands out in high relief among all the muddling is the way in which the Government has obeyed the dictates of the Labour leaders. To any business man it is pitiful to see members of the Cabinet appealing to the representatives of Labour not to ask for any further advance in wages, as the country cannot afford it. The manner in which the South Wales miners defied the Government in the early part of the year, the spectacle of munition workers going to prison rather than obey the laws of the country, and the Minister of Munitions begging the workmen to allow women workers to assist the country in its great need, can only be characterised as disgraceful. It is sad to think that men claiming to be citizens of this great Empire, in a time of stress, and when their brothers are fighting for their lives in the trenches to defend the hearths and homes of those left behind, should act in such a mean and selfish spirit, as if the only thing that mattered was to guard what they claim as their legitimate rights and privileges. It is, however, worse to know that this state of things is due mainly to the Government pandering to the demands of the Labour leaders in the past, and thus giving a loose rein, and even encouragement, to the propagation of Socialist fallacies, which teaching can only lead to anarchy. The duty of the Government was and is to guard and defend the liberty of the individual, whether he be workman or master.

The whole question has now become of vital importance—not only at the present time when the country is in danger, but also in the future—for there can be no doubt that, after this terrible war, the strife between capital and labour will become extremely acute, and it behoves every sensible man, whether he be employé or employer, to try and find some solution. It is no use blinking at facts, as business men have been obliged to do for some years past in their desire to make the best of the situation, whilst they saw Germany moving forward by leaps and bounds, wresting the markets of the world from them bit by bit. It is not generally known, but it is a fact nevertheless, that the great British coal trade, the staple of our industries, in so far as the export trade was concerned, would, in the course of time, have been controlled by German coal merchants, and it is well enough known how the German tentacles were reaching out to control the electrical industry.

Returning, however, to the point at issue, the latest move on the part of Labour is the amalgamation of three important trade unions, viz., the Miners' Federation of Great Britain, the Railway Workers' Union, and the Union of Transport Workers. To put it bluntly, its one object is to paralyse industry, and to put pressure on the British public to compel the employers to grant the demands of the members of any one of the unions. And it is highly probable that they expect to gain support from the Government, as they did—and obtained it—in the national coal strike. What is to be the outcome of all this combination for POWER? which, so far as the liberty of the individual is concerned, is equally as bad as, or worse than, German militarism, which we are now sacrificing blood—the best blood in the country—and treasure to break.. It is noteworthy that the greatest opponents to conscription in this country have been the Labour leaders, yet as regards their own particular trade unions they put into operation the vilest form of conscription, and it is well enough known that many members of the unions are only members through sheer terrorism. Britain has ever been known as the land of freedom, and, politically speaking,

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it still is, but it would appear that we are fast giving up our birthright for what is neither more nor less than trade union slavery.

One has become so accustomed to dealing with trade union officials that the individualism of the employé is wholly lost, and many employers are afraid to give any man work unless he is a member of the union. Other employers of labour have come to the conclusion that all workmen ought to be members of their union, and that all employers ought to belong to an employers' association. It has practically come to this. But one may ask, where is the boasted liberty of the individual? Again, what has been the effect of the power of the unions? Its acknowledged evils are slackness and defiance of all authority, even the authority of the trade union leaders themselves. But it sinks deeper than this. It has become a national curse in its effects upon the youth of the country, and the recent troubles between capital and labour, defiance of all law and order, wilful restriction of output—which even Mr. Lloyd George has at length had to admit—are but the fruits of want of discipline in the past. Bernhardi says in his "Germany and the next War," "The English nation, under the influence of growing wealth, a lower standard of labour efficiency—*which, indeed, is the avowed object of English trade unions*—and of the security of its military position, has more and more become a nation of gentlemen at ease and of sportsmen, and it may well be asked whether, under these conditions, England will show herself competent for the great duties which she has taken on herself in the future." Again: "We must never forget this. Hard, laborious work has made Germany great; in England, on the contrary, sport has succeeded in maintaining the physical health of the nation; but by becoming exaggerated, and by usurping the place of serious work, it has greatly injured the English nation." Unfortunately every word is true, and we question whether there is a single person—except, perhaps, a Labour leader, whose livelihood depends mainly on slackness and restriction—who would attempt to deny it. Is it any wonder the Prussians thought us "contemptible?" One is almost inclined to say, "Thank God for the war," as it has at least arrested us on the way to destruction.

For years past it has been well enough known to employers that restriction of output, and restriction alone, was ruining every industry in the country; and the wail of every coal owner is not so much against the Minimum Wage and the Eight Hours' Acts, as Acts of Parliament, but the fact that in each case the output decreased after the Acts came into operation. The higher the wages the less the work, the greater the cost of production, and the greater defiance to law and authority by the workmen. Yet the Government would not accept the owners' explanations, or believe the facts which were placed before it, but forced the men's demands upon them. These inevitably reacted on the public purse, and the great British public wondered why! Will this same great British public realise now, that the British workman, and especially the British miner, is neither more nor less than a spoilt child, petted and pampered by a weak Government until he is no longer fit to "fend for himself," and whose constant cry is "we *will* have more wages," without any thought for others, or the least exercise of intelligence by asking himself the question as to where they are to come from? He either cannot, or will not, realise that wealth is the result of production, and that if he refuses to produce there can be no wealth to distribute. To-day we are spending at the rate of £5,000,000 a day, and it has been estimated that at least £1,000,000 a day might be saved were it not for the evils of restriction in the past, and it is believed that at least 15 to 20 per cent. more coal could be produced per day in the coal mines of Great Britain if each workman would but do his best. The valiant Labour leaders will say this is a vile calumny on the British working man. Rubbish! It is true; and no one knows better that it is true than the Labour leader, but it is his profession to support methods and ideas which are fast sapping the very manhood from the British nation. That there are some splendid workmen no one would for a moment attempt to deny. This country would not have been in such a good position as she is to-day were it not for that fact, together with the patience and long-suffering of the employers. These men, however, have no great love for the trade union official, and thousands of them have emigrated to the Colonies where they are free to exercise their skill and ambition untrammelled by the rules and regulations of the "delegate," "shop steward," or "local secretary." England a free country—Free! When the Minister of Munitions must ask the "shop steward" if he will kindly allow the owners of the works to employ women; or when half-a-dozen pit lads can stop a concern involving thousands of pounds capital and cause hundreds of workmen to lose a day's pay. And it is the trade union leaders at the head of such freedom as this who aim at becoming the Government of the country, and who can claim the right to have absolute control of "all the means of production and distribution." Better the success of German arms! The iron heel of Prussianism would be lighter in comparison, than to be subject to the abject slavery and decadence of present-day trade unionism.

If, however, we are wise and take to heart seriously the lessons the past has taught us, and every man, whether employer or employé, will form a New Year firm resolution to do the very utmost for his country and incidentally for himself, it may yet prove that the greatest folly Germany ever committed was when she went to war.

TIPS FROM CHINA.

By George R. Archdeacon, A.M.I.E.E.

Four months ago I wrote a few hints which I hoped might prove useful in assisting British manufacturers in their attempt to obtain the German trade formerly done with China.

Since writing that article I have so frequently been asked for information about the Chinese workman that I am now attempting to set forth a few of the most common characteristics of what is, perhaps, the most complex type of humanity in existence.

All too frequently the newcomer is apt to take the peculiar Chinese temperament for granted without in any way trying to understand it. It is in this manner that opportunities of progress are so often missed, for a deeper knowledge of the native mind would naturally lead to a clearer understanding and a wider sympathy, which would be of inestimable value in assisting the Britisher in his financial dealings with the Chinese, whom I have often heard described as "the first gentlemen in the Far East."

Let me warn all British engineers and representatives that, although we may not find the Chinese of interest, the Chinese, from the moment of our arrival, will subject us to such scrutiny that before we are aware of it they will have our character so well summed up that they will be able to trick us and play upon our pet foibles and weaknesses in an amazing manner.

They will carefully watch us and plumb the depths of our knowledge until they are convinced whether or not we "savey our pidgin," and if they find us wanting we shall earn to the full their deepest contempt, for the Chinese are thorough. It may be only in one direction, but in that particular direction they soon acquire an almost uncanny aptitude in the application of that one quality.

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"First impressions are lasting," therefore we have to find some method of impressing the Chinese. A good way is to get him "tied up" on some piece of work in which we are particularly expert, go to his rescue, for once condescend to take our coat off, and show him how it should be done, most carefully seeing that we do it correctly, after which we must patiently explain the whole process, meanwhile commenting on the simplicity of the operation.

In this manner we shall have benefited him and shall have secured his profound admiration for our skill and knowledge, the advertising of our wonderful capacity will be for ever established, and we shall be listened to with all the credibility of a veritable Solomon.

Chinese foremen are usually referred to as "No. 1." The author has generally found that it pays to learn the man's name, and address him by such, as it implies a greater interest in, and familiarity with, him, which is instantly observed by the other workmen, thereby engendering greater authority for our "No. 1."

Perhaps one of the most extraordinary differences between the British and Chinese foreman is the manner in which each regards his job. The former is apt to consider it a great calamity to lose his berth, whilst the latter would prefer to lose a dozen berths rather than lose his dignity.

If at any time we arrive on a job and find the work in progress being wrongly executed, on no account should we lose our temper with our "No. 1" (if we value his services). We must explain with firmness that we object to that method, and order whatever alterations we consider necessary to be immediately undertaken.

If by any chance we had lost our temper and reprimanded our "No. 1" before the men, he would have "lost face," and would most probably say:—"Master, I no can stay more, better you makee pay me, I go catchee new pidgin." The correct mode would have been to screw down the safety valve and wait until we had the "No. 1" in the office, and there let the steam "blow off" to our heart's content.

The author has had experience of workmen in about six different countries, and he is of the opinion that, man for man, the Chinese workman will compare very favourably with the best skilled men in Europe. There is, however, one grave fault with Chinese labour—greater supervision is needed. Frequently the Chinese workman will be engaged for weeks upon repetition work, and will work in strict accordance with his instructions, when, suddenly, without any apparent reason, some curious kink in his mind will cause him to depart from his former method and adopt an entirely new one.

From time to time one hears a great deal about the terrible vice of opium smoking; upon closer acquaintance, however, it is found to be no more terrible than the alleged habit of the British workman of dropping into a convenient "pub" and coming out drunk.

The Chinese are, without doubt, amongst the most frugal and thrifty people in the world, and, with the exception of the various religious festivals, they will never lose time if they can possibly crawl to work. What would not the Minister of Munitions be able to do with such men!

In all intercourse with Chinese in superior stations in life the Britisher should not make the mistake of talking "pidgin English." A Chinese merchant takes it as a compliment if we speak to him in "pukka" English. He may not understand half we say, but he will smile blandly upon us, feeling that we are treating him as an equal, and not as a member of the coolie class.

It may, or may not, come as a complete surprise to many readers when we tell them that China is the home of Trade Unionism. The Chinese have probably forgotten more about the ethics of trade unionism than the whole of the British Labour Party ever knew! Everyone belongs to a trade union or a guild, as they are called—fitters, turners, tailors, shoemakers, nursemaids, washerwomen, house-boys, coolies, etc.—all have their separate guilds, and woe to the employer whose bad luck it is to be "black-listed." If our name does in time appear on this list, we shall slowly but surely begin to realise that our works are not running so smoothly as formerly, and our best men will leave and be replaced with some difficulty until we have appeased the powers that be.

BRITISH MANUFACTURERS AND FUTURE TRADE IN BELGIUM.

By "Belgian."

A good deal has been said and written about the extension of British exports to new fields of commercial activity, but although many schemes have been put forward, none has actually been accepted as a basis for such an extension. Up to the present manufacturers have been left to their own initiative, and that is where the trouble lies. It is not by independent efforts that a trade of any magnitude will be built up abroad; but it is by the co-ordination of ideas accepted by all, and followed by all, that a substantial and durable result will be attained.

An association of manufacturers—there is one for nearly every trade—was needed to keep up the interests of the Home market, and will be needed still more, after the war, to stop any new attempt at German competition. A similar organisation is needed to control the export of goods, and, if it be worked on a sound basis, it is bound to bring success.

But the manufacturers have got to make up their minds *now*, to form a board to consider, and take adequate measures to meet, the Continental requirements in the near future. Inquiries will then be pouring in asking prices for such-and-such materials, complying with the Continental Associations' and Supply Co.s' rules; and what will the answers of British firms contain? Will there not be offers of material made to the British standards and regulations, which is *not* what is required abroad, and will not do?

To point out the importance of my views, I may mention the following cases from my own experience:—

1. British-made china cut-outs (of an old type) were refused on account of their construction, when submitted to the Supply Co.—the type in question was made as nearly as possible to the Continental pattern.

2. A consignment of steel tubing by a well-known British firm, screwed to the Continental thread, had to be sent to a Belgian factory to receive the inside insulation required by all fire insurance companies. In my efforts to introduce the British article, I procured the necessary dies and tools from Germany, and had them sent over here at my own expense; but the cost of production and of insulation proved too much to compete against the German article.

3. The use of tumbler switches on a 220-volt A.C. circuit was objected to by the Supply Co.

4. The different Continental regulations and standards of output, well known here, but seldom applied, by the manufacturers.

The Board of Exports is required now, to prevent friction between dealer and manufacturer as regards the right article wanted, by making inquiries, and acquainting the trade with the results obtained, and to prepare for all emergencies that will arise. Another reason: We were dependent on Germany for a lot of articles that we did not make ourselves and that were too expensive to obtain in another country. We shall be confronted with the same problem after

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the war. If the British-made article is found too expensive, the duty of the Association will be to advise the firms concerned to have the articles asked for—they are nearly all patented—made for them in an acknowledged factory in Belgium, so as to save the expenses of transport, customs duties, and also the delay in delivery. Such a policy would increase the profit of the patentee, but it would enable the article to be made at a price suited to the Continental market.

The Association would also communicate the market conditions prevailing at any time, also the financial terms accepted. The sending of money before the dispatch of the goods, as required before the war, will not do.

There are, no doubt, many more reasons for taking steps to form an association at an early date, which have already been made known by other writers in previous articles.

THE DESIGN OF HIGH-PRESSURE DISTRIBUTION SYSTEMS.

By J. R. BEARD, M.Sc., A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *December*, 1915.)

(*Continued from Vol. 77, page* 863.)

Lay-out of Distribution System.—Except in special circumstances it is usually essential for each sub-station to have at least two separate sources of supply, and, if the supply to the sub-station is not to be interrupted by a failure of one source, some form of discriminating protective device must be installed on each feeder in order to isolate it automatically in the event of its breakdown. It is, however, not so generally recognised that it is of equal importance that a fault on one feeder must not interfere with the supply through the sound feeders however severe the fault may be. The only forms of protection in commercial use which meet these conditions under all circumstances are the balanced-current protective system with pilot wires and the split-conductor protective system. Both have the further advantage that the isolation of the faulty feeder is practically instantaneous and can be effected with quite a

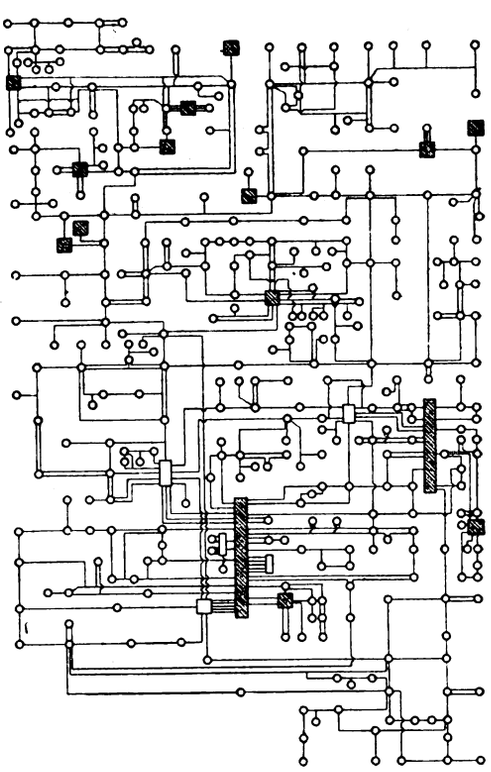

FIG. 7.—NORTH-EAST COAST HIGH-PRESSURE DISTRIBUTION SYSTEM. Generating stations shown cross-hatched.

low value of the fault current, so that the disturbance to the general system is a minimum. They increase the cost per mile of a main of given section, but this is counterbalanced by the saving effected by the possibility of using an interconnected system which allows of:—

(*a*) A reduction in the cost of mains due to the saving in spare feeders.

(*b*) A reduction in the cost of mains due to the possibility of replacing a number of small feeders by a few large ones which are cheaper per ampere of carrying capacity.

(*c*) A reduction in the amount of switchgear required.

(*d*) A reduction in the total annual cost of mains, owing to its being possible to take advantage of the diversity between the demands of different sub-stations.

The extent to which a system may be safely interconnected by the use of these devices is shown by fig. 7, which illus-

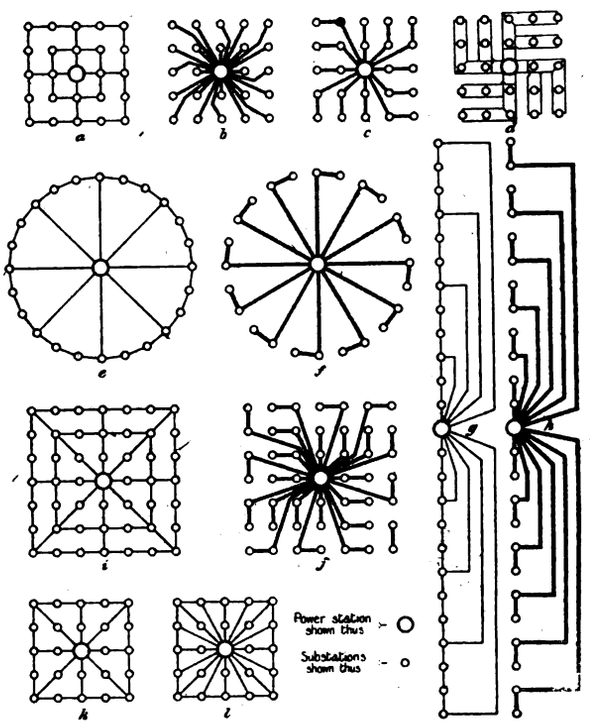

FIG. 8.—DIAGRAMMATIC LAY-OUTS OF DISTRIBUTION SYSTEMS.

trates diagrammatically the high-pressure distribution system on the North-East Coast. No less than 350 sub-stations are connected to this system, and it is fed by 15 power stations, many of which utilise waste energy in the form of exhaust steam and coke-oven gas. The whole of the feeders shown are normally in commission and interconnected, the older ones being equipped with balanced-current protection and the more recent ones with split-conductor protection. As showing the reliability of both these forms of protection, the operating records of this system show that over a period of time, selected quite at random, faults occurred on 23 feeders equipped with automatic protection, and that in 22 cases the faulty feeder was instantaneously isolated without causing an interruption of supply to a single sub-station except in one instance, where the sub-station in question was given a non-duplicate supply through the faulty feeder. In the remaining case, although the protective gear operated satisfactorily, one of the feeder switches failed to open due to a mechanical fault; this was equivalent to a bus-bar fault and brought out the overload gear at two sectioning points, thus limiting the trouble to this section of the system.

In the following investigation an attempt is made to give definite figures for the saving effected by an interconnected system. These figures show that the saving is not only sufficient to balance the cost of the special protective devices, but that a system so equipped is actually cheaper than systems protected by less efficient methods which do not give the same freedom from interruption of supply.

In order that the results may be on the conservative side the extra cost of the special protective devices has been taken at 10 per cent. on the switchgear, including building accommodation, and at 2s. per yard on the mains, which is sufficient to cover the cost of balanced-current protection, and decidedly more than sufficient to cover the cost of split-conductor protection. In the first place, a comparison will be made between the three types of system that are available in the case of the supply to a number of sub-stations, the supply to which must be reasonably free from interruption. These are:—

(1) An interconnected system equipped with balanced-current or split-conductor protection, which ensures complete continuity of supply to all sub-stations in the event of a fault on a feeder.

(2) A simple radial system with duplicate feeders direct from the power station to each sub-station, equipped with time-limit overloads at the power-station end and reverse-power relays at the sub-station end. This limits the risk of interruption to the sub-station fed by the faulty feeder, and has been adopted for important supplies such as that to the London underground railways. Owing to the defects of the reverse-power relay, it cannot ensure complete continuity of supply to the sub-station affected.

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(3) A series radial system with duplicate feeders to each sub-station protected as in (2), but with direct feeders from the power station to only half the sub-stations, each of these in turn feeding one of the remaining sub-stations. This involves graded overload gear, and a faulty feeder may shut down both the sub-stations in connection with it, and will probably shut down one of them; it is therefore only permissible where continuity of supply is not of such vital importance.

For the purpose of the comparison, a typical case is assumed of an area of 25 square miles with the power station at the centre and a sub-station with a maximum load of 500 KW. at 0.8 power factor and a load factor of 30 per cent. situated at the centre of each square mile, the distribution being effected by underground mains at 6,000 volts. It is assumed that owing to the diversity between the various sub-station loads the power-station load-factor will be 50 per cent., and the average feeder load-factor on an interconnected system, 40 per cent. The average maximum feeder currents are therefore deduced by assuming the sub-station maximum demand to be reduced in the ratio of the sub-station load-factor to the average feeder load-factor. This only holds for the interconnected system, but in the first instance the same reduced sub-station demands will be taken for other types of system, *i.e.*, the advantage which an interconnected system gains from its utilisation of diversity is neglected.

The annual cost per switch panel is taken from fig. 11, and the annual cost of the mains from fig. 6, the proper deductions being made in the case of types (2) and (3) for the omission of the special protective devices. Table I gives the comparison, while the diagrammatic lay-outs of the three types of system are shown in fig. 8 (*a*), (*b*), and (*c*).

TABLE I.

Type of system.	Reference to figs.	No. of switches.	Mileage of mains.	Annual costs. £	Percentage increased cost over interconnected system.
Interconnected ...	8 (*a*)	64	32·0	4,752	—
Simple radial ...	8 (*b*)	96	93·7	7,664	61·3
Series radial... ...	8 (*c*)	96	61·2	6,075	27·8

TABLE II.

Interconnected ...	8 (*a*)	64	32·0	4,752	—
Semi-duplicate "tee"	8 (*d*)	80	48·0	5,478	15·3
Change-over "tee"...	8 (*d*)	56	48·0	5,216	9·8

In certain cases where momentary interruption of supply is not of great importance a "tee" system has been used, arranged as shown in fig. 8 (*d*). Each sub-station is normally given a non-duplicate supply from one of the feeders, and arrangements are made for the sub-station to be changed over to the other feeder in emergency, thus involving a complete temporary interruption in the supply to all the sub-stations fed by the faulty feeder. In a modification of this system both tees into the sub-station are normally closed through switches equipped with time-limit gear, but the sub-station bus-bars are sectioned by a special switch. The sectioning switch may be either left open or it may be closed and equipped with instantaneous overload gear, so that it will immediately trip in case of a feeder fault. In either case supply is automatically maintained to half the sub-station bus-bars, and by opening the faulty feeder switch and closing the sectioning switch complete supply to the sub-station can be resumed.

Table II gives a comparison of these systems with the interconnected system, and it is interesting to note that the latter is still cheaper in spite of the great sacrifices in security entailed by the "tee" systems.

The foregoing comparison proves that the interconnected system is the most economical for the particular case which has been selected as typical; but in order to make the investigation complete it is necessary to show that this superiority still holds under other conditions, and accordingly the interconnected system will be compared with the cheapest system giving reasonable security of supply—the series radial system—under various modified conditions which may obtain in practice. These are:—

(1) The same number of sub-stations distributed one mile apart in a ring round the power station, or in line one mile apart with the power station at the centre, as shown in fig. 8 (*e*), (*f*), (*g*), and (*h*).

(2) The area of supply extended or decreased with the same number of sub-stations and the same total load on the system, *i.e.*, the sub-stations situated at the increased and decreased spacings of one per 4 square miles and four per square mile respectively, instead of one per square mile, the load per sub-station remaining the same.

(3) The area of supply extended to, say, 49 square miles with the same density of load and a correspondingly increased number of sub-stations supplied from the central power station, as shown in fig. 8 (*i*) and (*j*).

(4) The original distribution of sub-stations but with increased or reduced loads per sub-station, the alternative loads considered being 250, 1,000, and 2,000 KW. The arrangement of feeders remains the same for the series radial system, as a cable capable of dealing with the load of two 2,000 KW. sub-stations in emergency is not too large to be handled. For the interconnected system it is necessary to run more feeders from the power station to deal with the heavier loads, the feeder arrangements which would be adopted for the 1,000 and 2,000-KW. sub-stations being shown in fig. 8 (*k*) and (*l*) respectively.

The details of the comparison are given in Table III.

The outstanding features of this comparison are:—

(*a*) The economy of the interconnected system is generally maintained.

(*b*) The saving effected by an interconnected system rapidly increases as the area of supply is enlarged. This is important, as only relatively restricted areas have been considered.

(*c*) The saving is greatest for lightly loaded sub-stations and decreases as the sub-station loading increases. In the case of the most heavily loaded sub-station it would appear at a first glance that while the interconnected system may have other advantages, its direct economy is very small. This is only apparent, for in the first case the saving due to diversity has been ignored, and secondly it will be found on investigation that a point has been reached at which distribution at so low a voltage as 6,000 is uneconomical. With a sub-station loading as high as 2,000 KW. the distribution system costs 37.1 per cent. more at 6,000 volts than it would at 11,000 volts, while if a pressure of 11,000 volts were adopted the interconnected system would show a saving of 21.8 per cent. compared with a series radial system at the same voltage.

The possible further savings which may be effected if diversity is taken into account have been considered, and without going into details of the calculation it may be taken as adding something of the order of 4½ per cent. to the cost of a simple radial system, and rather less to the cost of a series radial system.

When comparing an interconnected system with other types, two further points must also be borne in mind.

(1) It is a very difficult matter exactly to forecast sub-station maximum loads or, as in the case of railways, definitely to fix the allocation between the various sub-stations. If the sub-stations are fed independently it is obvious that in proportioning the feeders to them allowance must be made for the assumed maximum loads being exceeded or varied, while if the sub-stations are interconnected, the particular distribution between the sub-stations does not greatly matter so long as the total system load is unaltered.

(2) The greater part of the saving effected by an interconnected system is in the trunk feeders, and in consequence it is more marked the farther the power stations are removed from the centres of load. In the above comparisons the power station has been taken at the electrical centre of gravity of

TABLE III.

Nature of modification to the typical system.	Type of system.	Reference to fig. 8.	No. of switches.	Mileage of mains.	Annual cost. £	Percentage increased cost over corresponding interconnected system.
Sub-stations distributed in ring	Interconnected	(*e*)	64	54·6	8,179	—
	series radial	(*f*)	96	115·9	10,977	34·2
Sub-stations distributed in line	Interconnected	(*g*)	66	84	11,508	—
	series radial	(*h*)	96	168	15,644	35·9
Sub-stations spaced one per 4 square miles	Interconnected	(*a*)	64	64·4	8,736	—
	series radial	(*c*)	96	122·4	11,103	27·1
Sub-stations spaced four per square mile	Interconnected	(*a*)	64	16·0	2,760	—
	series radial	(*c*)	96	30·6	3,562	29·0
Area of supply increased to 49 square miles	Interconnected	(*i*)	128	69·0	11,108	—
	series radial	(*j*)	192	166·9	16,135	45·2
Area of supply increased to 81 square miles	Interconnected	—	192	120·8	20,521	—
	series radial	—	320	347·7	33,124	61·4
Sub-station load reduced to 250 KW.	Interconnected	(*a*)	64	32·0	3,960	—
	series radial	(*c*)	96	61·2	5,295	33·7
Sub-station load increased to 1,000 KW.	Interconnected	(*k*)	64	35·3	6,533	—
	series radial	(*c*)	96	61·2	7,721	18·2
Sub-station load increased to 2,000 KW.	Interconnected	(*l*)	80	53·2	10,469	—
	series radial	(*c*)	96	61·2	10,572	1·0

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the load and, therefore, at the least favourable position for the interconnected system.

So far the investigation has been limited to the comparatively low voltage of 6,000; but, speaking generally, the higher the system voltage the greater is the economy to be obtained by interconnection. This is obvious if it is remembered that—

(*a*) The higher the voltage the less is the proportionate cost of the protective devices, which is practically independent of the voltage.

(*b*) The higher the voltage the smaller is the section of the mains for given loads, and consequently the greater the advantage offered by interconnection in reducing the total length of mains and increasing their average capacity.

TABLE IV.

Distribution voltage.	Interconnected system.		Series-radial system.		Percentage increased cost of series-radial system over corresponding interconnected system.
	Reference to fig. 8.	Annual cost—£.	Reference to fig. 8.	Annual cost—£.	
6,000	(*l*)	10,469	(*c*)	10,572	1·0
11,000	(*k*)	7,634	(*c*)	9,295	21·8
20,000	(*a*)	7,984	(*c*)	10,756	34·8

This is shown very clearly by Table IV, which gives the comparison at various distribution voltages between the annual costs of interconnected and series radial systems for the typical distribution of sub-stations and a load of 2,000 KW. per sub-station.

(*To be continued.*)

A TRAGEDY IN LIMITATION.

BY "WHISTLEFIELD."

Extracts from the Price of Coal (Limitation) Act, 1915. "*An Act to provide for the limitation of the PRICE of Coal.*"

"WHERE coal is conveyed from any pit's mouth over any railway in trucks not belonging to a railway company, the seller of such coal shall not be entitled to charge for the use of the trucks any sum exceeding by more than 50 per cent. the sum which the railway company conveying the coal was actually charging for the provision of trucks at the commencement of this Act."

. . . . . .

"If in consequence of this provision the price to be paid by any consumer to whom coal is delivered is reduced by any amount, the price to be paid by any person to whom the coal is delivered in pursuance of any subsidiary contract shall be reduced by an EQUIVALENT amount."

. . . . . .

This Act shall not apply to any sale of coal for export . . . . or to any sale of coal to be used on any ship.

. . . . . .

ACT I. SCENE.—Engineer's office in electric light undertaking in London area.

ENGINEER (dictating): Write to Gilchrist, the coal merchant. Dear Sir,—Confirming my telephone conversation with you to-day, I have notified the colliery people that I intend to take advantage of the clause in the Price of Coal (Limitation) Act, whereby the coal contracts of electric light undertakings made between April 1st, 1915, and July 29th, 1915, are included in the scope of the said Act.

Write to the Colliery. Dear Sirs,—In terms of the Price of Coal (Limitation) Act, 1915, I beg to notify you that I intend to claim the benefit of the Act for the Dambad D.S. nuts contract made through Messrs. Gilchrist & Co. last June. I shall be glad to learn the amended price of this coal at the pit under the terms of the Act, and the amount of reduction which you will make to Messrs. Gilchrist on the present prices when the regulations come into force at the beginning of November.

ACT II. SCENE.—Engineer's Office, November 1st, 1915. Enter Gilchrist, the coal merchant.

ENGINEER, picking up a letter. I say Gilchrist, what's the nonsense about you not being able to make any reduction on the price of our coal? I notified you and the colliery people that we were going to claim it, and the three months allowed by the Act has expired, so I don't see how you can avoid making the reduction; besides, the colliery people have written to say that they are reducing the price to you by 1s. 6d. per ton. You don't think I got them to make a rebate for your benefit, do you? Why, the Act says you are to allow us an equivalent amount.

COAL MERCHANT: That's all very well; I don't deny that the colliery is giving me a rebate, but you can see from the details I gave in my letter that if I gave you 1s. 6d. per ton I'd lose money. My profit now is only 1s. 2d. per ton.

ENGINEER: The figures you give have got nothing to do with it; you contracted last June to supply me at 26s. per ton, and I don't suppose you do that at a loss. Well, then, because you are supplying it to an electric light undertaking, and I've claimed it, the colliery are compelled to reduce their price from this month by 1s. 6d. per ton, although the contract was made before the Act was passed. Freights haven't altered since you made the contract, so we are entitled to the 1s. 6d., and your profit per ton is exactly what it was before.

COAL MERCHANT: What about wagon hire?

ENGINEER: They are your own wagons; you are not charging yourself any more for their use, are you?

COAL MERCHANT: I'm entitled under the Act to charge 50 per cent. more on private wagons than the railway company charge for the hire of wagons. Their hire rate is 1s. 10d., and I'm entitled to add 11d. to that.

ENGINEER: But that doesn't apply in this case. If I'm fool enough to fix up another contract with you, you are allowed by the Act, in reckoning the maximum price that you propose to make, to add 50 per cent. on to the railway hire rate for the use of your own wagons, but in the case of an existing contract wagon hires don't come in at all,

COAL MERCHANT: The Act doesn't say so.

ENGINEER: No, of course not; but the Act was framed to limit the price to the consumer. That's why the colliery has to reduce the price, but it didn't intend you to pocket the reduction. Why, man; on your own showing, even if you had to hire railway trucks you would have been making a profit of 7d. per ton, and you propose to take another 1s. 6d.; 2s. 1d. per ton for merely passing on my order and invoicing up the goods.

COAL MERCHANT: That's less than the profit I'm allowed to make.

ENGINEER: How do you make that out? There's nothing about it in the Act.

COAL MERCHANT: I was with a deputation of coal merchants who waited on Mr. Runciman, and he told us that 10 per cent. was a very reasonable profit for the coal merchant. I admit that 2 to 3 per cent. is our usual profit, and I've booked contracts with large users, like yourselves, at 1d. a ton profit; but if Mr. Runciman thinks half-a-crown a ton most reasonable, it's not our place to argue the point, is it?

ENGINEER: But whoever suggested 10 per cent. to him? Did he inquire what the usual profit was?

COAL MERCHANT: No; when we asked him what he considered a fair profit for our work, he hesitated; and when our spokesman asked if he would consider 10 per cent. too much, he said he thought it very reasonable.

ENGINEER: Well, anyway, I'm going to have that 1s. 6d. per ton; it's allowed for by the Act, and if you won't deduct it I shall have to hand the matter over to the Town Clerk to settle.

COAL MERCHANT: The Act may have meant you to get that 1s. 6d., but it hasn't put it clearly, and I think you will find that the Town Clerk will agree with me that it won't stand in Court of Law, especially as the Act says that the decision of the Board of Trade will be final on any points not otherwise allowed for, and Mr. Runciman allows us 10 per cent. profit. I'd advise you to go and see him about it; he's a very nice gentleman to deal with—at least, we found him so.

ACT III. SCENE.—Engineer's office, a month later. Enter Gilchrist, the coal merchant.

ENGINEER: I say, Gilchrist, what's gone wrong with your coal deliveries the last three weeks? You are only putting in half your quantities; I've not more than four days' supplies in my bunkers, and if you don't send more along in a hurry I'll have to draw from my reserve stock. It cost 6d. a ton to put it into that store, and it will take 4d. a ton to wheel it into the bunkers; 10d. a ton added on to the price of the coal through your bad deliveries.

COAL MERCHANT: Don't blame me, sir; it's your precious Act that's responsible.

ENGINEER: How do you make that out?

COAL MERCHANT: Why, London is always a cut market for coal; the collieries can always get about 1s. a ton more for coal sent to the Midlands, and it's going there.

ENGINEER: But the Act doesn't allow them to charge two prices?

COAL MERCHANT: The Act allows them to add 4s. on to the prices they used to get, so the coal goes to the Midlands, and it's only when they have coal to spare that it comes to London. Just now the Midlands can take all that they can spare from the shipping trade. I've never known such a shortage of coal on the London market as there is just now, and it's going to be worse. The Act allows them to charge anything they like for export coal, and there is a big demand abroad; if they could get enough boats there'd be no coal to be bought in this country; it's the shortage of boats that enables you to get coal at all. A man 'phoned me yesterday and offered to pay one shilling or two shillings a ton above his contract price if the colliery would send him his full quantities, but they daren't take it; it's against the Act to charge more than they are doing. He'd have had to do without, like other people, if I hadn't arranged to buy a quantity from a coal merchant who is a friend of mine in the Midlands; that means he pays two coal merchants' profits, and the extra shilling the colliery charges for coal to the Midlands, and nearly double the railway freight. That is how your Act works for those who must have coal. It hasn't limited prices at all except in a very few cases, and some of the poorer grades of coal are actually up in price. We would all have been far better off without the Act. Here am I allowed to charge 10 per cent. profit and can't get coal to sell.

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ENGINEER: Well, that doesn't help me; what am I to do when my reserve stock is used up?

COAL MERCHANT: You'd better ask Mr. Runciman.

(Exit the coal merchant and the engineer, the latter to take on a squad of labourers to wheel in coal from his store.)

TRADE STATISTICS OF CANADA.

THE following figures, showing the imports into and exports from Canada of electrical and similar materials during the year ended March 31st, 1915, are taken from the recently-issued trade statistics. Figures for the year 1913-14 are given for purposes of comparison, and notes of any increases or decreases have been added:—

IMPORTS.

	1913-14. Dols.	1914-15. Dols.	Inc. or dec. Dols.
Railway passenger cars.—			
From United States ...	2,067,000	257,000	– 1,810,000
Motor cars for railways and tramways.—			
From United States ...	72,000	50,000	– 21,000
Copper wire, plain, tinned, or plated.—			
From United Kingdom ...	1,000	2,000	+ 1,000
,, United States ...	115,000	23,000	– 92,000
Electric light carbons and carbon points.—			
From United Kingdom ...	5,000	1,000	– 4,000
,, United States ...	39,000	36,000	– 3,000
,, Germany	40,000	6,000	– 34,000
,, Other countries ...	5,000	1,000	– 4,000
Total	89,000	44,000	– 45,000
Incandescent lamp bulbs, etc.—			
From United Kingdom ...	—	1,000	+ 1,000
,, Austria	14,000	8,000	– 6,000
,, Germany	—	4,000	+ 4,000
,, United States ...	110,000	54,000	– 56,000
,, Other countries ...	8,000	3,000	– 5,000
Total	132,000	70,000	– 62,000
Electric apparatus not mentioned (insulators, batteries, telegraph and telephone instruments).—			
From United Kingdom ...	809,000	538,000	– 271,000
,, Austria	2,000	2,000	—
,, France	29,000	9,000	– 20,000
,, Germany	141,000	68,000	– 73,000
,, Sweden	80,000	41,000	– 39,000
,, Switzerland ...	3,000	2,000	– 1,000
,, Italy	5,000	8,000	+ 3,000
,, United States ...	5,515,000	3,675,000	– 1,840,000
,, Other countries ...	13,000	1,000	– 12,000
Total	6,597,000	4,344,000	– 2,253,000
Manufactures of india-rubber and gutta-percha (except tires, clothing, and similar goods).—			
From United Kingdom ...	231,000	224,000	– 7,000
,, Austria	15,000	3,000	– 12,000
,, France	9,000	3,000	– 6,000
,, Germany	61,000	24,000	– 37,000
,, United States ...	776,000	621,000	– 155,000
,, Other countries ...	5,000	2,000	– 3,000
Total	1,097,000	877,000	– 220,000
Gasoline engines.—			
From United Kingdom ...	111,000	85,000	– 26,000
,, United States ...	2,457,000	1,905,000	– 552,000
,, Other countries ...	2,000	44,000	+ 42,000
Total	2,570,000	2,034,000	– 536,000
Steam engines.—			
From United Kingdom ...	50,000	67,000	+ 17,000
,, United States ...	386,000	170,000	– 216,000
,, Italy	19,000	—	– 19,000
Total	455,000	237,000	– 218,000
Steam boilers.—			
From United Kingdom ...	112,000	35,000	– 77,000
,, United States ...	273,000	163,000	– 110,000
Total	385,000	198,000	— 187,000
Concrete mixing, cement making, and coal handling machines.—			
From United Kingdom ...	32,000	7,000	– 25,000
,, United States ...	459,000	241,000	– 218,000
,, Other countries ...	4,000	1,000	– 3,000
Total	495,000	249,000	– 246,000

	1913-14. Dols.	1914-15. Dols.	Inc. or dec. Dols.
Asbestos manufactures.—			
From United Kingdom ...	50,000	33,000	– 17,000
,, United States ...	415,000	188,000	– 227,000
,, Other countries ...	9,000	6,000	– 3,000
Total	474,000	227,000	– 247,000
Electric motors, generators, and dynamos.—			
From United Kingdom ...	136,000	175,000	+ 39,000
,, France	4,000	2,000	– 2,000
,, Sweden	103,000	25,000	– 78,000
,, United States ...	1,542,000	1,146,000	– 396,000
,, Germany	14,000	—	– 14,000
,, Other countries ...	8,000	1,000	– 7,000
Total	1,807,000	1,349,000	– 458,000
All machinery not mentioned, except sewing machines, textile machinery, printing machinery, etc.—			
From United Kingdom ...	1,702,000	992,000	– 710,000
,, France	79,000	5,000	– 74,000
,, Germany	163,000	110,000	– 53,000
,, United States ...	12,811,000	8,091,000	– 4,720,000
,, Other countries ...	67,000	66,000	– 1,000
Total	14,822,000	9,264,000	– 5,558,000
Iron and steel wire, single or several, covered with cotton, linen, silk, rubber, or other material, including cables so covered.—			
From United Kingdom ...	304,000	159,000	– 145,000
,, United States ...	563,000	175,000	– 388,000
,, Other countries ...	11,000	4,000	– 7,000
Total	878,000	338,000	– 540,000
Lighting fixtures of metal (including electric).—			
From United Kingdom ...	31,000	11,000	– 20,000
,, Austria	8,000	1,000	– 7,000
,, United States ...	637,000	401,000	– 236,000
,, Other countries ...	29,000	5,000*	– 24,000
Total	705,000	428,000	– 277,000

* Germany, 6,000.

Plumbago, ground and manufactured.—			
From United Kingdom ...	14,000	4,000	– 10,000
,, United States ...	47,000	34,000	– 13,000
Total	61,000	38,000	– 23,000

EXPORTS.

	1913-14. Dols.	1914-15. Dols.	Inc. or dec. Dols.
Mica.—			
To United Kingdom ...	36,000	32,000	– 4,000
,, United States	156,000	184,000	+ 28,000
,, Other countries ...	17,000	2,000	– 15,000
Total	209,000	218,000	+ 9,000
Electrical apparatus.—			
To United Kingdom ...	25,000	17,000	– 8,000
,, Newfoundland	9,000	16,000	+ 7,000
,, United States	67,000	49,000	– 18,000
,, Other countries ...	6,000	16,000*	+ 10,000
Total	107,000	98,000	– 9,000

* Newfoundland, 16,000.

Machinery (other than washing and sewing machines and typewriters).—			
To United Kingdom ...	84,000	40,000	– 44,000
,, Newfoundland	56,000	20,000	– 36,000
,, New Zealand	9,000	5,000	– 4,000
,, Argentina	9,000	21,000	+ 12,000
,, France	23,000	9,000	– 14,000
,, United States	729,000	188,000	– 541,000
,, Other countries ...	76,000	31,000*	– 45,000
Total	986,000	314,000	– 672,000

* Australia $9,000, and Russia $11,000.

Gasoline engines.—			
To United Kingdom ...	—	7,000	—
,, Newfoundland	76,000*	94,000	—
,, United States	81,000*	13,000	—
,, Other countries	—	3,000	—
Total	88,000†	117,000	+ 29,000

* Total exports. † Canadian manufactures only.

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FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AMENDMENTS.

NEW ZEALAND.—The text of the New Zealand "Finance Act, 1915," which was assented to in October last, confirms the amended rates of duty leviable on certain articles on importation into New Zealand which were proposed in the Resolutions introduced into the House of Representatives—*vide* p. 608 of the ELECTRICAL REVIEW of November 5th. Provision is also made in the Act that every Resolution passed on or after August 26th, 1915—the date from which the new duties take effect—and before the passing of this Act, purporting to impose any duties of Customs, or to create any exemptions from such duties, shall be deemed to have had the force of law, according to the tenor of such Resolution.

SWEDEN.—The exportation of copper (unmanufactured or raw) refined from raw material (not from scrap) at a Swedish refinery has been prohibited as from November 6th by a Royal Decree. The exportation has also been prohibited as from December 10th of carbon electrodes and carbon sulphide; ferro-tungsten (ferro-wolfram) and ferro-vanadium; wolfram and vanadium.

FINLAND.—In virtue of recent decisions by the Finnish Customs, the undermentioned articles are to pay duty on importation into Finland as follows:—Electrodes weighing each 3 kilogs. or more are dutiable under Tariff No. 155 (1) at the rate of 1 mark (Finnish) 20 penni (say 1s.) per 100 kilogs. (220.46 lb.), while electrodes weighing each less than 3 kilogs. are dutiable under Tariff No. 231 (2) at the rate of 12 marks (say 9s. 7d.) per 100 kilogs. Fastening arrangements for electro-technical machines (not being an integral part of such machines) are dutiable under Tariff No. 231 (1) *b* (1) at the rate of 14 marks 70 penni (say 11s. 9d.) per 100 kilogs.

Generators and transformers (which are to be dutiable separately) are dutiable under Tariff No. 231 (1) *c* at the rate of 47 marks 10 penni (says £1 17s. 8d.) per 100 kilogs.

JAPAN.—According to a decision issued by the Yokohama Custom House, electric condensers are to be dutiable on importation into Japan under Tariff No. 547 (3) at the rate of 25 per cent. *ad valorem*, the decision to come into force on February 5th, 1916.

BRAZIL.—H.M. Minister at Rio de Janeiro has telegraphed to the Foreign Office that a Commission is to be appointed to study the question of the revision of the existing Brazilian Customs Tariff. The result of the Commission's labours is to be embodied in a Bill which is expected to be laid before the Brazilian Legislature for discussion at the next session.

RUSSIAN FAR EAST.—The official *Bulletin of Laws*, of Petrograd, has published a Decree, which received the Imperial assent on October 10th/23rd, imposing Customs duties on certain goods imported into the Russian Far East. In virtue of this decree a number of articles which were formerly exempt from Customs duties on importation into the Governor-Generalship of the Pri-Amour and into the Transbaikal Territory of the Governor-Generalship of Irkutsk are in future to be subject to duty, when imported into these regions, at the rates fixed by the Russian Customs Tariff. Among these articles may be noted the following:—

	Rate of duty. Roubles.	Copecks.
Carbons for electrotechnical purposes, weighing—		
(*a*) less than 10 funts each ... ... per poud	8	80
(*b*) 10 funts or more each ... ... per poud	1	10
Electrical cables of all kinds ... ... per poud	7	37
Machines and apparatus, etc., as follows:—		
All kinds of machines made of copper or its alloys, or in the composition of which copper or any alloy of copper is present in a proportion exceeding 25 per cent. of the total weight of the machine ... ... per poud	9	90
Dynamo-electrical machines and electro-motors of all kinds; electrical transformers ... ... per poud	9	35
Parts of machines not specially mentioned (whether imported separately or together with the machine) composed of copper or copper alloys, per poud	9	90
Parts of dynamo-electrical machines and transformers are admitted under the immediately preceding classification, except the parts enumerated below:—		
Induction coils ... ... per poud	19	47
Armatures and commutators ... per poud	14	02½
Frames with parts (other than brasses) of copper ... ... per poud	9	35

Poud = 36 lb.; 100 copecks = 1 rouble = 2s. 1½d. at par.

"Z" Lamp Festivities.—On December 22nd, at Lawrence Hill, Southfields, S.W., the works entertainment of the "Z" ELECTRIC LAMP MANUFACTURING CO., LTD., was held. It took the form of a tea and concert, at which 200 were present. Among the items in the programme were sleight-of-hand feats by Mr. J. H. Palmer, the works foreman.

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

17,752. "Method and means of indicating or recording the frequency of periodic currents." N. C. F. JENSEN. December 20th.

17,753. "Control of electrical measuring instruments." M. J. E. TILNEY and N. C. F. JENSEN. December 20th.

17,754. "Variable automatic electric power cut-off device for auxiliary printing machinery." H. V. JAMES. December 20th.

17,776. "Combined electric grate and fan which could be used on floor, on a table, or hanging from the ceiling of a room." K. S. JASSAWALLA. December 20th.

17,780. "Electric relays." BRITISH THOMSON-HOUSTON CO., LTD., & E. B. WEDMORE. December 20th.

17,833. "Systems of electric welding." D. H. WILSON, J. M. ANDERSON, and K. L. CURTIS. December 21st. (Convention date, December 31st, 1914, U.S.A.) (Complete.)

17,834. "System of electric welding." D. H. WILSON. December 21st. (Complete.)

17,844. "Starting and lighting sets for automobiles." BRITISH THOMSON-HOUSTON CO., LTD. December 21st. (General Electric Co., U.S.A.)

17,856. "Wave transmission." G. CONSTANTINESCO & W. HADDON. December 21st.

17,857. "Storage of energy." G. CONSTANTINESCO & W. HADDON. December 21st.

17,876. "Keyboard controlling devices." WESTERN ELECTRIC CO., LTD. December 22nd. (Western Electric Co., Inc., U.S.A.) (Complete.)

17,878. "Cyclometer registering movement drop-figure action for electrical watt-hour meters." E. WISEMAN & T. C. KIRTON. December 22nd.

17,901. "Earth current detectors and cut-outs for electrical circuits." J. JOHN & W. J. JOHN. December 22nd. (Complete.)

17,910. "Construction of sparking-plug for internal-combustion engines." A. E. HEATH. December 22nd.

17,921. "Rotary interrupter for electric ignition devices." R. BOSCH (firm of). December 22nd. (Convention date, February 18th, 1915, Germany.) (Complete.)

17,926. "Combined dynamometers and counters, or tachometers." W. M. ROCKSTROH. December 22nd. (Complete.)

17,930. "Electrical fuse boxes or holders." H. W. COX. December 23rd.

17,946. "Selectors for telephone systems." SIEMENS & HALSKE AKT. GES. December 23rd. (Addition to 23,336/13. Convention date, April 20th, 1915, Germany.) (Complete.)

17,949. "Manufacture of thermo insulating material." J. CUTHBERTSON. December 23rd.

17,954. "Means for controlling the speed of a machine." MARCONI'S WIRELESS TELEGRAPH CO., LTD., & C. S. FRANKLIN. December 23rd.

17,956. "Electrical selectors or impulse responders." RELAY AUTOMATIC TELEPHONE CO., LTD., & L. C. BYGRAVE. December 23rd.

17,962. "Electric switches." H. K. TRECHMANN & BRITISH THOMSON-HOUSTON CO., LTD. December 23rd.

17,974. "Electric couplers for organs and like musical instruments." H. WILLIS, JUN., & A. S. COOKE. December 23rd. (Complete.)

18,016. "Automatic electric lamp filament replacement device in connection with signal lamps on board ship." W. G. KIMBER & A. L. ENGLISH. December 24th.

18,017. "Driving and control mechanism of planing and like machines." IGRANIC ELECTRIC CO., LTD. December 24th. (Complete.)

18,019. "Signalling by wave transmission." G. CONSTANTINESCO & W. HADDON. December 24th.

18,020. "High-frequency wave transmission generator." G. CONSTANTINESCO and W. HADDON. December 24th.

PUBLISHED SPECIFICATIONS.

1914.

23,563. ELECTRIC RINGING APPARATUS OR OTHER MECHANISM HAVING POLARISED ELECTROMAGNETS. V. Cleue and G. Bonneuil. December 4th. (December 17th, 1913.)

23,566. ELECTRICALLY-OPERATED TABULATING AND LIKE MACHINES. C. A. E. A. Greene & British Tabulating Machine Co. December 4th.

24,013. PREPAYMENT ELECTRICITY METERS. Landis & Gyr Soc. Anon. December 14th. (December 17th, 1913.)

24,543. BRAKE MAGNETS FOR ELECTRIC METERS. O. T. Blathy. December 23rd. (December 23rd, 1913.)

1915.

1,483. INTEGRATING ELECTRIC WATTMETERS. J. Hikeley. January 29th.

3,860. ELECTRIC FIRE ALARUM CONTACT MAKERS. R. G. Hislop. March 11th.

4,054. ELECTRICAL TURNING GEAR FOR STARTING INTERNAL-COMBUSTION ENGINES. F. H. Royce & Rolls-Royce, Ltd. March 15th.

4,585. PROTECTION OF ELECTRIC CABLES. J. H. Bowden & H. F. J. Thompson. March 24th.

8,895. ARRANGEMENTS FOR PROTECTING TELEPHONE, TELEGRAPH, AND THE LIKE INSTRUMENTS AGAINST LIGHTNING OR EXCESSIVE ELECTRIC POTENTIALS. A. E. Beattie. June 16th.

11,555. PRODUCTION OF UNDAMPED OR SUSTAINED ELECTRICAL OSCILLATIONS. F. K. Vreeland. August 10th.

Electrical Prosperity Week.—From the accounts which have reached us it appears that the celebration of the Electrical Prosperity Week throughout the United States resulted in a huge success, and public interest was aroused to an unprecedented extent. In Philadelphia, according to the *Electrical World*, prizes for electrical decorations were given to the amount of £100 per night, and 1,160 wiring contracts were signed on special terms; an electric show at Memphis was crowded (admission free), and in Syracuse the electric lighting company was highly pleased with the results obtained; in Milwaukee, during the first two days of a co-operative exhibit, orders for more than £10,000 worth of goods were received, and similar exhibitions took place in many other centres, always with prodigious success.

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THE

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VOL. LXXVIII. JANUARY 14, 1916. No. 1,990.

ELECTRICAL REVIEW.

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NOTICE.

IN view of the recent Increase in the Postal Charges, our Subscription Rates for Great Britain and Canada will until further notice be increased to £1 1s. 8d. and £1 3s. 10d. respectively.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

AT the last annual general meeting of the Institution it was suggested that greater publicity should be given to the doings of the Council and Committees. At present their proceedings are sedulously concealed until in May they are set forth in brief paragraphs in the Council's annual report. Why this practice should obtain, and whether it has any sound reasons to support it, other than the feeble excuse of long-established custom, we do not know; but we remember that the suggestion to change it was heartily welcomed, not only by the members, but also, we believe, by the then President, Sir John Snell.

In support of the proposal we may point out that the secrecy shrouding the proceedings of the Committees conceals from the members in general the activities of the members of the Committees, and thus inflicts an injustice upon the latter; it is also detrimental to the interests of the Institution, as it tends to the diffusion of distorted statements and unfounded rumours as to what is being done, and prevents the vast majority of the members from adequately appreciating the enormous amount of work that their Council and Committees in fact accomplish. Surely there is no necessity for so much mystery. At the risk of incurring the displeasure of the more dignified members—those, for example, to whom the very thought of shopkeeping is distasteful—we may cite the example of the younger body—the American I.E.E.—which prints in its *Proceedings* a report of the monthly meetings of the Board of Directors, together with personal notes, lists of the members of the various Standing and Special Committees (which number no fewer than 36), and a variety of other useful information available only to the directorate. The Institute has 32 Local Sections and 53 "Branches," and is a very live organisation indeed. The American Society of Civil Engineers practises similar methods, and so does the American Society of Mechanical Engineers; both have a membership over 6,600, and the latter has doubled its numbers during the past five years, thanks (in its own words) "to the policy of promoting the welfare of the individual engineer through the development of high ideals in the profession, and its activities in all matters of public interest—and this *without overlooking the human element.*" The words which we have italicised seem to us to touch the root of the complaints which are periodically preferred against our own Institution.

To take another point, the Institution of Civil Engineers has adopted the practice of opening its meetings at 5.30 p.m; the meetings are preceded, instead of followed, by a social cup of tea or coffee, and we understand that the new arrangement is very popular with the members. We believe that a similar reform would be heartily welcomed by the members who attend the London meetings of the Institution of Electrical Engineers. It has been argued that the members of Council would then be put to inconvenience in respect of their dining arrangements, but even if so unworthy a suggestion were "taken seriously," we cannot imagine that the Council would permit its decision to be swayed by its digestive faculties rather than by the advantage of the members as a whole. People do not wish to be out late nowadays, and the closing of the meeting at 7.30 p.m. would meet their wishes. It is for the members themselves, of course, to press the matter if they approve of the proposal;

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experience teaches that the Council will never move unless it is pushed.

A point on which, as a technical journal, we should like enlightenment from the Council concerns the relationship between the Institution and the International Electrotechnical Commission. The connection, apparently, is very intimate, yet the Institution, though it has published the list of symbols and abbreviations for electrical quantities which have received the sanction of all the leading nations, has not officially adopted them in its *Journal*. So far as we are aware, the only nations which consistently use the authorised notation are our Teutonic enemies, who are so inured to discipline that with them an official regulation must necessarily be complied with. But does not the Institution intend to uphold the international system? We confess that while the symbols for quantities are acceptable, we do not like some of the signs for the names of units to be employed after numerical values; for example, mA and kW for milliampere and kilowatt respectively, and kWh for kilowatt-hour—a confusion of types which, to our mind, is unsightly, as well as meaningless. There is no definite sign for the ohm, though either O or Ω is recommended—ω being used for $2\pi/T$; doubtless the context will generally show that Ω does not now mean megohm (which would be either MO or MΩ), but who would guess that μO stood for microhm? However, in spite of our objections, we will use these signs in the ELECTRICAL REVIEW if they are given an official standing by our leading authorities.

Another matter, which may prove of more importance than any of those that we have mentioned above, is the question: What are we to do with our aliens? That there is a strong undercurrent of feeling on this matter in the membership of the Institution cannot be denied, and it is not confined to the junior ranks of the profession, very strong views indeed having been expressed by some engineers of high standing. A society consisting largely of members of the Institution addressed a request to the Council to deal with the matter, but, as we recently noted, the Council returned an evasive reply. That the Council possesses adequate powers under the existing Articles to deal with the matter will be obvious from the extract which we reprinted, but we do not anticipate that it will take action unless compelled to do so.

Our own position in the matter can readily be defined. So far as concerns the British-born descendants of alien enemies, and those of alien enemy origin who were residents of long standing and had taken out letters of naturalisation before the war, we feel that they are entitled to immunity from interference of any description; the nation has accepted them as British subjects, and is bound in honour not only to respect but also to uphold their rights and privileges. But as regards actual alien enemies, the position is very different; for them, in view of the barbarities and ferocity, the treachery and dishonourable acts, of their compatriots, we feel no sympathy whatever. A certain number of such enemies are members of the Institution of Electrical Engineers: are we worse off, or are they better off, for that fact? We do not know that it matters one iota, for the moment, whether they retain the title or not; for that matter, they call themselves men, as we do, and we cannot make them divest themselves of the title. The real question, to our mind, is: would the expulsion of our enemies from membership of the Institution serve any useful purpose, now or in the future?

That it could have no possible influence on the conduct of the war is obvious; on the other hand, an alien enemy who could pose as a member after the war might find the title of advantage in promoting trade relations with neutrals, or even with our Allies, by sailing under false colours. The most important and immediate effect of such an expurgation of the roll, however, would be an indirect one. At present members of British nationality, but of alien enemy origin, are necessarily grouped, in the eyes of the public, in the same class as the actual enemy members, and the removal of the latter would help to lighten the shadow which undoubtedly has rested upon the former. Many of our readers feel very strongly on this matter; we urge them to consider it from all points of view and in a judicial frame of mind before taking action, lest injustice be done.

Where there is no Room for Retrenchment.

WE read in the newspaper Press that the Retrenchment Committee, to which has been relegated the duty of investigating the expenditure of Government Departments, had under consideration, at its last meeting, the accounts of the Board of Trade. Now we are quite prepared to believe that there are some sections of this all-important department whose staffs require shaking up in a wide-meshed sieve, and that a de-fossilising process might, by means of pensions, bring about a very wise retrenchment. We are not blind to the fact that, as a whole, the Board is an extremely complicated organisation, which over a long period of years has been adding compartment to compartment, until it has become one vast concern, though with its premises scattered here, there, and somewhere else; but, on the whole, we should say that at the present important juncture the Board of Trade is one of the last Government departments in which a reduction in expenditure can be looked for. It may be that there is certain waste taking place there as in too many other places, but it will be dangerous for a Retrenchment Committee to lop off anything here just now unless it has powers also to add something more efficient in its place. And such a privilege as that hardly seems to fall legitimately within the scope of a Retrenchment Committee. We believe it to be the conviction of the business community of the kingdom that the need of the moment is for a large increase in expenditure upon the department which is supposed to assist us in connection with our national industries and trades. The one branch of Mr. Runciman's widespreading department which has really at heart the interests of these industries is the Commercial Intelligence Branch, which has been for years poked away in Basinghall Street in miserably dull premises, as though neither it nor its staff were to be permitted to see the exhilarating light of day. It is true that since the outbreak of war other and distinctly more creditable premises have been taken for particular purposes in Cheapside, but the situation of its Basinghall Street offices—cribbed, cabined, and confined as they are—seems to us to be typical of the cribbed, cabined, and confined policy under which the Branch has to operate. Nationally we have been altogether too niggardly in our national expenditure upon trade-cultivation activities. For years we have urged the necessity for spending if need be an additional half a million sterling per annum upon bringing to a state of business efficiency our staff of Consular representatives, commercial attachés, and trade commissioners. We hope that Mr. Runciman will recognise that the good work done by the very small and inadequate number of Trade Commissioners that we have representing British interests abroad has shown that it would be a profitable national investment to appoint at least half-a-dozen or a dozen others. Their services have been appreciated by business firms, who are asking for more. Is it a fact that we have no actual trade representative watching over our affairs in Russia even now?—a market that calls for two or three. Is it not true that for so vast an expanse as Canada we have but one Trade Commissioner? What can reasonably be expected when we do things on such a scale? Of what *permanent* avail can it be to send a roving commissioner once to visit South America, or, say, China—he may issue an excellent report and answer many questions when he gets home, but these temporary or flash-in-the-pan appointments do not meet the needs of the case, and they certainly will not do so in the future. Hence we see little chance of retrenchment in connection with the Board of Trade Commercial Intelligence expenditure. Indeed, every important consideration just now calls for an increase, for not only must the Branch be enabled to continue and extend the excellent work undertaken consequent upon the war, but the Board's trade activities should be organised at home in such a way that it can intelligently deal with the requirements of different industries, and there ought to be a greatly increased staff of Trade Commissioners. Notwithstanding all the financial burdens that we have to carry at present, we believe that a substantial vote of money would be passed with practical unanimity at Westminster.

We greatly hope that such matters will not be deferred

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until after the war. Mr. Runciman has told us of some things that his Department has been doing alone, and in co-operation with outside experts. He says that we shall not be found unprepared for the trade war when it comes, and if we feel that he is a little optimistic in describing Germany as already commercially beaten, it may be because he is in possession of facts concerning which we know nothing, or because he has some far-reaching scheme drawn up which will embrace the above, and some other very interesting measures, for the protection or assistance of our industries. We hope that time will prove such to be the case.

A Teutonic Miscalculation.

In all Allied countries measures are being discussed with great zest with the object of rendering the peoples of those countries independent of the Central Empires, if they still exist as such, after the war. Movements are on foot which might never have been started, and others have been revived which might have been allowed to sleep on for decades, purely because of some of the lessons learned through the experiences of the last 18 months. The "Never Again!" determination is heard in all of these discussions, and in that spirit is being laid the basis of many an important scheme. The Teutonic organisers, scientists, and industrial magnates may not have foreseen that one of the consequences of the growth of Prussian militarism and the efforts to attain its ideals (!) would be the bringing up to a higher state of efficiency of the organisations and productive facilities of the countries which had previously been the Teuton's prey, and the fuller utilisation of natural resources so as to ensure a greater measure of independence. Germany, by her very ability to conduct hostilities in the way she has done, because of her vast industrial works and organisation, and her capacity for holding out economically, has been forging in the minds of her enemies a weapon which will increase their ability to deal with her economically and prevent her commercial inroads after hostilities have ceased. Some of the movements may take long to mature or to develop into actual works rendering the service they are projected to provide; it may be years before some of them exercise any really substantial effect upon the situation. While it is impossible to conjecture what the immediate after-the-war consequences of such investigations and schemes may be, one thing is clear, that by practically compelling—unintentionally—Russia, France, Italy, and ourselves to look into such matters and devise plans and measures for increasing our efficiency for the future, Germany has made a rod for her own back—a rod which we trust will not be easily broken. What we have to see to is that these plans and schemes are not allowed to end in talk.

One measure of the kind that we have in mind hails from Italy, where the initial steps in connection with a scheme proposed for the utilisation, on a vast scale, of the water powers still remaining unemployed in Italy, are being taken in the current week at Milan, in the presence of a number of members of Parliament. At the last meeting of the Association of Electricity Supply Works, Signor E. Conti drew attention to the importance which a greater use of water powers would have in regard to the national defence, the rendering of the country independent to a great extent of supplies of coal from other nations, the extraction of iron from the ore, and the production of fertilisers. As a number of members of Parliament have expressed the desire to be specially informed on the subject, Signor Conti has arranged to give a first lecture this week, which is to represent the initiation of a crusade in favour of the development of the "white coal" resources of the country.

Lead.

There has been a remarkable outburst of strength and activity in lead during the last few weeks, the supplies coming to hand and available for disposal being quite out of proportion to the demand experienced, and the result has been a very active market at prices showing rapid appreciation. The inquiries which found the market short of material in this way came almost entirely from the hands of munition firms in this country, there having been a lull in export buying, particularly from Russia, while generally consumption has, of course, become a thing of the past. It is, indeed, reported in some quarters that there is a disposition among manufacturers of pipes and so on to resell part of their holdings of metal, owing to the enormous price appreciation, and the fact that general merchant business has come almost to a standstill. The Russian demand, which some months ago constituted the great feature of the market, has become less aggressive, and one steamer, indeed, which recently took on board between 2,000 and 3,000 tons of lead for Archangel has not sailed at all, and will probably be headed for some other port when she does clear. Supplies coming forward are by no means excessive, and so long as the freight position remains as it is, any material relief is out of the question. There are believed to be considerable stocks of metal in Spain and also in the United States awaiting steamer room to bring it to the centres of consumption, while the Mexican output is certainly increasing. There is said to be little or no scarcity of lead for forward shipment, and this although prices have been moved up in a sensational fashion under the spur of demand. It has been well said that while there is no real scarcity of lead in the world there is a very pronounced scarcity in the centres where it is most needed, and this seems pretty well to sum up the entire situation. The outlook, however, appears to indicate a continuance of high prices for a prolonged period, though it is possible there may be sharp fluctuations, especially if sellers occasionally come forward and find the market temporarily bereft of buyers.

One of these fluctuations has now developed as the result of the determination of the Ministry of Munitions to put a stop to the speculation which has been largely instrumental in bringing about the present extravagant level of values. It is the intention of the authorities to place lead under the "Defence of the Realm Act," which prohibits dealings except under permit. Official intimation to this effect has been given to the London Metal Exchange, and the result was a sharp drop in prices.

Financial Troubles at Buenos Ayres.

The financial situation of certain countries in South America was rather critical before the outbreak of the war in Europe, and the subsequent occurrence of hostilities merely served to aggravate the position of affairs in that part of the American continent. Although improvements have recently been reported to have taken place in one South American country, probably a first instance of a great city—in that part of the world—being unable to meet its payments for public lighting, has arisen in the case of Buenos Ayres, of whose development in many directions so much has been heard in recent years. According to a local newspaper, the City Council has got in arrears in its payments both for gas and electricity, so that a sum of more than $1,049,000 was owing to the Compania Primitiva de Gas in November, and $900,000 to the German Transmarine Electricity Co., of Berlin. In order to meet these payments, the City Council has approved the allocation to the gas company of bills for the amount due, having a currency of six months, and bearing interest at the rate of 6 per cent. per annum. It is stipulated that the bills can be renewed for a further term of six months, the currency of six months having been fixed so as to enable the bills to be discounted. In the case of the electricity supply company, which had instituted an action against the city, in which it was sought to secure a partial settlement of the claim by setting the taxes payable by the company to the town against the amount owed by the latter to the former, a compromise has been arranged whereby six months' bills for $900,000, bearing interest at the rate of 6 per cent. per annum, and maturing on July 31st, 1916, are to be handed to the company. In addition the account for supply in the December quarter is to be partly equalised to the amount of one-half of the taxes payable by the company in this month, whilst the remainder will be settled by bills falling due in April, but yielding no interest. This process will be continued until October, and may be extended further by mutual agreement.

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OUR TRADING OPPORTUNITIES THROUGHOUT THE WORLD.

(*Continued from Vol. 77, page 795.*)

Trade with South America.

It must be particularly annoying to the export firms of the United States to find that the wonderful and long-cherished Panama Canal has "broken down" at a time when the various States of South America are so much in need of manufactures which, for reasons beyond their control, the Germans cannot supply, and which because of British manufacturing activities in connection with munitions of war, or else through lack of shipping facilities, we are at present unable to export. But, Canal or no Canal, it has for some time been the desire of the States to nurse South America commercially, and such attentions have been strikingly in evidence during these eighteen months of war. Expeditions big and expeditions small have been dispatched to cultivate relations with buyers and others there both for immediate and for ultimate advantage. There is not, however, an absolute certainty among our cousins that they will permanently hold what they now have so excellent an opportunity to gain. They have come up against the influence of European capital—and if anybody has a hold on South America on that ground British investors have. They have also come up against the hold that Teutonic influence establishes when German capital initiates a public undertaking, or buys up a British one and develops it. It has too often been the British way to lend millions sterling which have not brought back to us the consequent contracts to benefit our industries. The Teutonic way has been to get a footing, to elaborately entrench, and to create by this, that, and the other way, under the terms of the concession, or by local arrangements, a system and an atmosphere which made it necessary for German apparatus and supplies to be employed, and so the capital put down, either to buy or to develop the undertaking, has brought both dividends and contracts too. An excellent arrangement no doubt for the other fellow, and one that makes us regret that it is ever possible for a British undertaking abroad to be sold to foreigners at however high a premium on the shares. The loss or thereabouts of a coming market for manufactures over a period of years, may mean far more to us industrially than the mere premium gain that came to the few lucky shareholders. These bargains look very nice on paper when we consider them from an investor's point of view—we like to read of men (other men!) making money out of electrical investments, but we do not like the transfer to what we now call "enemy hands," of undertakings which carry with them valuable trading facilities and connections. The United States then is up against European financial influence in its efforts in certain South American fields, and some of its advisers are not too confident that efforts to establish far-reaching schemes for the development of permanent future trade connections are going to yield all that the apparently favourable factors would suggest as being probable or possible. There is no doubt whatever that very determined efforts are being made there by American manufacturers, under the auspices of the U.S. Government, to take advantage of the present disabilities of European countries. Those efforts have been the outcome of a scheme which is outlined in a recent Commerce Report. One part of the scheme—a feature with which we are by no means unfamiliar—is this:—Arrangements are being made for giving training-course positions in American manufacturing plants to young South American technical graduates. Several firms have expressed their willingness to take these students, and it is now proposed that the scheme shall be extended to the training of South Americans in the offices of commercial houses. The advantages of the scheme are obvious. In some cases the students will return to their own countries as representatives of American houses. They will be well-equipped, native representatives, familiar with conditions in their own countries, and naturally loyal to the firms with which they have studied and worked. Even if later they enter business for themselves, or engage in entirely different lines, it is confidently expected that their influence will continue to make itself felt. Señor Eduardo Carrasco, chief of the commercial section of the Foreign Relations Department of Chile, who is at present visiting the United States to make a study of American commercial methods, is also establishing committees in the more important American cities to help young men, selected by a committee in Chile, to find positions in the universities, factories, or commercial houses.

Investors' Gain—a Traders' Loss.

To Americanise the Student Mind.

As we say above, we are used to this sort of thing. Particularly have British electrical engineers who have followed occupations in such countries as China, had very good reason for knowing how important a card this was in the hands of German electrical manufacturing works. The managers or heads of such works in Berlin or elsewhere in Germany took the long view of things, and the readiness with which they would offer to take the sons of influential Chinese gentlemen into their electrical works in Europe, and give them several years' training, is perfectly familiar to those of our readers who followed the "Correspondence" columns of this journal a few years ago. The young Chinaman duly takes up his place in the German factory, the father is placed under an obligation to the company, and not many months after, a personal letter from some distinguished official or other of the concern is received by the fond parent reporting the "progress" that his excellent son is making, and suggesting in the closing sentences that the time may now have arrived for orders for the requirements for a certain electrical installation, in which the said parent is interested, to be placed with the works where his dutiful and promising son is employed. That is the German method. You have one of the examples of the British way in evidence at the Hong-Kong University, where, by the foresight of Professor C. A. Middleton Smith, by the generosity of a number of British manufacturers, and by the efforts of this Journal, there exists to-day in the engineering laboratories a collection of machinery and apparatus destined to make a lasting impression upon the minds of thousands of young Chinese engineers who, after completing their studies, will go to the different parts of China with the names of British engineering firms "at their finger tips" so to speak. But we have no monopoly of this method of foreign education. Our rivals practise it wherever they get the opportunity.

Father and Son: A Family Obligation.

Can We not do More?

Whether this country has ever done so much as it ought in trying to educate the minds of potential buyers who pass through the engineering and other colleges in the countries which must depend on industrial nations for many years to come, is at least doubtful. Whether we have given sufficient facilities for such students to come into our factories and so familiarise themselves with British manufactures and abilities is also a point we should do well to consider. We hear that one organisation is already trying to arrange such a matter effectively in the lands of one of our chief Allies. We may be pretty certain that Germany will not do less of this kind of

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thing again, if she gets the chance, and from what we have said in the foregoing it is clear that the United States is going to adopt the practice as one of the long ways of winning South American trade. In the North, the geographical nearness of Canada has given the States untold advantage. In the South, Canal or no Canal, the problems are very different. There is no United States atmosphere; there are strong competitors on the ground in normal times—competitors whose hold is good, whose roots are deep, and whose knowledge of the markets is not a thing to be scoffed at; so the problems must be tackled in a different way. It seems to be thought, however, that if South Americans can be Americanised as many Canadians have been, practice may be inclined to pursue a favourable course for the United States in time. Part of that Americanising is to be found in receiving South Americans into United States works and colleges.

The Outlook in Canada.

The greatness of the engineering potentialities of Siberia has been frequently referred to in these pages. We have lately conversed with young Colonials who have come Home at the Empire Call after years of daring and interesting prospecting work in certain parts of Western and North-Western Canada, and their stories of what the future has in store for those who make the venture there are as fascinating and entrancing as the fairy tales of our childhood and as wonderful as the tales of the Arabian Nights. But for the time the war-fiend holds the key. The movement is Homeward for our sons—not to the lands across the seas at present unless they have "done their bit" and can do no more. Population has re-traced its steps in order to aid in our endeavours to wipe out the menace of the hydra-headed monster of Central Europe, so that the Colonial Britisher in a free, pure atmosphere, may carry on his occupation knowing that the heritage of Freedom for which our Empire stands is not endangered. Population more than ever will our Colonies require, and after the war they will doubtless gain more than they have lost by the war. The financial position, too, has been a serious factor in Canada for some time, but munitions work and a glorious harvest will ere long assist to relieve the situation—indeed, already the tide of prosperity has risen in the East, and it will doubtless soon reach the West. The Canada of the future will be a different land, and the character of the people will be somewhat changed. The huge munitions contracts are not being executed without leaving their mark upon the manners, habits, occupations, etc., of many of the people, and Canadian peace-time manufacturing operations will probably be more mechanical in future than in the past. May-be some of the lines of manufactured goods that were freely brought up over the border from the States will be Canada-made. For that we must wait and see, but what is happening at present will form one of the new factors to be taken into account in considering the future position. We hazard no opinion at the moment regarding the future of British electrical importations into Canada, for the position is a peculiar one. We have our hands so full, or prospectively so full, with markets nearer home, and possibly on some grounds easier to work, that there will be less reason to begrudge the States the greater opportunity for strengthening their hold on the market that the war has inevitably brought to them. We shall do well, however, not to neglect the market, for after a few years, given population and financial ability, the strides that Canada will take out West will be large indeed; where the railway goes there will be a need for electricity, especially remembering the great hydro-electric traction work that is now in hand or planned, and if we *can* meet the need we shall have at any rate a share of the spoils.

A Period of Change.

The Promise of Siberia.

But we did not start out to write about Canada—we were led on to it by our sentence about Siberia—to which it has been likened by those who have with eager eyes studied the position in their travels through both countries. Canada is a land of promise, of course, but Siberia is a land of promise too, almost beyond the limits of our poor industrial imagination, and the United States trade authorities, who know something about the matter, have, in one of their Commerce Reports, circulated among American firms some information which has been prepared by a special *Canadian* Trade Commissioner on "Trade Development in Siberia." So great is the Russian and Siberian territory, and so vast the population, that when once the wheels of what we may term ordinary industrial life have been set smoothly running, the requirements for machinery and many engineering supplies will be immense.

British Firms Co-operate.

The opportunity has been recognised for years by a number of British engineering firms, though we suspect that so successful have been their efforts in Russia that they have not needed as yet to push their efforts on to those farther eastward points which form part of their original project. We congratulate them upon their success, and we welcome with feelings akin to delight the co-operative efforts which have been set on foot by the seven British electrical manufacturing concerns who have grouped themselves for Russian business in a separate organisation—the Electrical Manufacturers' Company of Great Britain, Ltd.—to which we referred in our issue of December 31st, 1915. We may return to that most timely and promising scheme later, but meanwhile we quote the comments of the Trade Commissioner who has reported upon Siberia. He finds that during recent years a very marked progress has taken place, due largely to the opening out of transportation facilities—what a building of railways there will be in many parts of the world when this war is done! The whole hydrographic system that supplements the Trans-Siberian Railroad is bisected by that railroad, and for thousands of miles, north and south of the line, there is provided a splendid means of cheap access to vast areas during the greater portion of the year. These facilities are being continually increased by the construction of new railways and by river-improvement works, which aim to connect the whole river system of the country for practical transportation purposes. Trade expansion is shown by the business of the fairs and markets, the carrying trade returns of the chief centres of distribution, the growth in the number of banks, forwarding houses, insurance offices, etc., and the extraordinary activity in the building trade. The census figures of 1910 show an increase in the number of factories of 75 per cent., and of 150 per cent. in their output over those of 1900. Flour mills, sawmills, and breweries have been responsible for a considerable portion of the increase, and practically the entire equipment of these and similar undertakings was imported. Moscow merchants control fully 50 per cent. of the trade of Western Siberia. These firms have branches in the principal centres, but the purchases for their stores are made in Moscow. The growth of the country and the establishment of strong local independent firms is, however, tending to produce more direct buying. Most foreign firms have been content to leave their representation in the hands of a single firm in European Russia, and to pay little attention to the Siberian market. Germany has, however, by trade grouping, and the employment of competent travellers speaking the language, been able to build up a direct trade on a satisfactory basis. This trade grouping, with a view to sharing the somewhat high expense, is now

Developing Siberia.

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recognised as being of first importance, and local agents urge that responsible representatives of grouped industries should visit the country and get into touch with local conditions. Here, as in Russia, circumstances require the granting of extended credit, but the cost of credit can be realised in the prices. It is practically a question of finance—money out on loan. Shall we ever be able to employ that weapon to a sufficient extent to meet our rivals on their own ground? Electrical supplies have hitherto been almost entirely in the hands of Germany, but, with the depletion of accumulated stocks, and the stoppage of that source of supply, electric light fittings, lamps, bell-pushes and fans, meters, as well as dynamos and other plant, are said to be urgently required. And so we see Siberia holding out her hands of welcome to Allied electrical and engineering manufacturers.

(To be continued.)

BRITISH ENGINEERING TRADE EXPANSION.

By Edgcumbe Brighten.

It is the opinion of many that the time has now arrived when the question of after-war trade should be reviewed.

If Great Britain is to make the most of the advantages it will have obtained at the termination of the war, active steps must be taken to prepare the markets of the Empire and neutral countries for the enormously increased output of material which will be available owing to the extension of factories which are now engaged upon war work.

An important step in a campaign to promote the extension of our trade would be to form an association covering all the engineering and hardware industries. Such an association should seek the co-operation of all existing trade associations, and should be governed by a council consisting of representatives of such. The chairman or president should be a neutral personage, not connected with any other association.

The work that such an organisation should carry out, to be effective, must be very extensive. Its first duties would be to initiate a campaign within the British Isles by means of meetings, articles in the Press, etc., to bring home to the people the value and quality of British goods, pointing out the fact that Germany has been able to wage this war to a large extent through the support we have given her by purchasing goods and financing her industries in the past, and showing that one of the surest guarantees of Peace in the future would be the permanent annexation of enemy trade.

The association should interest itself, and use whatever influence it possessed, in protecting the interests of its members engaged in export trade.

The activities should be of the most wide-spread character. Capable representatives, chosen from local residents (British) who have had experience of some years' standing in such country to which they may be appointed should be sent to the great trade centres abroad.

The policy that has been adopted in the past by other associations of appointing people without experience, or without knowledge of the country, has proved its futility by its lack of usefulness.

Such foreign or colonial representatives would have, beyond the primary object of interesting natives of such country in British goods, the duties of keeping the association advised as to the possibility of future business. Also, it would be such a representative's business to encourage friendly legislation as to tariffs favourable to British goods.

The immense benefit that would be obtained by members of the association if its representatives abroad were organised on such lines as to be able to supply information in relation to business in prospect, would be too high to estimate.

The system that I put forward is that the agent or representative of any members of the association in any country should be kept advised as to possible new business by the resident representative of the association in such country, instead of information being sent to London before being disseminated. To obtain information of value, the representative would have to be an expert organiser.

The cost of maintaining such an organisation would be high, as I do not think a representative suitable for such an appointment in any country could not be found under £800 to £1,000 a year. A cheap man would be of no value to the association. In some cases this estimate would have to be very largely exceeded.

I think that as each industry represented in the association should have its interests properly maintained, a section covering each industry should be arranged.

One of the chief reasons why Germany has been so successful in pushing her engineering products in foreign countries is because she has offered many inducements to young men—sons of possible purchasers or manufacturers of industries—to go to Germany to receive their technical training. The importance and value of doing this is, of course, easily apparent to anyone, for to train a boy just as he is reaching manhood, and is susceptible to influence, is to create a life-long sympathiser. From personal experience, I have found it always most difficult to do business abroad when the prospective buyer had received his instruction in Germany, as he invariably thinks in German and believes in German methods.

One of the great difficulties with which we in this country shall have to contend after the war will be labour. I think it will be absolutely imperative that the situation be explained to the trade unions and to the Labour leaders. Also, one of the troubles that will have to be faced by manufacturers will be the continuance, and possible extension, of the policy "Ca Canny" or—limitation of output. It should not be assumed that the limitation of output is caused entirely by socialistic or labour principles, because one of the chief reasons that brought about the adoption of modern trade union restrictions was the frequent tactless behaviour of certain employers. To be more explicit, the limitation of output has frequently been brought about by fear on the part of the workmen that the "piece rate" would be reduced. At this point I leave the question, finally, believing that careful, cautious, and unbiassed negotiation would do much to reduce the evil here mentioned.

Unless the greatest care is exercised by His Majesty's Government after the war in disbanding the armies then in being, the fear of unemployment will be so great that all possible restrictions which can be put into force by the trade unions will be exercised to their utmost.

To combat such a policy, an extensive campaign should be inaugurated, to extend to trade unions, the Labour leaders, and the workmen themselves, so that there would be no reason for the fear of unemployment if labour would realise that the securing of markets and trades now dominated by the Central Empires should be effected by this country. From my experience and knowledge of many Labour leaders, I am convinced that they and the men could be interested. The spirit of patriotism, and the knowledge of what large wages mean, will make the near future a most opportune time for such a campaign.

I may be accused of laying too much stress on this question of labour, but I believe that unless action is taken, the time immediately succeeding the war

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will hold almost as much danger for this country as that with which we are now faced.

The fact that thousands, hundreds of thousands, perhaps millions of men will be released on to the market of labour after the war, is not fully realised. Industries and factories will have to be reorganised, and I fear that, in the meantime, the percentage of unemployment will be very high, with the cost of living not reduced. The situation that may arise is not difficult to imagine.

The expansion and recapture of British trade should be commenced as soon as possible, so that the seeds may be sown and the crops ready for reaping at the cessation of hostilities.

COKE AS A BOILER FUEL.

By E. W. L. Nicol, A.I.E.E.

The article on the above subject which appeared in the Electrical Review for December 31st (page 839) is of considerable current interest in view of the present high cost of coal and shortage of supplies from the usual sources; and, on the other hand, the plentiful supplies of coke available, particularly in districts so affected.

At many of the more important gas works during the present period of maximum demand for gas, the output of coke is to some extent controlled by increasing or decreasing the manufacture of carburetted water gas in its relative proportions to that of coal gas, as carburetted water gas plant is a consumer—not a producer—of coke. The residuals from which the much required, high explosive by-products are derived are, however, obtained only in the process of coal gas manufacture. This fact, coupled with the curtailment of export and shortage of labour, necessitates fresh outlets being obtained in directions which do not entail the employment of extra labour other than grading or loading into trucks or barges.

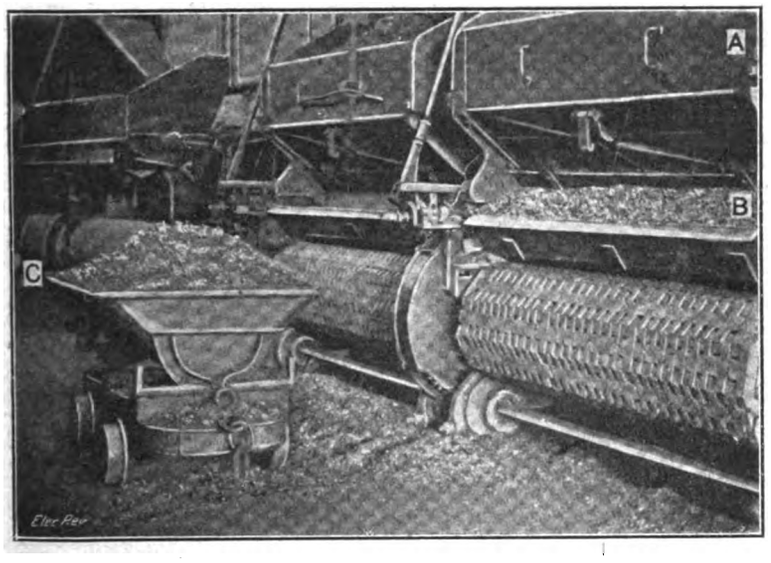

Fig. 1.—Chain-grate Stoker adapted for Burning Coke.
An auxiliary hopper B for coke is fixed below the usual hopper A, and the coke C is fed upon the grate with a thin layer of coal on the top of it to ensure its ignition.

The method of adapting a chain grate to burn coke, as illustrated in the previous article, is simple, and, no doubt, effective, but the air leakage through the improvised grate bars in the feed hopper would result in relatively poor thermal efficiency and low evaporation being obtained. The photograph reproduced herewith shows how chain grates working in this country under boilers of 20,000 lb. per hour capacity, have been modified to burn coke without material reduction in capacity or efficiency. In this case the ignition arch has been retained, and satisfactory ignition is effected by admitting a thin layer of coke slack with the coke, which is graded to convenient size. With this method, air leakage into the furnace is eliminated and normal capacity and efficiency are obtained.

To break and grade coke to suitable size, for either coking or sprinkler-type stokers, should not be a matter of very great difficulty. An ordinary coke cutter, absorbing about four or five H.P., will deal effectively with 30 tons per hour at a very insignificant cost.

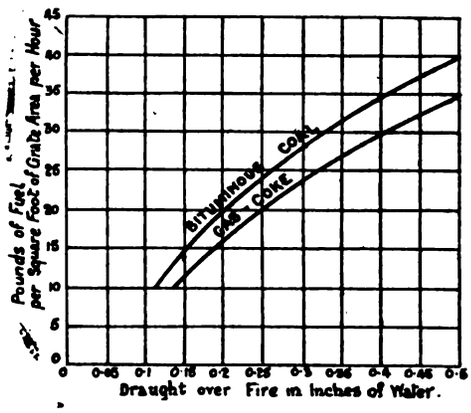

Fig. 2.—Rates of Combustion of Coal and Coke.

The results of other evaporative tests, given in the previous article, on ordinary fixed grates showed the higher evaporative value (about 10 per cent.) of coke, as compared with coal of a higher calorific value, obviously due to the smaller proportion of excess air necessary in burning a non-volatile fuel and consequent greater proportion of CO_2 obtainable in the waste gases.

As to the relative cost of coal and coke as boiler fuels, due regard must be had to quantities, locality and delivery facilities. Taking the river Thames, prices for washed slacks having an average of about 12,500 B.Th.U. have lately been about 30s. per ton, including delivery, while coke of equal calorific value, and, as it has been shown, of considerably greater value to the user, may be obtained in the required quantities at considerably less cost. Having these figures in mind, and the fact that the normal surplus of coke exported, according to a recent Home Office report, is about two million tons annually, there should be little hesitation in making, not temporary and improvised, but permanent provision to utilise these sources of supply. The surplus normally available on the Thames is probably from 400,000 to 500,000 tons of coke and coke breeze annually.

From the national point of view, which is one of considerable and growing importance, every ton of coke made from sea-borne coal and used in towns and cities in place of rail-borne steam coal will relieve the congestion on our railways to that extent, while the equivalent, in the case of Welsh coal, which is less suitable for carbonisation, would be released for export.

In considering the question of substituting coke for coal fuel in a power station handicapped by being laid out and equipped to use a uniform class of coal only, the problems of storage and capacity of machine stokers and boilers naturally arise. The reserve stocks of coal usually carried by gas authorities are necessarily considerable and, to a coke-user buying under contract, would, of course, be available.

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This consideration should to some extent offset the disadvantage of the relatively greater bulk of coke. At normal rates of combustion, and with equal draught, the steaming capacity of a hand-fired boiler will be reduced by about 15 per cent. to 20 per cent. by substituting coke for coal of similar calorific value (see diagram, fig. 2). There are, of course, ready means of supplementing an inadequate draught, but in the case of stokers of the coking type the problem is more complicated. To start from the beginning, there are obvious bargaining and other advantages to be realised by installing a stoker that will equally well handle coal, coke, coke breeze, and possibly anthracite, and it is a matter for considerable satisfaction that such a stoker has been developed and is now receiving the patronage it deserves in this country. While on this subject it may be profitable to anticipate the trend of the findings of the several committees appointed to deal with the question of fuel conservation and smoke abatement. The national requirements in high-explosive material and other by-products of coal carbonisation will, no doubt, be held to be paramount. The future tendency will therefore probably be to discourage shipment of coking coals, and gradually to limit export to anthracitic non-coking and other coals less suitable for carbonisation. The resulting output of coke will necessitate improved means for its economic combustion under steam boilers, in gas producers and for domestic use.

THE MAGNETIC HAND.

ONE of the lamentable results of the great war will be the return of many thousands of our brave comrades, martyrs to the cause of liberty and progress, crippled for life by the loss of a hand or arm. Obviously it is of the first importance to adopt every possible means to enable these men to resume their customary occupations, by the provision of efficient substitutes for the missing members. With their usual foresight, our enemies are taking steps to cope with this difficult problem, and in a recent issue of the *E.T.Z.* Prof. Klingenberg, one of the leading electrical engineers of Berlin, describes a number of devices which have been developed for that purpose. We reproduce herewith the illustrations which accompany his article. Fig. 1 shows an armlet which can be strapped on the stump of the arm, and is provided at the end with a pot magnet; the latter is

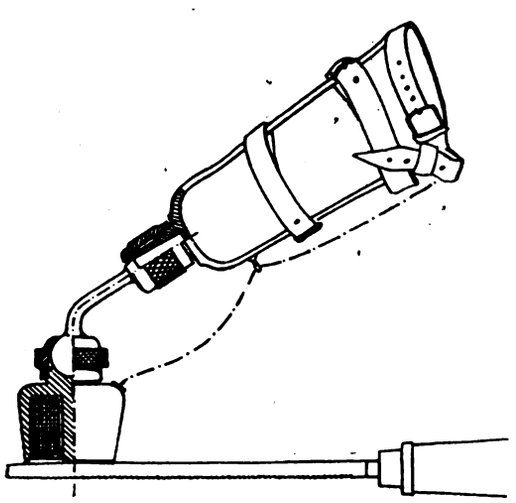

FIG. 1.—MAGNETIC HAND HOLDING FILE.

mounted on a ball and socket joint, so that the magnet poles can be brought into any desired position, and the magnet can then either be clamped firmly or left movable with a moderate degree of friction. The magnet is supplied with current by means of a flexible cord and a plug, the current being switched on and off by the movement of some other part of the body such as the foot, the chin, or the sound arm, or by a particular movement of the injured arm itself. With this device all articles made of iron can be held in a powerful grip for any length of time, and can be lifted and moved about or released, at pleasure. Hence the magnetic hand is suitable for all jobs in which iron tools or iron articles are employed. As a rule, therefore, the tools need not be specially made to suit the requirements of the maimed man. In the example illustrated in fig. 1, the magnetic hand is holding the end of a file, and being movable with regard to the armlet, offers no hindrance to the control of the file with the sound arm.

Fig. 2 shows a plane which is fitted with a small iron plate for the magnet to take hold of, and which is handled exactly like any other plane. Stamping machines working on sheet-iron can be managed as well as with a sound hand, or even better, for the magnetic hand can grip the smooth

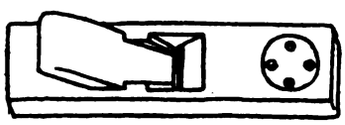

FIG. 2.—PLANE FITTED WITH IRON PLATE.

surface of the sheet. Work can be put into lathes, &c., with the aid of the device while the sound hand makes the adjustments. Tools which are not made of iron can often be easily fitted with iron plates, and switchgear can be manipulated if the levers are so fitted. Magnets of different sizes and tractive forces can be fitted to the same holder.

The plain magnet, as above described, suffices for a variety of simple operations; improvements in the device will readily suggest themselves in particular cases. By means of a switch to fix and release the magnet alternately, the rotation of iron articles can be effected. Special tools can also be devised, such as those illustrated in figs. 3 and 4, which represent tweezers, pincers, and pliers, actuated by electromagnets. The author further states that there is no special difficulty in providing for the movement of the forearm with respect to the upper arm, the gripping action of artificial fingers, and of the thumb, &c., and he concludes by pointing out the exceptional facilities afforded by electric

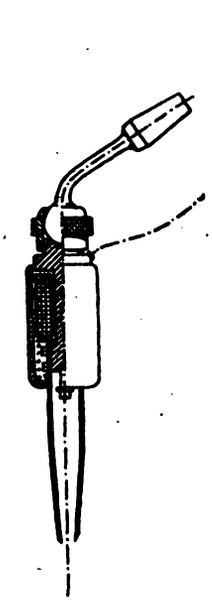

FIG. 3.—MAGNETIC TWEEZERS.

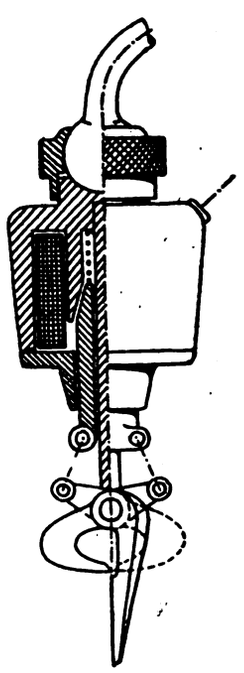

FIG. 4.—MAGNETIC PINCERS OR PLIERS.

power for fulfilling these various functions, as compared with other agencies. The use even of a portable battery to energise the magnet when away from an electrical installation is not overlooked. No stone should be left unturned to aid our crippled workers, and we trust that good results may be obtained from these interesting suggestions.

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THE ELECTRIC PROPULSION OF SHIPS.

IN a paper read before the INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND by Mr. J. DORNAN, the relative efficiencies of different systems of propulsion of ships were discussed. The author stated that turbo-electric systems had been fitted into one ship in this country, four in the United States (including a battleship now building), and one ship in Sweden. Seven steamers were building in Sweden which would be fitted with the Ljungström system of turbo-electric propulsion, aggregating 10,200 H.P. The turbine, however, had not secured a firm hold on the average tonnage of this country, mainly owing to the high turbine speed necessary for economy. He had worked out the data for the equipment of a ship displacing 21,000 tons and running at 19½ knots, on seven systems as follows:—

(A) Two sets of quadruple-expansion steam engines driving twin-screw propellers direct at 85 R.P.M.; saturated steam at 210 lb. pressure per square inch; vacuum in the condensers of 27 in.

(B) One set of turbines arranged in series on four shafts running at 200 R.P.M.; saturated steam at 200 lb. per square inch; vacuum 28 in.

(C) Similar to (A), only steam is superheated 200 deg. F.

(D) As (B), only steam is superheated 100 deg. F.

(E and F) Geared turbines arranged on two shafts. The former has two turbines running at 1,000 R.P.M., and driving twin-screw propellers at 200 R.P.M. through hydraulic gearing of the Föttinger type. The latter has four turbines arranged in series, driving the propeller shafts through Parsons mechanical gearing at 1,800 and 160 R.P.M. respectively. Superheat, (E) 200 deg. F., and (F) 100 deg. F.; working pressure 200 lb. per square inch, and vacuum 28½ in.

(G) Two shafts driven at 85 R.P.M. through Parsons mechanical gearing by electric motors running at 500 R.P.M., and driven from two Ljungström turbo-dynamos which run at 3,000 R.P.M. Vacuum 28½ in., working pressure 200 lb. per square inch, superheat 260 deg. F.

As the rotors revolve in opposite directions, the relative revolutions of the blade disks are 6,000 per minute, and, therefore, only one quarter the number of blade rows are necessary as compared with a single-rotation type turbine of 3,000 R.P.M.

The dynamos and motors are three-phase A.C. for 2,500 volts. The manœuvring is mainly done electrically, speed regulation being obtained by resistances in the motor circuits when manœuvring, and by altering the speed of the turbines when reduced power is required for a lengthened period of time. Reversal is effected by interchanging the poles of the phases.

The figures calculated in the table are based on actual performances of machinery recently built.

By mechanical efficiency is meant the sum of all the mechanical losses between the point where the horse-power developed is measured and the power delivered to the propeller.

The table shows the steam and coal consumptions of the various designs, also weights of machinery and particulars of extra deadweight and cubic capacity.

By primary horse power in line 3 is meant the power which must be put into the prime mover to provide the necessary horse power in line 2. The losses in the mechanical gears of design F have been taken at 2 per cent., and the primary horse power of the turbines is, therefore, 21,800. In addition to the mechanical gear losses as in F, design G has losses due to the dynamos, cables, and motors. These amount to 11½ per cent., including a 2 per cent. loss in the helical gears.

As the turbines used in E and G always rotate in the one direction, no matter whether the propeller is going ahead or astern, and thus eliminate the troubles due to astern turbines, high superheats are used. Design G, having Ljungström turbines, can safely use as high a superheat as 350 deg. F.

The distance run by the ship in nautical miles per ton of fuel burnt is shown in line 12. These figures are very important, and from them the economies in line 13 have been calculated. This is the most just and accurate method of computing economy, for such variables as horse powers, revolutions, and steam consumption per primary horse power are eliminated.

It is difficult to calculate the years for depreciation for each type of prime mover, but it may be safely stated that design G will be an efficient and modern one many years after A is obsolete, as the probability of a new invention increasing the efficiency of G is very much more remote than of one improving A. An attempt to state the years of life is shown in line 23. These figures are extremely important, as the rate of depreciation being decreased from 6⅔ per cent. of A to 4½ per cent. of G means some £3,000 per annum.

Line 25 shows the net annual return on the cost of ship. These figures are the most important in the table. They have been calculated after allowing for the usual deductions from the gross returns, and for the years of depreciation stated in line 23.

It is hoped that the comparisons made will clearly show that by spending 4½ per cent. more money in the first instance, the net annual return may be increased from 7 per cent. in A to 15 per cent. in G.

The selection of a 21,000-H.P. 19½-knot design forms a good point to view the application of the various alternatives to ships having higher or lower powers and revolutions corresponding to the power and speed.

If the lower scale be first considered, machinery types B, D, and E become more and more inadmissible, as the horse-power and revolutions decrease, on the grounds of extravagance in steam consumption, of excessive weight, and abnormal dimensions. Types A and C are applicable to the lowest of powers and revolutions. The steam consumptions of these types, considered alone, favourably compare with some of the other designs, and it is the excessive weight that places the piston-type machinery at a disadvantage.

Types F and G are applicable to the lowest powers, with the stated degree of economy maintained and very often improved.

Taking now powers and corresponding revolutions, higher than in the case examined, types A and C fall out of the running very quickly, as the weight of machinery and necessary space become too great.

The remaining designs are all applicable to high powers with even better results than given in the table. Type F would, however, require to have four shafts with eight or more turbines for higher powers, on account of the dimen-

Reference letter	A	B	C	D	E	F	G
Design.	Quadruple engines.	Direct turbines.	Quadruple engines.	Direct turbines.	Hydraulic gears.	Mechanical gears.	Turbo-electric gears.
1. No. of shafts	2	4	2	4	2	2	2
2. I.H.P. or S.H.P.	21,650	21,800	21,650	21,800	21,300	21,350	20,000
3. Primary H.P.	21,650	21,800	21,650	21,800	23,450	21,800	22,600
4. R.P.M.—Propellers	85	290	85	290	200	160	85
5. ,, Turbines	—	290	—	290	1,000	1,800	3,000
6. Superheat, Fah.	Nil	Nil	200°	100°	200°	100°	260°
7. Vacuum, inches	27	28	27	28	28½	28½	28½
8. Steam per hour, total pounds	318,000	302,000	261 000	276,000	246,050	255,200	196,240
9. Equivalent coal per hour, lb.	31.800	30,200	27,200	28,200	25,700	26 600	20,650
10. Coal used per H.P.-hour, lb.	1·47	1·385	1·257	1·292	1·205	1·218	1·032
11. B.TH.U. per H.P.-hour	20 600	19,400	17,600	18,100	16 900	17 050	14,500
12. Distance run in nautical miles per ton of coal	1·355	1·426	1·585	1·53	1·68	1·67	2·09
13. Economy over A, per cent.	—	5	14½	11½	19	18	35
14. Coal per day, tons	341	324	292	302	276	279	222
15. Weight of machinery plus bunker coal, tons ...	6,403	5 557	5,946	5,316	4,653	4,837	4,086
16. Gain in deadweight, tons	- -	846	457	1,087	1,750	1,566	2,317
17. Cubic capacity gained, feet	—	18 100	21,200	24,250	64,900	56,970	80,600
18. Value of coal saved	—	£2.550	£7,350	£5 850	£9 750	£9,300	£17 850
19. Value of extra deadweight carried	—	14,213	7,678	18 261	29,400	26,308	38,925
20. Total saving per annum	—	£16,763	£15,028	£24,111	£39,150	£35,608	£56,775
21. Cost of ship	£650.000	£650,000	£668,500	£670 500	£673 000	£672 000	£678,000
22. Brake efficiency	0·70	0·68	0·74	0·70	0·76	0·71	0·87
23. Probable years to render machinery obsolete ...	15	16	17½	17	18½	18	22
24. No. of boiler furnaces	64	64	60	60	56	56	44
25. Net annual return on cost, per cent.	7	9½	9	10	12¼	11¼	15

Assumptions made:—Ship at sea 150 days per annum—*i.e.*, 24 voyages. Average cost of coal = 20s. a ton.
One ton deadweight worth 14s.

D

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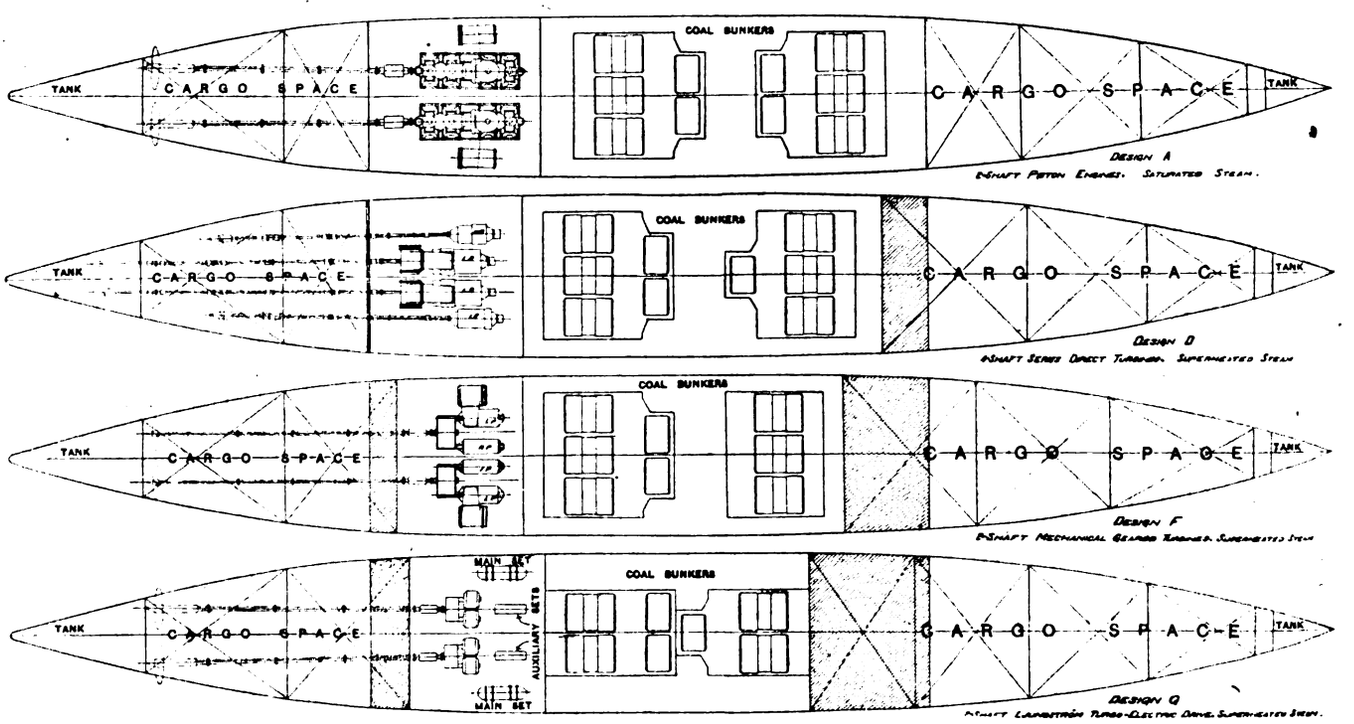
sions of the gearing, and is, therefore, at a disadvantage over E or G.

With a view to securing further economy in turbine-driven ships, it is recommended to increase the propeller revolutions, so as to produce machinery which will be small and light, and also decrease the steam consumption, so that a larger number of nautical miles may be run per ton of fuel than in ships having slower-running propellers. The machinery would also decrease in first cost, not per unit of weight, which would, of course, increase, but per unit of power, which is the more important factor. The decrease in fuel used, and the decreased capital cost of the ship in conjunction with the increase in cargo capacity, will result in a commercial success satisfactory to all concerned.

DISCUSSION.

Mr. P. A. HILLHOUSE said that the centre of gravity of vessel G with Ljungström turbines would be about 3¼ ft. higher than design A with reciprocating engines, which would probably necessitate an increase in breadth, or a reduction in the displacement, even if the Ljungström turbine had the same height of centre of gravity as the reciprocating machinery. Mr. Dornan showed the increases of deadweight, as compared with the ship having reciprocating machinery, and he also showed the increases of cubic capacity. In the Ljungström turbine ship it would not be possible to utilise all the increase in deadweight, owing to want of stowage space, and probably some compromise would have to be adopted.

Mr. W. D. MCLAREN compared the turbo-electric gear G with the mechanical gear F, and pointed out that, in the electrical system, design G, yielded the maximum ratio between speed of prime mover and propeller shaft. The Ljungström turbine, owing to its highly ingenious construction, was designed for a maximum obtainable superheat, and the resultant economy stated in Mr. Dornan's paper was by no means a speculative one. The Swedish boat *Mjölner*, of 850 S.H.P., with Ljungström electric-turbo drive, had been running since December, 1914, between Stockholm and Gothenburg, and her performance compared well with her sister ship, *Mimer*, running on the same route, and fitted with triple-expansion reciprocating engines. With similar coal of 13,500 B.TH.U., the electrical ship's daily consumption in 24 hours was 9 tons when developing the equivalent to 940 I.H.P., as compared with the consumption of the *Mimer* of 15 tons under the same conditions of power, speed, weather, and displacement, showing a saving of 40 per cent. The coal consumption reduced to I.H.P. in each case was .89 lb. for all purposes in the electrically-driven ship, and 1.52 lb. in the ship with reciprocating engines. The steam conditions in the *Mjölner* were:—Pressure 200 lb., superheat 190 deg. F., and vacuum 29 in.; in the *Mimer*, saturated steam, pressure 180 lb., and vacuum 26 in. (barometer 30 in.). An aggregate of 10,000 H.P. was now in course of construction in Sweden for five additional electrically-propelled vessels, based on the performance of the *Mjölner*, and approximately 200,000 H.P. in Ljungström turbines was either running or in course of completion for land work. It might be interesting to state the results of a 5,000-KW. Ljungström turbo-alternator, which would shortly be running in one of the London power stations. At 40 per cent. of normal full load, the consumption was 8.1 lb. per B.H.P. per hour; at full load the consumption was 7.34 lb. per B.H.P. per hour, in each case for turbine only. The



SHIP PLANS SHOWING THE INCREASED CARGO SPACE (SHADED) AVAILABLE.

former, the revolutions were chosen at 85 per minute, and in the latter 160 per minute. The net result of this change was that he got improved propeller efficiency, and so saved 1,350 H.P. The steam consumption per H.P.-hour of the main engines was only 7.4 lb.; from the data supplied, this necessitated a turbine efficiency based on the Rankine cycle of 83 per cent. He was aware that the Ljungström turbine showed a higher efficiency than any other which had yet been constructed, but he would be somewhat chary in placing it at this figure for continuous service conditions. Using the same propellers in F and G, and assessing the turbines of G at about 10 per cent. higher efficiency than in F, the overall efficiency of G would not be greater than the overall efficiency of F. If such were the case, all the other considerations would be levelled down. He was aware of the difficulties of admitting superheated steam to an astern turbine which might have been working at a comparatively low temperature, but there were ways of overcoming these difficulties, such as adopting astern turbines of the impulse type. It would be noted that the greater proportion of the saving effected by each type of machinery, as compared with design A, was due to the extra deadweight that Mr. Dornan estimated could be carried; even though the difficulties mentioned by Mr. Hillhouse were in some manner overcome, it did not follow that the cargo accommodation would be fully utilised every voyage.

Mr. H. S. PORTHAM said that design A, he understood, represented actual figures, and design B represented the trial figures of one of the most recent turbo direct-driven Atlantic liners. The performances of the other designs appeared to him to be based on sound and well-established data. The turbine ran at 3,000 revolutions per minute, corresponding to a relative rotation of 6,000 revolutions per minute. The thermal efficiency of the turbine at normal full load, including condenser, worked out at the excellent figure of 79 per cent. The efficiency of the alternator at full load was over 96 per cent., which included exciting and ventilating losses. These results were in close agreement with Mr. Dornan's predetermined figures. Given such a cheap source of electric power as the above, in addition to the ordinary condensing auxiliaries, considerable advantage would be gained by running refrigerating and ventilating plants, sanitary pumps, steering engine, and electric lighting, electrically from the main generating sets, through an intermediate motor-generator. He felt confident that a saving would be effected in the galley and electric ovens. One of the 600-KW. exciting auxiliary sets would drive the auxiliaries and electrical winches in port, and would be a stand-by at sea. Should one of the main generating sets break down, the ship could proceed to port at about 15 knots on one set alone, with unimpaired efficiency, and with equal power on both propellers.

Mr. R. T. C. BLACK pointed out that when a rapid reversal was made a very large amount of energy was transmitted to the shafting, and if any perceptible braking effect was to take place, it must be in the turbine casing. Some indication of the probable limit in the size of the Ljungström turbine for a speed of 3,000 R.P.M. would be of great interest; the largest turbine of the type of which details were available had an output of 5,000 KW. at 3,000 R.P.M. It was understood that this output approached the limit for this speed. Referring to the electrical equipment of vessel G, the motors

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appeared to have 12 poles, which seemed to be as large a number as was consistent with a reasonable power factor. Quite a number of inventors had proposed schemes having ratios of reduction between the generator and motor of the order of 20 or 30, necessitating 40 to 60 poles on the motor. No figures of probable power factors had ever been given, though, from the weights stated, very hopeful views were taken. He took it that the designers of the Ljungström arrangement found that geared motors, including the gearing, were lighter and more satisfactory than large slow-speed motors. Mr. Dornan stated that speed regulation while manœuvring was effected by resistances in the motor circuits. These resistances, capable of handling 22,000 H.P. at 2,500 volts, must be of rather formidable dimensions. There did not seem to be any reason why this speed regulation should not be effected by varying the alternator voltage. The power of an induction motor varied as the square of the applied voltage, which should agree fairly well with the power-speed curve of the ship.

HIGH STEAM PRESSURES.

In a paper presented at a recent meeting of the American Society of Mechanical Engineers (and reprinted in our contemporary *Power*), Mr. Robert Cramer discussed the possibilities of using higher steam pressures in power plants, showing by means of tables and curves the relative gain in thermal efficiency by so doing; the following is an abstract of his remarks:—

In steam engineering practice the tendency to increase the range of the working fluid has led to the recognition of well defined limits: A maximum steam temperature of about 600 deg. F., above which lubrication of piston engines and maintenance of valves and packings are difficult, and a minimum condenser temperature of about 80 deg. F. corresponding to 29 in. of vacuum, or ½ lb. back pressure. This temperature is so near the usual cooling water temperature that a higher vacuum would require disproportionately large quantities of circulating water. The necessary size of the circulating pump and increase in size of the air pump render higher degrees of vacuum unprofitable.

If, taking these limits, all heat were transferred to the steam at 600 deg. F., or 600 + 460 = 1,060 deg. abs., and all heat were rejected at 80 deg. F., or 80 + 460 = 540 deg. abs., the Carnot cycle would be realised and the efficiency of the engine would be (1,060 − 540)/1,060 = 0.491. Thus nearly one-half of the heat transferred to the steam would be transformed into mechanical energy.

While the condition of the rejection of all heat at the lower temperature can be closely attained, it is impossible to cause the steam to absorb all heat at the higher temperature.

In the best present practice, except for slightly higher pressures in some few isolated cases, the maximum steam pressure is 200 lb. per sq. in. absolute, and the superheat is 200 deg. F. The corresponding temperature of evaporation is 382 deg. F. and the bulk of the heat is absorbed at a temperature of 200 deg. F. below the maximum. It seems reasonable to expect that the approximation to the ideal Carnot cycle, and simultaneously the economy, would be improved by using higher pressure and less superheat; that is, by increasing the temperature at which the bulk of the heat is absorbed without increasing the maximum temperature.

Even a casual reference to steam tables and diagrams confirms this expectation and reveals the remarkable fact that the higher the steam pressure the less the total heat in the steam if the final temperature be kept constant, and correspondingly the superheat is reduced with advancing pressures. This difference, while not great, is decidedly noticeable, as Table I shows (the values throughout are taken from the Marks and Davis steam tables).

TABLE I.—Total Heat of Steam at Various Pressures.

	Temperature of steam, 600 F.						
Steam pressure, lb. per sq in.	100	200	300	400	500	600	1,571
Temperature of evaporation, deg. F. ...	328	382	417	445	467	487	600
Superheat, deg. F. ...	272	218	183	155	133	113	0
Total heat, B.TH.U. per lb.	1323·3	1317·6	1310·7	1305·6	1301·8	1298·8	1176·0

An examination of the Mollier total-heat entropy diagram shows that the amount of heat convertible into mechanical energy in adiabatic expansion to any given back-pressure is considerably higher for high pressure and little superheat than for low pressure and much superheat, if the maximum temperature of the steam is the same in both cases.

We have thus two cases making for better thermal efficiency with increasing steam pressure at constant maximum temperature—the decreasing total heat of the steam and the increasing amount of that part of the heat convertible to mechanical energy in adiabatic expansion.

A number of tables, compiled by the author, are included to show what gains can be expected with increased pressures and varying conditions; of these, Tables II and III are a summary showing the theoretical percentage of gain for certain comparisons selected on account of their relation to conditions prevailing in present practice; in the case of atmospheric exhaust these gains are so large as to justify an endeavour to use high steam pressures.

TABLE II.—Relative Gain in Thermal Efficiency due to Increasing Steam Pressure to 600 lb. per sq. in. abs.

Final condition of steam	29-in. vacuum.		Atmospheric exhaust.	
Initial condition of steam	Constant temperature, 600° F.	Constant superheat, 100° F.	Constant temperature, 600° F.	Constant superheat, 100° F.
As against 100 lb. initial pressure...	25 %	30 %	52 %	85 %
As against 200 lb. initial pressure...	13 %	15½ %	32 %	37½ %

TABLE III.—Relative Gain in Thermal Efficiency due to Increasing Steam Pressure to 1,574 lb. abs.

Final condition of steam	29-in. vacuum.	Atmospheric exhaust.
As against 100 lb. initial pressure, 100° superheat	44½ %	187 %
As against 200 lb. initial pressure, 218° superheat	22½ %	105 %

The ideal Rankine cycle cannot be realised in practice. In steam turbines, steam expansion cannot be effected without friction losses, which are converted into heat, and to that extent make the expansion deviate from the adiabatic. It is also impossible to extract fully the mechanical energy manifested in steam velocity, the residual velocity representing a loss.

In piston engines of the double-flow type there are large losses due to initial condensation and heat transfer; in the uniflow piston engine such losses can be almost avoided by suitable design, but it is impossible to carry the expansion down to condenser pressure, because the compression, commencing at the point of the stroke where expansion ends, would be a reversal of the expansion, and no work would be done in the cylinder.

These sources of loss—friction in the turbine, condensation in the double-flow piston engine, and incomplete expansion in the uniflow engine—determine the practical limits of possibility of realising the Rankine cycle. In large steam turbines, the Rankine cycle efficiency has been carried to about 76 per cent., and a very similar efficiency has been realised in uniflow engines, even in small sizes. In the steam turbine, higher steam pressures will mean either higher velocities or more stages, both introducing higher friction losses, although it is to be expected that by careful design the percentage of these friction losses as compared with the total amount of energy available in adiabatic expansion can be kept the same as in present practice.

Present Boiler Design and High Pressure.—The foregoing seems to justify the employment of higher steam pressures. Standard boiler designs, however, do not permit the production of steam at a pressure higher than about 200 lb. without sacrificing safety and without calling for an investment in the boiler plant high enough to offset the gain in economy caused by higher steam pressures.

The solution of the problem of boiler safety under high steam pressures demands two fundamental changes in boiler design.

The boiler must be constructed entirely of tubes of relatively small diameter. All drums and vessels of large diameter, as well as all flat surfaces (even if stayed), must be abandoned.

Expanded beaded or riveted joints exposed to the action of the fire must be avoided. That part of the boiler which receives the heat of the furnace must be practically a one-piece structure.

It is important that in meeting these requirements the essential characteristic of water circulation in the boiler be retained to make possible a control of the steam pressure and of the water content of the boiler by simple means. Flash boilers, while permitting high steam pressures, are not desirable, because they require complicated automatic regulating devices, necessary on account of the interdependence of feed and fire control.

In considering boilers for high steam pressures, it must not be overlooked that the water in the boiler is at a higher temperature than that in a low-pressure boiler. This difference amounts to approximately 100 deg. for 600 lb. pressure, as compared with 200 lb. Even if the heating surface is made large, or, in other words, the evaporation per square foot is kept low, the stack gases will leave the high-pressure boiler at a temperature 100 deg. higher than the corresponding gases of the low-pressure boiler. The boiler efficiency, other things being equal, is correspondingly reduced.

It is possible to meet this difficulty by making the heating surface of high-pressure boilers larger in proportion to what is practised in boilers working under pressures used to-day. It is also possible to increase the effectiveness of the heating

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surface by proper design. Boiler designers are realising the possibilities in this direction, even with steam pressures not higher than 200 lb. This is demonstrated by modern boilers which show an evaporation per square foot of heating surface twice as high as was customary only a few years ago, at the same time realising a better efficiency than formerly.

The possibilities of extraneous heat-saving devices should not be overlooked. Even though the waste gases leaving the boiler have a temperature of 700 deg. or more, a properly installed economiser will reduce this temperature to any desired degree within the limits given by the temperature of the feed water.

The question of strength of constructional parts outside of the boiler to withstand high steam pressures is of importance. In reciprocating engines this question can be answered from practice, because pressures far exceeding 600 lb. per sq. in. are used successfully in gas engines and Diesel engines, and therefore the design of cylinders for high steam pressures should not present difficulties not already overcome.

Extra-heavy High-pressure Casings for Turbines.—In steam turbines, especially in those of larger size, the casings of large diameter would need to have disproportionately heavy walls were they required to withstand pressures much higher than those now employed. The solution of the problem of adapting turbines to high pressures is found in the principle underlying most present designs of large steam-turbine units. According to this principle, the pressure of the steam is greatly reduced in the first nozzle and the resulting high velocity is utilised in several rows of blades of the velocity-stage type. Thus it is possible to confine high pressures to the steam piping and to the "steam belt" carrying the steam to the first nozzles, but to have comparatively low pressure even in the first part of the casing. The lesser efficiency of the velocity staging is not so serious at the high-pressure end as it would be at the low-pressure end, because the loss manifests itself in a somewhat higher superheat of the steam entering the succeeding stages and is partly recovered.

With high pressures the difficulties with piping and fittings are reduced on account of the lower specific volume of the steam. Even if lower rates of flow than those at present customary are permitted in high-pressure steam lines (on account of the greater density of the steam), the fact that 1 lb. of steam at 600 lb. pressure occupies approximately one-third of the space required by 1 lb. at 200 lb., reduces the required size of the piping and fittings to such an extent that difficulties in both design and cost for a given capacity are, if anything, less than for lower pressures.

Single-acting Steam Engine.—In piston engines the question of cylinder lubrication is important. It is apparent that high steam pressures will permit neither slide nor Corliss valves. The advent of higher pressure will cause the poppet valve to come into its own.

Most of the lubricating oil now used in piston engines is required for the steam-distributing valves.

For a given output the cost of a uniflow engine suitable for high steam pressures should be less than that of double-flow engines, as soon as it can be manufactured under economical conditions of manufacture. Such an engine, if single-acting, has but one simple organ of steam distribution, and on account of its high mean effective pressure its weight per horse-power is low. Even in a single-acting engine of this type the mechanism is utilised twice as efficiently as in a 4-stroke cycle Diesel engine.

Steam turbines for high steam pressures would probably cost a little more than those using lower pressures and giving the same power, on account of the extra stages required. The extra cost would be offset by a considerable saving in the required condenser cooling surface on account of the larger percentage of moisture in the steam entering the condenser and the reduced steam consumption due to better thermal efficiency. Table IV will make this clear.

TABLE IV.—Reduced Steam Consumption due to Better Thermal Efficiency.

Initial condition of steam.	200 lb. 600 F.	600 lb. 600 F.
Ideal efficiency with 29-in. vacuum	0·329	0·373
Percentage of steam in exhaust	0·814	0·749

Ratio of condenser cooling surface = 0·329 × 0·749/0·373 × 0·814 = 0·812. Thus, a saving of about 19 per cent. of the condenser cooling surface might be expected.

The question of stuffing-boxes can be eliminated in both turbines and piston engines—in turbines because high steam pressures need not be carried beyond the first nozzle, and in piston engines because the single-acting type of engine is from many points of view the logical design for high pressures. In such a piston engine the stem of the one valve can be provided with a "labyrinth" packing.

Auxiliaries.—In very large plants all auxiliaries are often driven by electric power, and the current is furnished by a separate unit. As these "house-service units" in modern power plants have capacities of 2,000 KW. and over, it is simple to operate them directly with high-pressure steam.

Where it is desired that the auxiliaries be driven independently, it should be possible to drive them with high-pressure steam turbines if the size of the auxiliary unit warrants this, or by high-pressure uniflow engines for the smaller sizes. In the latter case the lubrication could possibly be accomplished with graphite only, so that the amount of lubricant introduced into the condenser would be insignificant and harmless.

Another way would be the noncondensing operation of the uniflow engines, using the heat of their exhaust in a feed-water heater. This manner of operation appears to be attractive, because the economy of noncondensing uniflow engines, as compared with noncondensing engines of other types, is high.

It seems clear that if steam pressures are increased to, say, 600 lb. per sq. in. without using temperatures higher than those employed in modern practice, the difficulties encountered by the designer are not formidable and are more easily met than in the case of some types of explosion engines which have been successfully designed. The result to be attained by adopting such high steam pressures appears to be fully worth the effort, because thermal efficiencies closely approaching those of explosion engines can be realised with simpler and less expensive apparatus and consequently better overall economy, at the same time retaining all the practical advantages which steam utilisation has over any other method of producing power.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Limitation of Output.

From all the discussions upon the new trade campaign, which is being so insistently urged at this time, one feature emerges each and every time. So much stress has been laid upon the necessity of the trade unions abolishing the supposed limitation of output, that one is constrained to look at this point in detail, so as to establish the fact beyond cavil, or to show that it may be merely a glib statement which is being produced as a dummy on the stage of argument. It is surely insufficient to lay to the charge of the trade unions that they are deliberately guilty of keeping down the output of their members in the workshops, or that they have done so in the past. After all, there are trade unions in enemy countries, and if there is limitation of output here, one may inquire whether enemy trade unions are faultless. Perhaps the docile Hun would blush to turn out anything less than his full working capacity. Maybe he has more encouragement to do his full share than his British counterpart. Few will dispute that much suspicion and mutual distrust exists between masters and men in this country. One of the causes of this is the feeling that employers never lose an opportunity of lowering prices. The usual piecework or bonus system of payment is too often unfair to one party or the other. Again, there may be in the same shop piecework on one job, and day work on another. For instance, in a locomotive boiler shop the boilers are made on piecework, but it is not possible to fix piece rates for the men who test the finished boilers, because of the great variation in results. One boiler will only take hours to test, where another occupies days. One set of men are drawing bonus regularly, while others maintain only the bare weekly rate. In other cases a piece-rate is easily fixed, but is often whittled away by the employer until only the best worker makes any extra money, and he not much. On ordinary day work the best man draws the same reward as the inferior or more careless worker. It is common knowledge in factories where only semi-skilled workers are employed that the piecework rates are such as to afford the man or woman only a bare existence. Especially so is this the case where girls and women are concerned. The worker has no voice in the matter, except to take it or leave it, and the rates are usually left to the mercies of the time-office or some zealous reformer with an eye on the wage packets.

In the high-speed tool trade the writer has seen night men do their "whack," which is the equivalent of the slowest day worker, and still have plenty of time to spare. The rate paid was the usual trade rate per hour, and the quantity of work was the same for the same money. The trade unions are blamed for such a possibility, but no mention is made of the precise course to be adopted for alterations. The trade rate paid in a district is supposed to be the minimum: in how many cases is it also the maximum, and why should it be so? Output will never be increased while the poor or slow worker's minimum is also the good worker's maximum. The employer is asking for more work in the same time. The worker demands more money. Already since the war began certain semi-skilled and unskilled workers, many thousands in number, have been granted a minimum wage for all over 19 years, plus a war bonus. New demands are now in arbitration varying from 4s. to 6s. per week for the same people. Whether the wages already in vogue are adequate or not is not a matter for present discussion. The facts are simply mentioned to show the present trend. Both employer and worker are out to make the best of the present situation; the one to demand more work as an aid to beat the German, the other to boost up his standard wage for the uncertain future. One can only hope that each may be satisfied. In passing, however, it may be pointed out that the prices of our rivals' goods, if and when they do once more appear in the markets of the world,

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will have some influence upon the wages of the British worker, and this should not be forgotten. It would seem better to give a fair wage and see that it is earned, than either to treat all alike on a dead level, or swindle the worker by offering an illusory, and ever-changing, bonus system, under which only the pick of the workers can make extra money.

Restriction of output may be the child of bad times. It is feasible that a man may pardonably not rush his work when he hardly knows whence the next job will come. This has often of old been the case in British factories. No system of protection can guarantee a full order book, but, at the same time, we have too often seen German and other foreign goods on our markets when our own workers have been idle. Restriction of output may, then, even be good; the output of enemy works which flows into our Empire's markets and our home ports. British mechanics will make more money constructing a complete machine than in assembling one made in America. The C.M.A. will have more dividends if they make both the tubing and the cable, instead of making the conduit at home alone, and allowing German cable to be drawn into it. The Minister of Munitions, likewise, will not long complain of his own countrymen "going slow" when once he and his brethren take the plunge and restrict once for all the output of the Central Empires.

Commercial.

Electrolytic Copper.

All engineers will be indebted to Mr. Thos. Bolton, who is an authority on this subject, for his contribution in your issue of December 24th towards finding a generally acceptable definition of hard-drawn copper of circular section, and I feel sure that his views will be fully considered before the Engineering Standards Committee completes its revision of the present standard, which was issued in March, 1910. I fully share his hope that the Director of the National Physical Laboratory will be able to carry out the suggested investigations before any final decision is taken by the E.S.C.

Mr. Bolton is a manufacturer, and approaches the consideration of this subject from a somewhat different point of view to myself. My Manchester address was prepared chiefly from the point of view of the user of hard-drawn copper wire, who has been looking in vain for many years for guidance from the E.S.C., the I.E.E., or the manufacturers, towards a satisfactory definition. Failing this, a considerable advance towards a complete definition has been suggested by Mr. D. R. Pye, and my experience is that an increasing number of engineers are using his formulæ to ascertain what are the MINIMUM values of tensile strength and extension for any particular size of wire. Each formula provides a sort of datum line in each test, and the 4 per cent given in the E.S.C. report provides a maximum extension limit while omitting all guidance about tensile strength.

One cannot help feeling that Mr. Bolton does not fully realise the convenience to the purchaser of hard-drawn wire, who is not an expert, of being able to obtain these MINIMUM [illegible] Pye's formulæ, and of thus having a check on the manufacturers, not only for all standard sizes of wires, but also for the many intermediate sizes which are constantly being used, and of being reasonably sure that, if these figures are attained, he will obtain wire which is free from brittleness.

I have referred to Mr. F. Johnson's contribution to the discussion on Mr. Pye's paper, and I am interested to find that, while he agrees with the view that the strength of wire does not lie in its skin, he also agrees with the practicability of Mr. Pye's formulæ.

With regard to the proposed inclusion of the limit of proportionality in the definition, it is my opinion that this point on the load-extension curve is of more importance than the elastic limit, and for a fuller discussion of this matter, which is not an academic one, I would refer those who are interested to the leading article in the *Engineer* of October 8th, 1915. It is the limit of proportionality which is really of importance to the users of hard-drawn copper wire, as it is the point where the elastic extension ceases to be directly proportional to the load, and where no question of permanent set is involved. My basis figures for the values quoted were taken from the E.S.C. Report No. 55 for wires up to 0.194 in. diameter, and I was surprised to find how low some of them are. They are lower than the elastic limit values which are given by some makers, and which are, in my opinion, misleading, although not intentionally so. The position is unsatisfactory, and I think Mr. Bolton will agree that the uncertainties should be cleared up. The E.S.C. values were based on tests made with great care by the N.P.L., and we must accept these results unless we can show an error in the method or later improvements in the material, or in its method of manufacture. Further tests of the same authoritative kind by the N.P.L. are now needed on wires from No. 5 S.W.G. to 7/0 S.W.G., which have not been specially manufactured for the purpose of the tests.

Under ordinary works conditions, autographic records can be taken, when required, while samples are being tested for tensile strength, and from these the limit of proportionality can be determined with sufficient accuracy for most purposes.

We get on to controversial ground when we discuss wrap and torsion tests in preference to extension tests as a test of brittleness. There is a considerable weight of opinion against the former. The report of the Wire Committee of the American Society of Testing Materials may be quoted against them, and also the fact that American engineers have discarded them, and now use extension tests. With proper apparatus, an approximately accurate extension test need not be a lengthy one, and, further, it is not essential that every coil of wire should be tested nowadays, whatever may have been needed at the time the G.P.O. engineers first adopted their wrap and twist tests.

In conclusion, in adding my own thanks to Mr. Bolton, I would hazard the opinion that he has in mind already a definition of hard-drawn copper which would completely satisfy him. Perhaps, at this stage, it would not be desirable to discuss it in the technical Press, but if the I.E.E. would take the whole matter in hand, as I have suggested, there need be no great difficulty in getting a small committee, representing the I.E.E., the N.P.L., the manufacturers, and the users, to agree on a definition and then to send a joint recommendation to the E.S.C. A little extension of the work would also produce a standard specification.

B. Welbourn.

Rainhill, Lancs., *January 4th*, 1916.

WAR ITEMS.

After the War Trade.—In the House of Commons on Monday there was another discussion on after the war questions, and we think that it must be unhesitatingly described as the best of the three Parliamentary debates that have so far taken place on such matters. The discussion was opened by Mr. Hewins, who moved that, with a view to increasing the power of the Allies in the prosecution of the war, His Majesty's Government should enter into immediate consultation with the Governments of the Dominions, in order with their aid to bring the whole economic strength of the Empire into co-operation with our Allies in a policy directed against the enemy. Other speakers in the debate were Mr. Peto, Sir A. Mond, Mr. Shirley Benn, Mr. Prothero, Mr. Chaplin, Mr. Mackinder, Sir G. Croyden Marks, Mr. Bryce, and, finally, Mr. Runciman. In the course of the speeches reference was made to the commercial position after the war, the economic resources of the British Empire, German organisation and system, the possibility of the rapid restoration of German scientific competition, the prospect of the United States becoming a dangerous competitor, and very many other points that have been covered in articles that have appeared in our own and other journals during the last eighteen months. Mr. Runciman's reply showed that he regarded the discussion as an important one. Had he regarded it as a merely academic one he would have asked leave of the House to be attending to practical business elsewhere. Any decision which the House or Government came to with regard to trade matters at the present time had a direct bearing either on the strength of this country or on the strength of the enemy. He believed that Germany was at last beginning to feel the effects of the blockade. So far as treaties with Austria and Germany were concerned they were non-existent, having come to an end with the outbreak of war. History could not go on, after the war, from exactly the same point. In regard to tariff arrangements between Germany and Russia, the latter would be more likely than in the past to listen in the most friendly spirit to the representations that we might make in regard to future arrangements. How far she would be prepared to go no-one could say. No Russian statesman could yet say exactly the lines on which her economic development was likely to proceed. He was confident, however, that she was not going to make herself the tool of Germany. "Peaceful penetration" would not be allowed to continue in Russia. We should be able to make up our vast losses in a shorter period of time than any other State, and it would be our duty, so far as we could, to aid Italy, France, and Russia in the same process. Mr. Runciman proceeded to justify the efforts made to capture German trade. Many of our firms had built up, during the war, strong connections in South America which he hoped would last long after the war. They had studied their customers' tastes with greater ingenuity than ever in times of peace, and they had made almost unprecedented efforts in commercial travelling. The President went on to refer to efforts made by our manufacturers to take up industries once in German hands—glass, chemicals, dyes, electrical apparatus, etc. It was more than a mere matter of competition with Germany. It ought to be part of our national organisation to see that there was no essential article, either for the arts of peace or for the arts of war, which could not be obtained within the Empire. Government assistance might do a great deal, but not without the personal ability, training, skill and industry of the individual. He laid it down as one of the first necessities of this country that if she was to hold her own during times of war, and when war was over, we must improve our research methods, the education of our people, and the training of our young men. We should not attempt to economise on the money that we now spent on technical colleges and modern appliances. If our present well-managed banking systems could not be

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more adventurous we must have some additional institutions. Commercial banking must play a large part if we were to hold our own against Germany. We must once more overhaul our patent system. The development of new inventions, and the restrictions which we put on their use, may have a greater influence on the extension of our trade and industry than even the juggling of a tariff. The importance of co-operation with the Dominions, the spirit of the Dominions, and the question of foreign shipping competition, were among the other matters referred to by Mr. Runciman in the course of a long speech which is well worth reading from beginning to end by all of our readers who are keenly studying the problems of the present hour. Now, repeated the speaker, Germany was a commercially beaten nation if there ever was such. But the real trouble was, when the war was at an end, she might wish to embark upon a new campaign. In this connection it would be necessary for us in making peace to see to it that she did not raise her head.

Russian Trade.—Speaking on the Russian electrical trade opening, at a meeting of the French Syndicat des Industries Electriques held at the end of last year, M. de Halgouet, commercial attaché at the French Embassy at Petrograd, stated that before the war the Russian electrical industry had become a veritable German monopoly. Three great companies, German in origin, divided the business between themselves. These were the Volta Company, of little importance; the A.E.G., operating at Riga; and the Siemens-Schuckert companies, which were formerly distinct, but were now amalgamated. Owing to this important trust, the Germans had succeeded in securing all the orders. The *modus operandi* of these houses was as follows:—First, they granted long terms of payment; then they had agents, who waited on the Russian manufacturers, studied their wants, and submitted estimates for the carrying out of installations complete to the smallest detail. Furthermore, the Germans had a wonderful acquaintance with the Customs tariffs. In Russian workshops which they opened, they made all those parts which it would cost too much to import; thanks to these measures, it might be said that, in 1913, the Germans monopolised three-fourths of the Russian electrical trade. Of the three German houses, the two principal—the Siemens-Schuckert and the A.E.G.—were constituted with capitals of 15 and 12 million roubles respectively; together they did, in the year 1913, business to the extent of 130 million of francs, of which 40 million only represented goods made locally, and 90 millions were imports by these German houses working under a Russian label. These houses are still operating; moreover, if they were stopped, the whole Russian electrical industry would be stopped too, and as this industry is indispensable for the National Defence, it is impossible to do so. One could, on the other hand, call for the liquidation of these companies if a French group could subscribe the necessary capital, and replace by French importations the German importations made by these companies. To do so, a capital of 50 million roubles would have to be got together, and a similar machine-tool equipment and skilled staff as that possessed by the Germans would have to be forwarded to Russia. . . . . If however, the liquidation of the A.E.G. only were called for, a capital of only 10 million roubles would be required.

In subsequent observations relating to the fostering of French exports to Russia he advocated, as a preventative against bad debts, representation on the boards of Russian electrical concerns, and reaffirmed his statements that the best methods of developing exports towards Russia was to establish on the spot technical bureaux identical with those possessed by the Germans. Russians preferred comprehensive and complete estimates, and, only after their study, were orders placed. The technical bureaux mentioned should have branches, and the most competent agents, in every industrial district. An electrical section might also be attached to the Sales Office which the French Foreign Trade Bureau was about to open, while the Syndicat's affiliation to the French Chamber of Commerce in Petrograd was also advisable in this connection.

To Platinum Dealers.—The Director of Materials at the Ministry of Munitions has addressed the following notice to dealers in platinum:—

"I am directed by the Minister of Munitions to inform you that, in exercise of the powers conferred on him by the Articles of Commerce (Returns, &c.) Act, 1914, pursuant to arrangements made with the Board of Trade, he hereby requires you within three days from the date of this notice to make a return to the Director of Materials of the Ministry of Munitions, Armament Buildings, Whitehall Place, S.W., of the whole of the stock of platinum, ores, residues, or bars containing the same, now on your premises or under your control.

I am at the same time to draw your attention to Defence of the Realm Regulation 30A, and to the Order made by the Minister of Munitions thereunder, and I am to observe that any person buying, selling, or dealing in platinum, or goods manufactured wholly or partly of platinum, offering or inviting an offer or proposing to buy, sell, or deal in it or them, or entering into negotiations for the sale or purchase of or other dealing in it or them, without a permit, is liable to the penalties provided for offences against the Defence of the Realm Regulations.

Birmingham Electrical Volunteers.—We read in the "Birmingham Daily Dispatch" that the first batch of men raised by Mr. W. E. Milns, adjutant of the Birmingham Electrical Volunteers, for engineering work in connection with coast defence, left Birmingham on January 10th. The local corps have been asked by the Admiralty to supply and maintain a section of skilled engineers who are ineligible for military service. Mechanical and electrical workmen of all grades, and also clerks with a knowledge of the engineering trades who are willing to give a week or more to this work, are asked to communicate by letter with Mr. Milns at 14, Dale End, Birmingham. A meeting of all interested in the scheme will be held at the Birmingham Arms, Jamaica Row, at 7.30 p.m. to-day, Friday, at which Mr. Milns will explain the scheme in detail. Those who volunteer will have their train fare paid, billets will be provided, and a small daily allowance will be made.

St. Helens and Enemy Contracts.—A somewhat lengthy discussion took place at a meeting of the St. Helens T.C. on January 5th respecting a proposal to accept the tender of a certain firm for the supply of a water cooling tower. The point of discussion was as to whether or no the firm with whom it was proposed to place the contract was a British firm with British capital, and Ald. Sir John Beecham (chairman of the Electricity Committee) said that inquiries had been made and the committee was satisfied. Some members of the Council appeared doubtful, and Sir John Beecham ultimately accepted a suggestion that the Mayor, the Chairman, and the Town Clerk should find out definitely what the position was. Following the discussion the Mayor (Ald. Bates) moved: "That no contract shall be entered into with any person, firm or company, of enemy nationality." This was seconded by Sir John Beecham, and carried.

The Trade War.—It is announced that, at the request of a large number of business men, the Lord Mayor has convened a meeting for Monday, January 31st, at 3 p.m., to consider the questions of trading and employment after the war. Many organisations will be represented.

The Italian Chamber of Commerce in London has passed resolutions expressing the opinion that it is desirable:—(1) That the Allied Governments should arrive at an agreement to institute a reciprocal preferential tariff, and in that case all goods imported from countries which are not parties to the agreement should plainly indicate their origin. (2) That the shipping and railway services between the Allied countries should be improved and extended, the shipping lines subsidised and granted special facilities, including reduced port and dock fees. (3) That the principal commercial laws of the Allied countries should be made uniform to correspond with the needs of international trade; and (4) that for all supplies for, and contracts with, the Allied Governments and public bodies only the Allied countries should be allowed to tender.—"Morning Post."

London Lighting.—Replying to a question in the House of Commons on January 6th, Mr. Hayes Fisher said the President of the Board of Trade was strongly in favour of any economy that could be effected in the electric lighting of London, and he understood that in a very large proportion of the public lamps the candle-power had already been reduced; but in some cases the type of lamp employed was such that to reduce the candle-power would involve a considerable amount of initial expenditure which would be thrown away in so far as it was not recouped by savings before the end of the war. He was informed that the employment of lamps of low candle-power not blacked over would not fulfil the main object of the regulations.—"Times."

Enemy Capital.—In the House of Commons last week a member asked the President of the Board of Trade whether he would publish the list of firms trading in this country influenced by German capital, of which the Public Trustee had official cognisance as supervisor or in any other official capacity, in order that the public might be made aware of the character of the firms with whom they dealt. Mr. Runciman replied: "As at present advised, I do not propose to publish a list of firms with German capital, but legislation will shortly be introduced to confer further powers upon the Board of Trade to take steps in suitable cases to prevent the continuance of businesses carried on for the benefit of enemies."

Petrograd Electro-technical Institution and the War.—The Council of the Professors of the Petrograd Electro-technical Institution has made its lectures free to 121 of the students. On account of the consequent reduction in the receipts, the firm of Erikson has made a gift of 1,000 roubles. On the question of commemorating the death of those connected with the Institution who had fallen in war, it was decided to decorate the lecture hall with black and white marble slabs. On the black slab will be inscribed the names of all those students who have fallen in the war, and on the white slab the names of those who have distinguished themselves in battle.

Australian Councils and British Preference.—A Melbourne paper says that in his report to Hawthorn Council in November, as delegate on the Prahran-Malvern Trust, the Mayor (Councillor Russell) stated that in accepting tenders for overhead equipment for the Burke Road and White Horse Road tramways the Trust had given preference to a British tender as against an American one. Councillor Russell added that, as far as he was concerned, he would carry out this policy in every case. He trusted that after the war was over municipalities and public bodies would continue the practice of always giving preference to British goods over American.

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A New Canteen.—At a certain very progressive and well-known electrical instrument factory not very far from London, where a variety of instruments for the Government are being made, the Y.M.C.A. has organised a canteen for the convenience of the workers, on lines similar to those followed at Woolwich and other industrial centres, but, of course, on a smaller scale. Mrs. Winston Churchill, who is actively engaged in this branch of Y.M.C.A. work, enlisted the sympathetic assistance of a staff of local ladies, and she opened the new building with an address to this voluntary staff of about thirty ladies. The proprietor of the works expressed the gratitude of the working staff for the assistance rendered, which made it possible to provide the good food which was necessary to enable good work to be done. He briefly demonstrated a few of the instruments which were being made at the works. He also said that much of the work was already being done by young women, and that there was scope for many more in such work, even after the war.

Recruiting Notes.—It was reported to the Tunbridge Wells T.C. that the whole of the eligible staff at the electricity works had applied to be attested under Lord Derby's scheme. Five had been rejected and nine accepted. The Council has decided to apply to the tribunal for the retention of the nine men as being indispensable for the maintenance of the undertaking.

The number of men connected with the electrical department of the Great Western Railway who are now serving with the Colours, is 71, this being 25 per cent. of the staff. From the same department no less than 125 have presented themselves for attestation under Lord Derby's scheme.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Horn-Gap Fuses.

Reading the note on horn-gap fuses which appeared in our last issue, the ELECTRIC AND GENERAL WORKS, LTD., of 15, Victoria Street, London, S.W., noticed the resemblance of the apparatus to one which they supply, and which has been on the market for a number of years. The accompanying figure shows one of their triple-pole horn-gap fuses for mounting on a transmission-line pole in the open; it will be noted that the horns are precisely of the form advocated, and, in fact, the company's works, which claim very special experience extending over many years in all types of horn-gap switchgear, have been making all their horns in this form for some time past.

In the example illustrated herewith, the horns consist of $\frac{5}{16}$ in. copper wire and are very easily renewable. The fuse-strip consists of pure silver wire, which the makers find gives by far the best results, as it is to a great degree unaffected by climatic conditions, and the fusing point remains much more constant than in the case of copper. It also blows far more quietly. A great advantage of the design consists in the fact that the fuse-strip is not attached to the horns themselves, but is supported in substantial terminals immediately below the gap. In this way the wear and tear of the metal forming the horns at either side of the gap is reduced to a minimum, the life of the horns being thus greatly lengthened, so that renewal, or any attention at all to the horns, is rarely necessary. The replacing of the fuse-strip, which is not enclosed in any way, is also greatly simplified. These horn-gap fuses are supplied for pressures ranging from 4,000 to to 35,000 volts, and for currents up to 200 amperes.

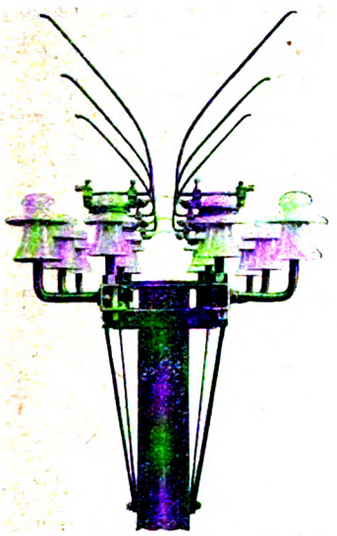

FIG. 1.—TRIPLE-POLE HORN-GAP FUSE.

New Insulated Lampholder.

We have received from MESSRS. ST. JOHN DAY (PATENTS), LTD., of Mumps Electrical Works, Oldham, particulars of a new insulated lampholder of extremely simple design, constructed throughout of Oldamit insulating material, with the exception of the contact making plungers and wiring terminals, which latter are wired on the firm's "one part" principle.

The holder consists of three main parts, viz., the body in which are inserted the two one-piece contact plungers and wiring terminals, with an insulating partition between the latter; a nipple which screws into the upper end of the holder, and through the centre of which the flexible passes: and a "combined shade ring and lamp support," which is screwed on to the lower part of the body, and, a shade being slipped over the body first, takes the place of the ordinary shade ring. At the same time the lower portion of this ring is provided with internal groves to form the lamp socket, the groves being in the correct relative position to the plungers, when the ring is screwed up.

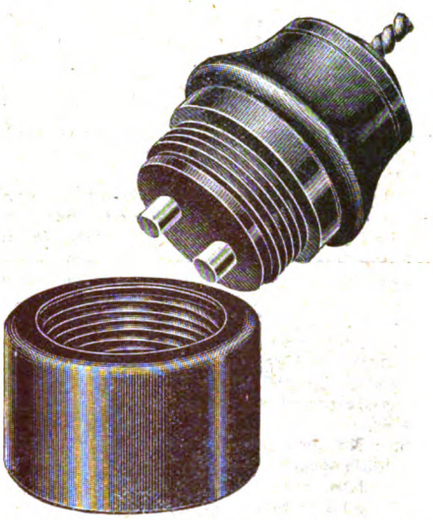

FIG. 2.—INSULATED LAMPHOLDER, WITH COMBINED SHADE RING AND LAMP SUPPORT.

Independent adjustment of the shade fixing can be obtained by a separate ring screwed on the outside of the combined shade ring and lamp support, and an insulating hood, or petticoat, can also be provided, if desired.

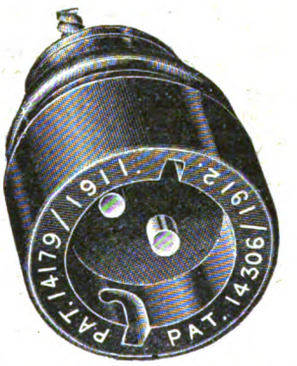

FIG. 3.—LAMP SUPPORT IN POSITION.

By slightly turning the combined shade and lamp support in a left-hand direction, and thus disconnecting the lamp contacts, the device can be used as a switch-holder, and a limit stop is supplied, if desired, for this purpose.

An improved design of the same kind is being made in which the switch break takes place in the body with an insulating wall between each pole. The holders are made in various qualities of material to withstand heat, gases, acids and rough usage, and are covered by several patents.

LEGAL.

POWER SUPPLY USED FOR LIGHTING.

AT the Halifax Police Court, on January 7th, J. W. Scott, motor engineer, pleaded guilty to a charge of having fraudulently consumed electricity at his premises, and was fined £5, including costs. Electricity supplied at 2d. per unit for power purposes had been used for lighting, whereas the lighting rate was 4d. It was stated that defendant had offended unwittingly, the wiring having been done by a former employé, who should have known that it was improper. Defendant had now offered to pay the Corporation at lighting rates for all the electricity he had used during the past year.

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SENDING ELECTRIC BATTERIES TO AMSTERDAM.

IN the City of London Court, on January 7th, before Sir John Paget, Bart., K.C., Deputy Judge, Van Oppen & Co., Ltd., carriers, 90 and 91, Bartholomew Close, E.C., claimed £5 12s. 11d. against Mr. A. France, 79, Shaftesbury Street, New North Road, electrician, for shipping charges in taking 4,000 electric batteries from London to Amsterdam. Mr. Gibson appeared for the plaintiffs, and Mr. Gowing for the defendant.

MR. HUBBARD, plaintiffs' dispatch clerk, said that they carried the goods under a consignment note. They were refused by the consignees in Amsterdam, and had to be brought back. That involved the payment of duty in Amsterdam, Customs charges, &c.

Defendant told the Court that he bought 5,200 batteries in Amsterdam. Only 1,200 were good ones, and the rest were bad. Consequently he engaged the plaintiffs to take back the 4,000 bad batteries and collect good ones in their place. Plaintiffs did not do that. Therefore they were entitled to nothing. It was ridiculous to suggest that duty was payable in Amsterdam on goods which were manufactured in Holland.

The DEPUTY JUDGE thought the defendant's suggestion a very unreasonable one, seeing that the plaintiffs would not get paid anything if they could not get the good batteries in exchange. Mr. Gibson: And the firm in Amsterdam have gone bankrupt. That is why we could not get the good ones. Defendant said that was not so. In cross-examination he said that he did not sign the consignment note. It was signed by a German who had since been interned. Many firms took out goods to Holland to exchange them, and were paid nothing unless they brought back the goods. The Deputy Judge did not think the plaintiffs would enter into such a silly contract as was suggested by the defendant. It was very improbable.

MR. GIBSON: No firm of carriers would be able to carry on business if the defendant's view were to prevail.

The DEPUTY JUDGE found for the plaintiffs, with costs. Mr. Gowing asked for leave to appeal. Plaintiffs had been guilty of a breach of duty, and it would mean a serious loss to the defendant. The Deputy Judge refused leave, and said that the consignment note was dead against the defendant.

URBAN ELECTRIC SUPPLY CO.'S APPEAL.

THE Lands Valuation Appeal Court (Lords Salvesen, Mackenzie, and Cullen), sitting in Edinburgh, disposed of an appeal by the Urban Electric Supply Co., Ltd., who appealed against the valuation of their electric works and mains in the burgh of Hawick. The works at 20, Commercial Road, Hawick, were entered in the roll at £1,210, and the mains in the burgh at £1,210, and the appellants claimed that the valuations should be reduced to £590 each. It was stated that the parties were agreed that the "profits principle" should be the basis for calculating the assessed rent. The Burgh Valuation Committee reduced the valuation by £121 to £2 300 for works and mains.

The Court affirmed the determination of the Valuation Committee except to the extent of £25, which was allowed as a further deduction from the valuation.

LORD SALVESEN said the most important question was as to whether certain machinery, which was *de facto* in its nature heritable, and was used for the purpose of supplying motive power, must, nevertheless, be included in the tenants' capital, so as to reduce the assessable value of the buildings belonging to the company. His Lordship was clearly of opinion that that claim was excluded by the Valuation Act. The machinery consisted principally of superheaters and mechanical stokers, and was used for the purpose of producing or transmitting first power, and although these might affect a certain saving in the labour bill, they could not be regarded otherwise than as heritable. Another question was whether the tenant was entitled to include in tenants' capital a sum of £500, which he kept in the bank to meet current expenses, and which earned no interest. The tenant required that sum to carry on his business, and accordingly was entitled to a deduction of £25, being at the rate of 5 per cent. A third point dealt with the claim of the appellants that four months' extra stock of coal should be treated as part of the necessary capital of the tenant. His Lordship was of opinion upon the facts that that extra stock was not necessary. The Assessor had already allowed for five months' working expenses, which included the cost of coal for five months, and the appellants claim that nine months' supply was a minimum had not been proved.

Lords Mackenzie and Cullen concurred.

ELECTRICAL ENGINEER'S CLAIM.

IN the Court of Session, Edinburgh, a settlement has been effected in the action pending before Lord Anderson, in which James Kyle, electrical engineer, 3, Crichton Place, Edinburgh, sued John M. Roger, Balgrove Farm, St. Andrews, for payment of £700 as damages in respect of personal injuries. The pursuer was serving as a dispatch-rider in the Lothians and Border Horse, and was stationed at Ceres. On September 14th, 1914, he was riding a motor-cycle towards St. Andrews, when, near the village of Dairsie, he was run into by a motor-car belonging to, and driven by, the defender, coming in the opposite direction. He was severely injured. The defender denied fault, and alleged several faults against the pursuer in driving his cycle. The case has now been settled by a payment to the pursuer of £100 and expenses, and the action has been taken out of Court by joint minute.

WORKMEN'S COMPENSATION CLAIM.

IN the City of London Court, on January 10th, before his Honour Judge Atherley-Jones, K.C., a claim was made by a labourer, named George F. Ling, against Messrs. Babcock & Wilcox, Ltd., water-tube boiler makers, to recover damages under the Workmen's Compensation Act for injuries received while working for them. Mr. Rowe appeared for the plaintiff and Mr. Harold Morris for the defendants.

MR. ROWE said that the plaintiff sustained severe injuries in July. He was employed by the defendants at the London and South-Western Railway Co.'s generating station at Wimbledon. They were putting in boiler tubes, and the method of lifting them was to use a piece of wood. The wood slipped in one instance, and the tube fell, cutting off a piece of the plaintiff's left ear, and bruising his head and face. He was taken to the hospital, where he remained a fortnight. During his illness he was paid 15s. a week half-wages and now he was paid full wages. Plaintiff was fit to work and might be discharged. Then plaintiff would have no remedy under the Act unless the Court made an order.

MR. MORRIS urged that no dispute had arisen; therefore the Court had no jurisdiction. Plaintiff was only entitled to a declaration of liability, and that had never been asked for. He was still getting his full wages.

The JUDGE said that the plaintiff would have a declaration of liability and costs. If he got worse he could come back.

THERMIT WELDING.

AN application was made before the Patents Court on January 5th, by the British Thermit Co., of the Albany, Liverpool, for a licence to use eight patents owned by Thermit, Ltd., of London, alleged to be necessary for carrying out the Thermit process of welding the joints of rails.

Mr. E. R. Royston, patents agent, of Liverpool, appeared for the applicants, and Mr. Colefax, K.C., and Mr. Hunter Gray for the opponents.

MR. ROYSTON said that Thermit, Ltd., was a company registered in England, but with German shareholders. It was now a controlled establishment with a supervisor appointed by the Government. He urged that an alien company could not be allowed to remain in possession of the patents, and contended that in view of the advantageous position of the opponent company, any royalty should be very small.

MR. COLEFAX, in addressing the Court in opposition to the application, referred to the rules laid down in the Act of 1914.

The CONTROLLER said it would take a good deal to convince him that it was not in the interest of the community that an independent, purely English company, in which the profits went to English shareholders, should be set up. The object of the whole of this legislation was that English trade might be fostered.

MR. TURNER, the managing director of the British Thermit Co., Ltd., giving evidence, said that it was practically impossible to go on any further in view of the patents held by the competing company. If the applicants had a licence to use these patents, they would be able to weld tramway rails for corporations themselves. At present they could only sell Thermit, and corporations did not give them orders because they could not weld the joints, owing to the patents held by the opponent company.

MR. COLEFAX submitted that the needs of the country were satisfied by Thermit, Ltd., that there was no ground for apprehending that there would be a scarcity of the material, and that the applicants were entirely incapable of doing the work.

In the case of a licence being granted, he suggested a royalty of 2s. per joint as against 6d. suggested by Mr. Royston.

The Court reserved its decision.

BUSINESS NOTES.

Norwegian Nitrogen.—The report for 1914-15 of the Norwegian Nitrogen Co., which is a Franco-Norwegian undertaking, states that the increase in the turnover kept pace with the development of the production; the profits correspondingly experienced an expansion, and the further progress of the company is regarded with optimism. The net profits, which amounted to £275,000 in 1913-14, rose to £399,000 in the past year, and the dividend proposed on the ordinary share capital of £3,188,000 is at the rate of 7 per cent. as compared with 6 per cent. in 1913-14, the preference shareholders receiving 8 per cent.

Patent Restoration.—An order has been made restoring Letters Patent No. 16,237 of 1910, granted to Henry Norman Leask for "Improvements in charging doors for furnaces."

New Industries in the U.S.A.—According to a Reuter telegram, a company has been formed in the United States to manufacture nitric acid by extracting nitrogen from the air, with the aid of water-power in Canada, near Lake St. John and on the Saguenay River.

The manufacture of quartz glass from sand deposits found in the State of Nebraska has been developed on a large scale, owing to the cessation of importations from Germany.

Bankruptcy Proceedings.—AUGUSTINE GARBUTT, "electrical engineer, now weighing-machine attendant," Leeds.—First meeting January 14th; public examination, February 1st; both at Leeds.

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Trade Announcements.—Mr. A. G. Ingleby, late of the machinery department of the Adnil Electric Co. has joined the Electrical Supplies Co., of Tottenham Court Road, W., in order to take charge of their engineering department. This department has been reorganised. The company is now representing the following in London and the South of England:—The Keighley Electrical Engineering Co., Ltd., for A.C. motors and dynamos up to and including 125 H.P., and Messrs. Firth & Russell, of Leeds, for A.C. motors up to 100 H.P.

Messrs. Cave & Higgin, Ltd., have removed into their new premises at 265, Deansgate, Manchester. (Telephone: Central 1282.)

Messrs. A. J. Greenly & Theodore Denison have taken over Baldwin & Wills works, St. Albans Road, Watford, and commenced business as manufacturing electrical and mechanical engineers, under the style of Greenly & Denison, with offices at 37 and 38, Strand, W.C. The firm are in a position to do small turning, boring, screw-cutting, and other work. The Greenly Advertising Service will be carried on by Mr. Greenly as heretofore.

The Chloride Electrical Storage Co., Ltd, of Victoria Street, London, S.W., intimate that their telephone numbers are:—442 and 443 Victoria. Some of their friends continue to call up numbers that were discontinued some time ago.

Liquidations.—South Wales Wireless Training College, Ltd.—This company is winding up voluntarily with a view to reconstruction. Mr. G. F. Willett, 92, Queen Street, Cardiff, is the liquidator, and a new company known as the South Wales and West of England Wireless Training College, Ltd., is to be formed.

Empire Portland Cement Co, Ltd., Northfleet, Kent.—A meeting of the committee of creditors was held on January 5th, and adjourned until January 13th.

British Metal Engraving Co., Ltd.—A meeting is called for February 11th, at 3, Warwick Court, Gray's Inn, W.C., to hear an account of the winding up.

Parana Power Syndicate, Ltd.—Creditors must send particulars of their debts, &c., to Mr. L. Maltby, 4, London Wall Buildings, E.C., the liquidator, by February 1st.

Catalogues and Calendars.—Messrs. Stewarts and Lloyds, Ltd., of Winchester House, E.C., have again favoured us with one of their white and gold wall calendars, with the flags of the Allies artistically inset above the monthly date cards.

Messrs. Mather Bros., of 35 and 36, Farringdon Street, London, E.C., have issued a wall calendar with monthly sheets for 1916.

Messrs. Simplex Conduits, Ltd., of Garrison Lane, Birmingham, have sent us one of the admirable pocket diaries which have become identified with their name—a pocket-book which in shape, size and make-up, is, perhaps, the most handy and useful that we know of. With it comes a novelty in the form of a "cable capacity gauge"—a set of hinged brass disks, perforated with holes exactly corresponding with the internal diameters of the eight sizes of Simplex heavy-gauge conduit. A set of cards is provided, showing the outlines of 12 sizes of insulated cable packed close together, and, by placing the gauge over the appropriate diagram, the maximum number of cables of a given size that the conduit will contain is at once ascertained. The gauge and cards are provided with a neat leather case for the pocket, and should prove extremely useful to contractors.

Messrs. Turner Bros., Rochdale.—Twenty-page publication showing reproductions of a series of advertisements, which have appeared in the Press, of their asbestos and other goods.

Messrs. Berry, Skinner & Co., 78, Upper Thames Street, London, E.C., have prepared an embossed metal perpetual calendar, the metal work of which is made to a design around an archway through which is seen an illustration of one of the firm's "Ironsafe" switchboards.

The Steel Tubes and Conduits Co., Alice Street Works, Keighley.—Twenty-four-page illustrated catalogue giving particulars and prices of their conduits and fittings for electrical purposes, including "Spring" inspection fittings, "Staco" grip fittings, tees, couplings, bends, circular junction boxes, cast-iron universal boxes, and sundries.

Rugby Lamp Co., Ltd., Rugby.—Illustrated price list of "White Star" metal-filament and "Rugby" carbon-filament lamps.

Messrs. Ferranti, Ltd., Central House, Kingsway, London, W.C.—List Hb. 145 gives a description and tabulated sizes, weights, capacity, prices, &c., of their type Wb electric water-heater.

Messrs. C. J. Edwards & Son, Ltd., of 32-34, Great Sutton Street, Clerkenwell, E.C., have prepared a large hanging calendar-sheet for 1916, with the dates for the year very clearly set out, also a list of engineering stores stocked by them.

Electric Horns.—The Benjamin Electric, Ltd., of 1A, Rosebery Avenue, London, E.C., have issued a circular embodying a special New Year's offer to the trade of Benjamin electric motor horns.

LIGHTING AND POWER NOTES.

Aberystwyth.—Fire.—According to the *Times* a fire occurred on the switchboard at the electricity works on Monday, which it was expected would result in shutting down the electric supply for two days.

Argentina.—It is proposed to form a local co-operative electric light and power society in Mar del Plata, with a capital of $500,000 m/n.

After allowing several extensions of time to the municipal authorities for payment of a debt of $22,000 m/n. for electric lighting, the local electric light company of San Antonio de Areco cut off the current. The general public who pay their rates and taxes punctually are disgusted at the awkward situation the municipal maladministration has placed them in.—*Review of the River Plate*

Ashtead.—Street Lighting.—With regard to restricted lighting, the Leatherhead Electricity Co. has pointed out to the P.C. that the greater part of the cost of the street lighting was made up of interest and sinking fund charges on the mains and fittings, and that, although if the lamps were not used a certain amount of fuel was saved at the E.L. station, the fixed charges remained just the same. It was also pointed out that the present contract terminated next May, and the company had no assurance that it would be renewed, and it might be compelled to disconnect all the mains and fittings. The company offered to discuss a reduction in the charge for the present year when the lamps were not used for the full time, at the same time it discussed the question of the contract for the lighting for the next five years. The Council has decided to renew the request for a rebate.

Attleborough.—E.L. Scheme.—The promoters of an E.L. scheme for this parish have applied to the Eastern Highways Committee of the Norfolk County Council for permission to erect poles for overhead wires, and sanction has been withheld pending a report from the county surveyor.

Australia.—The Mount Gambier (S.A.) Corporation agreement with Messrs. Bridger, Ltd., for the supply of electricity to the town is for a term of 10 years, at the conclusion of which the Corporation is to have the option of purchasing the plant. It is expected to have the scheme completed by the end of 1916, when the agreement with the Colonial Gas Association expires.

The proposal to utilise the water supply system of Grafton and South Grafton (N.S.W.) in connection with a hydro-electric power scheme has been adopted by the Councils. The scheme is estimated to cost £23,000.—*Tenders.*

The Melbourne City Council has decided to give a H.T. supply to the mining school in connection with the research work into the manufacture of high-speed tool steel.

In connection with the lighting of St. Kilda's Road, it is stated that the Electric Supply Committee will shortly have before it a big scheme for the lighting of this thoroughfare.

Electrical Pumping.—The Works Committee of the Brisbane City Council reported on a scheme for providing water for the city baths, street watering and drain-flushing purposes. It was suggested that the proposed reservoir on the crest of Spring Hill should be supplied with water from the river by a turbine pump installed on the river bank, with a capacity of about 650 gallons a minute. It was estimated that the cost of the pumping station and main would be about £1,900. The City Electric Light Co. had offered to supply power for pumping at 1·06d. per unit provided the pumping was carried out between 11 p.m. and 7 a.m. The engineer estimates that the price worked out at 1·20d. per 1,000 gallons for pumping, which, together with working expenses, would not exceed 1·5d. per 1,000 gallons pumped. It was pointed out that the authorised loan for the work was £13,000, but the estimate was made in 1910, and that the extra cost of labour and material and the extended nature of the scheme now submitted must be taken into consideration. The City Council adopted the report.—*Tenders.*

Bacup.—Loan Application.—The T.C. has decided to apply to the L.G.B. for sanction to a loan of £300, for the purpose of supplying electricity to a new factory.

Birkenhead.—Price Increase.—The Electricity Committee of the T.C. has decided to increase the charge for current to ordinary consumers for lighting and power from the New Year by 7½ per cent.; and to pre-payment meter consumers by ½d. per unit.

Bolton.—Loan Sanction.—The L.G.B. has sanctioned the borrowing of £2,000 and £215 by the T.C. for the supply of electrical energy to Messrs. W. A. Openshaw, Ltd., Hill Fold Mills.

Bo'ness.—Proposed Extension.—At a special meeting of the T.C., on Friday last, a letter was read from the National Electric Construction Co., requesting consent to a permanent extension of the burgh electricity works in place of the proposed temporary extension recently approved by the Secretary for Scotland. Plans and specifications of the new works, submitted by the company, showed that the proposal was to introduce a 500-KW. steam turbine set, together with an extension of the power station and other additions estimated to cost, in all, about £10,000. The company stated that the proposed extensions were imperative to meet the demands upon the station. The Council, after consideration, agreed to call in the services of an independent engineer to report on the state of the works and the necessity for the extension.

Burnley.—Insurance.—The electrical engineer having reported that he does not consider the plant of the electricity department sufficiently insured against damage by fire, the Electricity Committee has resolved to obtain a covering note for a further £20,000 on the plant in the main generating station, sub stations and sub-station buildings, and to obtain tenders for the valuation of the whole plant installed at the electricity works, with a view to re-arranging the insurance against damage by fire.

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Brandon and Byshottles.—STREET LIGHTING.—The Council is considering a letter from the Brancepeth Coal Co., requesting payment in full of its street lighting account. It was reported that three collieries had accepted the Council's basis that lighting should only be paid for according to the actual hours of burning, but the Coal Co. had returned the account, and pointed out that it had put down machinery and plant, was having to pay increased wages, and that the cost of coal for supplying current had advanced.

Bath.—HOSPITAL LIGHTING.—The electrical engineer reported that the Bath War Hospital was to be lighted with electricity, and for that purpose it would be necessary to extend the H.T. main from the sub-station at Portway works, at a cost of £170. The Mayor had authorised him to make an offer to supply electricity at a flat rate of 4d. per unit. The Electricity Committee recommends that this offer be confirmed, the work required be put in hand at once, and that the War Office be requested to erect the building required for the sub-station at the hospital.—*Bath Herald.*

Continental.—RUSSIA.—The Minister of Trade has submitted proposals to the Moscow authorities for reduced electric lighting and early hours for theatres, the owners of which, however, prefer later hours with fixed duration of performance. Warehouses must cut off current by 7 p.m., and restaurants must reduce their light by 30 per cent. compared with the previous year. Cinematographs are to have four hours per day, like the theatres, but double time on holidays. The T.C. has replied, objecting to the proposals, and suggesting decreased current supply, so that the use of improved lamps would help. The Council has already reduced the current supplied in the town thoroughfares.

In Tula, incandescent lamps are being used in place of arc lamps, owing to lack of carbons.

The Karkoff Electric Station Bureau has submitted an estimate to the T.C. for changing over from gas to electric lighting.

Cuba.—With a view to displacing three stations of insufficient capacity, there has been erected in Havannah a single large plant capable of supplying the current required for lighting, power and traction. The equipment of this station comprises three groups of turbines, of 12,500 KW. each. The current is generated at 2,200 volts, and distributed at 6,000 volts, and 220 volts, according to its application. The installation of a fourth group of plant is in contemplation.

Dewsbury.—PLANT EXTENSION.—The T.C., on Thursday last week, considered a proposal of the Electricity and Tramways Committee to purchase a secondhand generating set from Dumbarton and install it at an estimated expenditure of £3,000, the money to be provided out of the profits of the undertaking. There was a lengthy discussion on the matter. The chairman of the Electricity Committee explained that the present plant at the electricity works was working very near to the margin of safety owing to heavy demands, and a breakdown would be a serious matter. The proposed purchase was only a temporary expedient. The Committee's proposal was approved. The Council also approved a recommendation that the present charges for electricity be continued until further notice.

Dinas Powis.—The Bishop's Palace at Llandaff is being rebuilt and will be lighted throughout with electricity generated upon the premises. It has not yet been decided whether the improved lighting of the Cathedral shall be by gas or electricity.

Mr. R. H. Fletcher (of Messrs. Lewis & Fletcher, electrical engineers, Cardiff), has been appointed consulting engineer for the electrical undertaking of the District Council.

Hawick.—RATING APPEAL.—The Urban Electric Supply Co., Ltd., appealed against the valuation of the electricity works and mains in the burgh, which were assessed at £2,420, and which the Burgh Valuation Committee reduced to £2,300. The Court affirmed the valuation of the Committee, less £25, which was allowed as a further deduction from the valuation.

London.—BATTERSEA.—The Electricity Committee reports that the work of linking up the electricity supply undertakings of Battersea and Fulham has almost been completed, and that satisfactory tests of the cables have been made. The Committee recommends that it be authorised to arrange for the supply of electrical energy from and to the Fulham Council as and when required.

HACKNEY.—The Electricity Committee reports that the 3,000-KW. Willans turbo-alternator set has undergone official tests. The borough electrical engineer has been authorised to place an order with Messrs. Ferranti for a grid-type earthing resistance of 200 amps. capacity for three minutes, at a cost of £105.

Lynton.—STREET LIGHTING.—The Electricity Co. has informed the P.C. that it is not in a position to make any substantial rebate on the cost of public lighting, solely on the ground that the lamps are extinguished early, as this does not reduce the cost of maintenance to any marked extent.

Luton.—COAL PRICES AND EXTENSIONS.—The town clerk is in communication with the B. of T. in reference to matters relating to the electricity coal contract. The contractors state that the pitmouth prices for Ibstock coal for the year ended November 30th, 1914 were at 7s. per ton, and for the 12 months ending November 30th, 1916, 13s. 3d. per ton. The colliery proprietors contend that they were entitled to 13s. 3d. as being only 4s. per ton in excess of the average price received by them during the year ended June 30th, 1914, and that they are not restricted by the Price of Coal Act to 4s. upon the actual price paid by any one purchaser. The L.G.B. has advised the Electricity Committee that it is prepared to sanction loans, amounting to £27,790, on being furnished with a copy of a resolution of the Council in respect of the difference (£2,140) between that sum and £25,650, the amount of the original application. The Board states that it has deducted from the total amount (£30,327) the sum of £2,537 remaining unexpended on account of the loan of £5,000 sanctioned in August, 1913, for general extensions of mains, as it considers that this balance should be used towards defraying the cost of the mains now proposed to be laid in connection with the present scheme for additional plant. The full amount for the proposed new cooling tower would be sanctioned on condition that the outstanding debt on any of the depôt buildings which may have to be pulled down will be paid out of the reserve fund. The Electricity Committee proposes to reply to the Board's remarks to the effect that it has erroneously deducted the £2,537, as the £25,650 represented the net cost after deducting the first-mentioned figure; and to remind it that in November last the Council undertook to pay out of the reserve fund any outstanding loan debt on any of the depôt buildings, which will be demolished or interfered with by the new cooling tower. The Council, therefore, again requests the Board to sanction the £30,327 originally applied for. The Committee also proposes to apply for sanction to borrow the additional sum of £4,677, being the difference between the amount of the original application (£25,650) and the £30,327 asked for. Subject to the requisite order being granted by the B. of T., the Electricity Committee has asked the Council to agree to a supply of energy being given to the premises of Messrs. Hewlett & Blondeau. The agreement will provide for a fixed period of 14 years, determinable at the end of the seventh year, and for the payment by the company of a total minimum sum of £1,750 during the first seven years.

Middlesbrough.—CHEAP ELECTRICITY.—The Corporation has agreed to a request by Mr. Gridley, of the Cleveland and Durham Electric Power Co., who suggested that in the case of seven of the company's officials whose duties require them to reside in the town, a deduction should be made by the company from the Corporation's bill in respect of energy supplied to the residences of these officials in order to give them the same facilities for obtaining energy at a nominal rate, which they would enjoy were they able to get current direct from the company's mains. Eight units for every lighting unit and two units for every heating unit used by the officials are to be deducted from the Corporation's account.

Newport (Mon.).—PLANT EXTENSION.—It is proposed to establish a factory at Maesglas, and, according to the report of the electrical engineer, it is desired that the Corporation should provide certain electrical equipment costing about £3,170, or alternatively, about £4,450. The engineer has submitted the proposed terms of agreement, providing for the payment to the Corporation at the termination of the period of supply, of certain amounts in respect of the equipment to be furnished, and the Electricity Committee has decided to instruct the engineer to order the necessary cable and plant and other equipment when he has been informed that the terms of supply were approved.

Nuneaton.—LOAN SANCTION.—The T.C. has received from the L.G.B. sanction to a loan of £6,000, less £778 received for the sale of a 200 KW. set, for extensions to the plant at the electricity works, and has suggested that expenditure for mains and services should be met out of the unallocated balance of profits of the undertaking.

Philippines.—A hydroelectric central station is about to be established at Lucban, in the Province of Tayebas. The estimated cost of the station is 150,000 pesetas. The machinery will be American, and the constructing and working company, organised by the municipality, will be formed with Philippine capital. The power will be obtained from a waterfall on the River Pagsipi, which belongs to the municipality. Lucban is one of the centres of the Philippine hat industry.—*Industria e Invenciones.*

Reigate.—STREET LIGHTING.—The T.C. has referred back to the Highways Committee a recommendation that the E.L. Committee should allow a reduction at the rate of £1 6s. per annum for all street lamps not lighted from October 23rd, and so long as the lighting restrictions remain in force.

Rugeley.—PROV. ORDER.—The Rugeley Gas Co. has informed the U.D.C. of its intention to apply to the B. of T. for a prov. order to supply electrical energy for public and private purposes.

San Domingo.—The need for the erection of a new electric light station has been felt for some time in this city, the local Press having made frequent references to the deficiencies of the existing lighting arrangements. In June, 1914, the municipality signed a contract with a certain Senor Michelena, who proposed to start a company to supply the city with electricity. In March last, however, this contract was cancelled for various reasons, and a municipal committee appointed to study measures for the provision of the public services. A practical preliminary step already taken is a resolution to raise a loan for the installation of the new central station.

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Sheffield.—The offer of the electric supply department to provide for £185, the necessary switchboards and fittings for charging the electric vehicles of the Health Department has been accepted. The superintendent of the Heeley Health Department depôt has received instructions to extend the electric lighting in those buildings now lit by gas, the supply pipes of which are worn out. The Electric Supply Committee has undertaken to bear the annual charges in respect of the expenditure incurred in laying a new feeder cable from Kelham Island to Newhall Road: mains are to be extended to various parts of the city at an estimated cost of £5,910. The L.G.B. has sanctioned the borrowing of £2,500 to cover the cost of increasing the accommodation for coal storage at the Neepsend power station, and the installation of coal-handling plant, &c., and £1,200 for the provision of rails, &c., crane track, sleepers, and reinforced concrete retaining walls. The Committee has decided to lease a piece of land for the erection of an electric furnace, and has granted permission to place three 150-KW. transformers in the Forncett Street sub-station for operating the furnace.

L.G.B. INQUIRY.—Notice has been given that an inquiry will be held on January 21st into the application of the T.C. for a prov. order to authorise the transfer of the Kelham Island power station from the tramways to the electric lighting department, and to amend any Acts as may be desirable.

Stockton-on-Tees.—BULK SUPPLY.—The Corporation has ordered a new rotary converter for the electricity works, to enable a larger supply to be obtained from the Cleveland and Durham Electric Power Co. The engineer reports that the saving in capital expenditure in providing rotaries, as compared with new steam generating plant and the extension of the buildings, will fully warrant the change. There will also be a saving due to the present increased price of coal.

Swansea.—The Committee has adopted a recommendation of the borough electrical engineer (Mr. J. W. Burr) to dispose of two sets of engines and dynamos at the works, which would leave sufficient space for the installation of a 3,000-KW. turbine; the alteration would also benefit the staff, which, owing to enlistments, is now overworked.

It was decided to extend the mains to the new public elementary school, at a cost of £800, providing the Education Committee paid the interest and sinking fund on the cost of the extension for five years, in addition to the annual charges for current consumed.

South Shields.—PROPOSED LOAN.—The T.C. has adopted the recommendation of the Electrical Committee that application be made to the Treasury and the L.G.B. for sanction to borrow £1,000 to carry out a scheme for the hiring out of motors, and £850 for a motor wagon.

St. Annes.—Mr. J. H. Clothier, the electrical engineer, reports a continued falling off in supply for lighting and traction, which is, however, more than compensated for by heavy increases in supply for both industrial and domestic power. In regard to coal, the engineer says the question is causing great anxiety; although he has sent out a number of inquiries, up to the present he had not been able to secure a renewal or offers for any quantity, with the exception of a 100-ton lot.

Torquay.—The T.C. has been informed that the L.G.B. has consented to an extension of plant at the electricity works.

Walsall.—NEW PLANT.—The Electricity Committee reports that tenders have been obtained for a turbo-alternator set to replace the commandeered plant, and that it had given instructions for the sale of certain obsolete plant. Instructions have also been given for a further reduction in the public lighting, by about 300 lamps, and in this connection the borough surveyor has been authorised to negotiate with the electrical engineer as to the replacement of the high-power electric lamps in the centre of the town by metallic-filament lamps of lower power.

Watford.—STREET LIGHTING.—The U.D.C. has adjourned consideration of the question of public lighting until immediately after the current financial year, but in the meantime, £2,500 is to be paid on account for the year to the Electricity Committee.

Wigan.—The Electricity Committee reported that it had purchased 16,000 tons of coal from the Bryn Hall Colliery Co., at 14s. 6d. a ton, as compared with 11s. 6d. paid to the same firm in March last. This quantity, it was stated, would provide for the requirements until about next Christmas.—*Wigan Observer.*

Wolverhampton.—LOAN APPLICATION.—The Electricity Committee proposes to apply to the L.G.B. for sanction to borrow £1,780 for mains extensions and for permission to spend £670 out of the loans already raised in connection with the above extensions.

TRAMWAY and RAILWAY NOTES.

Batley.—The T.C. has instructed the town clerk to write to the Yorkshire Electric Tramways, Ltd., protesting against the recent increase in fares on the Batley to Dewsbury section of its line.

Bolton.—Through running from Bolton to Clifton, through Farnworth and Ksarsley, on the Corporation and South Lancashire tramway systems has been discontinued, the passengers having to change cars at Moses Gate. Representations are being made to the responsible authorities for the re-establishment of the service which has been in operation several years.

Bolton-on-Dearne.—LIGHT RAILWAY APPLICATION.—The new application promoted by the Dearne Valley Light Railway Board for power to construct light railways between Wath-upon-Dearne and Bolton-on-Dearne is to form the subject of an inquiry by the Light Railway Commissioners at the end of this month.

Bournemouth.—LOAN SANCTION.—The T.C. has received the consent of the B. of T. to borrow forthwith up to £6,000 for the reconstruction of a portion of the tramway track at Constitution Hill between the borough and Poole.

Bradford.—FEMALE LABOUR.—The Tramways Committee has decided that, in accordance with the recommendation of the general manager (Mr. C. J. Spencer), instructions be issued to make arrangements for a certain number of women conductors, and that one or two routes be experimented with; that the rate of wages and the hours of duty be the same as for male conductors, with the exception of longer meal reliefs: and that the necessary uniforms be purchased and other essential equipment for such experiment be immediately put in hand; and that all women be dispensed with at the conclusion of the war on the return of the former male employés, or as soon as sufficient male labour can be obtained. It has also been resolved that no women who are engaged in productive employment in the textile trade shall be employed as conductors.

In view of the exceptional conditions prevailing in regard to the employment of women, owing to the war, the Tramways Committee has given authority for increasing the maximum wages of the female staff at the tramway offices from 20s. to 30s. per week.

Burnley.—The manager of the Corporation tramways reports a shortage of drivers and has been authorised to ask the recruiting tribunal for the retention of tramway drivers attested under Lord Derby's scheme. It was reported that the Postmaster-General desired to transfer the carriage of mails from the tramways to the railway company, and desired the present agreement to end. The Committee resolved that the application be not acceded to.

Gateshead-on-Tyne.—TRAMWAY RECONSTRUCTION.—At a meeting of the T.C. on the 5th inst., the Town Improvement Committee reported on the application of the Gateshead Tramway Co. for leave to substitute span-wires suspended from poles placed at each side of Durham Road, from Shipcote to Low Fell terminus, in place of the existing bracket construction. The Committee recommended the Council to agree to the following arrangements:—That the application of the company be granted on condition that the whole of the centre poles on the several routes in Gateshead be removed by, and at the sole cost of, the company within two years of the date of the declaration. If at any time any of the new poles are found to be in the line of a new street, the position of the pole to be altered at the cost of the company. Each pole to be fixed and fitted with a base similar to those on the west side of Durham Road, to the satisfaction of the surveyor. The Committee also recommended that the application of the company for permission to carry a double set of rails along Sunderland Road, in accordance with plans submitted, be granted on condition that the company pays £180 towards the cost of widening the road. The recommendations were adopted.

Glasgow.—RECORD RECEIPTS.—The tramway receipts for the week ended Saturday, January 8th, are the highest so far recorded in the history of the tramway service. The total receipts from passengers amounted to £24,236—£1,100 better than the previous best, and over £3,000 more than in the corresponding week a year ago. The major portion of the revenue came from the ½d. and 1d. fares.

London.—Considerable delay was caused on the Bakerloo tube railway, on Wednesday, by an outbreak of fire on a train between Oxford Circus and Regent's Park Station.

Manchester.—FEMALE LABOUR.—About 200 women conductors are now employed on the tramway system, and many tributes have been paid to the courtesy and efficiency with which they do their work. It is expected that even larger use of the services of women as guards will have to be made in the near future.

Newcastle-on-Tyne.—INCREASED SERVICES.—The tramway service in the city and the suburbs, which some weeks ago closed down at 9 o'clock at night, is gradually being extended, especially on the more distant routes, as more female workers are being started, and as further volunteer workers are being obtained.

Reading.—FEMALE LABOUR.—The T.C. has engaged 26 women for the tramways, 22 as conductors, two as inspectors, and two as clerks. The first named are paid the same wages as men, viz. 5d. per hour: the inspectors, 30s. per week; and the clerks, 25s. per week.

Rotherham.—The T.C. has been recommended to agree to the Sheffield Tramways Committee's proposal to refer all matters in dispute in connection with the running of additional cars for munition workers to an independent arbitrator, subject to certain protective conditions.

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Rochester.—Traffic Difficulties.—The City Council has received a petition protesting against the stoppage of the tramway service on Strood Hill, and in this connection a letter was received from the general manager of the Chatham and District Light Railways Co., which pointed out the difficulties of maintaining the service owing to over 60 per cent. of the employés joining the Colours. Partial service, however, could be given, but only by curtailing the service at Frindsbury Hill. As the result of a subsequent conference, however, the general feeling was that the Frindsbury Hill service was by far the more important, and in the result the company intimated that an effort would be made to provide a modified morning service at Strood. To maintain an afternoon or evening service was practically impossible.

Sheffield.—In view of the services rendered to the State by the Pure and Applied Science Departments of the Sheffield University, and the depletion of the income from students' fees, the City Council has been recommended to make special grants totalling £5,000 out of the revenue of the tramway undertaking.

TELEGRAPH and TELEPHONE NOTES.

New Wireless Receiver.—According to the *Madrid Cientifice*, trials have been made at Corunna of a radiotelegraphic receiver, invented by Prof. Gonzalo Brano, with excellent results. The increase in sound has allowed of the hearing of messages from Madrid and all the stations on the Spanish military system, including those in Africa. It has also been found possible to receive by ear, with the telephone, messages from the Eiffel Tower, Poldhu, and Norddeich, and to record on the Morse tape messages from all the stations mentioned.

Wireless Communication Across the Pacific.—Communication has been established between the United States and Japan by way of the Marconi wireless stations at San Francisco and Honolulu, in conjunction with the new Japanese Government station at Funabashi, near Tokio. The distance between terminals is 3,400 miles. Commercial service will shortly be commenced.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—January 19th. P.M.G. Carbon and manganese powder, manganese chloride, chloride of ammonia, porous pots, outer jars and carbon blocks. See "Official Notices" January 7th.

February 18th. Melbourne, Brunswick and Coburg Tramways Trust. Six radial trucks.*

Brisbane.—January 23rd. P.M.G. Wheatstone apparatus. See "Official Notices" Dec 17th.

April 15th. P.M.G. Common-battery multiple switchboard, or automatic or semi-automatic switchboard, and associated apparatus. See "Official Notices" December 31st.

Melbourne.—February 16th: 51 electric staff instruments. February 23rd: Two commutator slotting machines, for the Victorian Railway Commissioners.*

February 2nd. Agent-General for Victoria. Fuse distribution boxes and fuses, for the Victorian State Railways. See "Official Notices" to-day.

Sydney.—January 31st. Three electrically-operated railway freight-car transferers for Jones Bay wharfage, Pyrmont. Particulars from Engineer-in-Chief of the Harbour Trust, Circular Quay.

January 20th. Silk-covered wire, for P.M.G.*

February 7th. Metropolitan Board of Water Supply and Sewerage. For No. 1 pumping-station, Ultimo. Two centrifugal pumps and electric motors (4,000 gallons per minute each), switchboards, starters &c. Contract No. 1,301.*

February 28th. Municipal Council. Tenders for induction regulators. Specifications (11s. 6d.) from the Electric Light Department, Town Hall, Sydney.

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-kw. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.

Birkenhead.—January 17th. Corporation Electricity Department. Washed and unwashed rough slack coal for the period ending June 30th, 1916. Mr. G. P. Shallcross, Electrical Engineer, Craven Street.

Croydon.—January 24th. Corporation. Stores for the Tramways Department. Particulars from the Manager, Tramways Department, Thornton Heath.

Dublin.—January 21st. Corporation. Arc lamp carbons. See "Official Notices" to-day.

London.—Islington.—January 21st. B.C. Twelve months' supply of engine-room stores, electrical fittings, meters, cables, &c. See "Official Notices" Dec. 31st.

Battersea.—The B.C. is recommended to invite tenders for the supply of oils, engine-room stores, electricity meters, service joint-boxes, troughing, ironmongery, &c., and coal, for the electricity undertaking, for alternative periods of three, six, nine and twelve months from March 31st next.

H.M. Office of Works.—January 17th. White earthenware electric lamp shades. Forms of tender from Controller of Supplies, H.M. Office of Works, 18, Queen Anne's Gate, S.W.

Manchester.—January 18th. Corporation. Sub-station converters, traction boosters, high and low-pressure steam piping, for the Electricity Committee. Specification from Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall.

New Zealand.—Auckland.—February 23rd. City Council. Centrifugal pumping electric motors, and automatic starting and controlling apparatus, for the four city pumping stations. Specifications from the office of the Water Board, Town Hall, Auckland.

Dunedin.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.

Raetihi.—March 14th. Town Board. 40-h.p. hydro-electric generating set, switchboard, &c. Plans and particulars from Messrs. H. W. Climie & Son, Raetihi.*

Wellington.—March 8th. Public Works Office. One 3,000 kw. generator and one 4,300-h.p. water turbine, at Lyttelton, for the Lake Coleridge electric power scheme. Specifications, &c., may be consulted by British firms at the office of the High Commissioner in London for New Zealand, at 13, Victoria Street, S.W.

Pembroke (Dublin).—February 7th. U.D.C. Twelve months' supply of electrical goods. Specifications from the Town Hall, Ball's Bridge, Co. Dublin.

South Africa.—January 17th. S.A. Railways Administration, Johannesburg. 74,966 drawn-wire tungsten lamps.*

Spain.—Tenders have just been invited by the municipal authorities of San Ildefonso (Province of Segovia) for the concession for the electric lighting of the town during an indefinite period.

Todmorden.—January 24th. Electricity Department. 1,000 tons of steam slack or nuts (40 tons per week). Tenders to Mr. H. Garratt, Town Clerk, Municipal Offices.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Australia.—The Broken Hill Associated Smelters Pty., Ltd., has accepted the tender of Messrs. Fraser & Chalmers for two 2,000-kw. turbo-alternators.

Bradford.—The Electricity Committee has given instructions for a spare rotor for the 3,000 kw. turbo-generators at the electricity works to be obtained from the British Thomson-Houston Co.

Bristol.—The Docks Committee of the T.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for a motor starter for a two-ton electric capstan at the Royal Edward Dock.

Bury.—The tender of Messrs. Jas. Byrom, Ltd., has been accepted for the extension of the boiler house at Chamber Hall generating station.

Chesterfield.—The T.C. has been recommended to accept the tender of the British Thomson-Houston Co., at £1,180, for the supply of a 6,600-volt, 30 period, 600-h.p. induction motor installation subject to a loan being sanctioned.

London. The Metropolitan Water Board [illegible] motor-driven [illegible] pump, the value of the contract being £175.

The Metropolitan Asylums Board has accepted the tender of Messrs. J. W. Gray & Son, at £25, for repairing defects in the internal telephone system at Queen Mary's Hospital.

Luton.—The Jackson Electric Stove Co., Ltd., has obtained the order from Messrs. Dudeney & Johnson for a complete cooking equipment for their restaurant in Luton. The installation is designed to cope with the requirements of 250 people.

The Electricity Committee recommends the acceptance of the tender of Messrs. Aiton & Co., at £758, for the supply of pipework for the additional cooler. Six tenders were received.

Nuneaton.—The T.C. has accepted the following tenders:—

Feeder panel.—British Thomson-Houston Co., Ltd., £71.
Overhead electric line.—B. I. & Helsby Cables, Ltd., £487.

Southampton.—The T.C. has accepted the tender of Messrs. Driver & Co., at £588, for the supply of 60,000 deal blocks for the Tramways Department.

Sunderland.—The T.C. on Wednesday accepted the following tenders:—

Ferranti, Ltd.—Meters.
Underfeed Stoker Co., Ltd.—Two Underfeed stokers.
R. Hudson & Sons.—Work in connection with installation of stokers.

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Stockport.—The Tramways Committee has accepted the following tenders:—

Steelbanding wire.—British Westinghouse Co.
Field coils for motors.—Dick, Kerr & Co., Ltd.
Bell pushes, P. & B. Tape.—L. Andrew & Co.
Castings.—Malleable Steel Castings Co.

The Electricity Committee has accepted the tender of the Yorkshire Commercial Motor Co. for a steam wagon, fitted with mechanically operated tipping end body, rubber tires, and three-speed gear, £695.

Wigan.—The E.L. Committee has purchased 16,000 tons of coal from the Bryn Hall Colliery Co., Ltd., at 14s. 6d. per ton, compared with 11s. 6d. paid last March.

FORTHCOMING EVENTS.

Association of Supervising Electricians.—Tuesday, January 17th. At 8 p.m. At St. Bride's Institute, Bride Lane, E.C. Half-yearly meeting and informal discussions.

Nottingham Society of Engineers.—Wednesday, January 19th. At 7.30 p.m. At the Welbeck Hotel, Milton Street. Paper on "The Use of Electricity in the Conveyance of Coal from the Working Face to the Pit Head," by Mr. R. A. Sheldon.

Institution of Electrical Engineers.—Thursday, January 20th. At 8 p.m. At Victoria Embankment, W.C. Paper on "The Principles of Modern Printing Telegraphy," by Mr. H. H. Harrison.

Chemical Society.—Thursday, January 20th. At 8.30 p.m. At Burlington House, Piccadilly. Ordinary meeting.

Royal Institution of Great Britain.—Thursday, January 20th. At 3 p.m. At Albemarle Street. Lecture on "The Utilisation of Energy from Coal: The Chemistry and Economics of Coal and its By-products," by Prof. W. A. Bone, F.R.S.
Friday, January 21st. At 5.30 p.m. Lecture on "Problems in Capillarity," by Prof. Sir J. Dewar, F.R.S.

Greenock Electrical Society.—Friday, January 21st. At 7.45 p.m. At the Temperance Institute, 19, West Stewart Street. Paper on "Direct-current Machines," by Mr. J. A. Kinnaird.

Institute of Mechanical Engineers.—Friday, January 21st. At 8 p.m. At St. George Street, S.W. General meeting.

Association of Mining Electrical Engineers (West of Scotland Branch).—Saturday, January 22nd. At 4.30 p.m. At the Royal Technical College, Glasgow. Paper on "Electrical Shaft Winding," by Prof. D. Burns.

Manchester Association of Engineers.—Saturday, January 22nd. At the Grand Hotel, Aytoun Street. Paper on "Cast Iron: The Strength and Properties of Castings," by Mr. E. L. Rhead.

NOTES.

Information Invited.—Will any of our readers who have lately had unfortunate dealings with a firm supplying refills for electric pocket-lamps kindly place themselves in communication with the Editors of the ELECTRICAL REVIEW, sending particulars? The strictest confidence will be preserved.

Foreign Trade.—FIGURES FOR DECEMBER AND FOR THE YEAR.—The following are the electrical and machinery figures given in the official returns for December:—

	Month of December.		*Inc. or dec.*	*Twelve months, 1915.*		*Inc. or dec.*
IMPORTS.						
Electrical goods and apparatus, excluding machinery and uninsulated wire	£ 112,003	+	£ 22,087	£ 1,096,234	−	£ 146,536
Machinery ...	700,808	+	156,572	8,847,844	+	2,135,345
EXPORTS.						
Electrical goods and apparatus, excluding machinery and uninsulated wire	258,792	+	74,429	3,180,809	+	162,209
Machinery ...	1,474,256	+	17,975	19,192,153	−	12,170,940

Fatalities.—An inquest was held on Monday into the cause of death of James Hughes. The evidence of a taxi-driver was to the effect that he was on his stand in Piccadilly on the previous Friday when he saw two men on an extended telescopic ladder tower. They were repairing electric arc lamps. He noticed that while they were at the foot cleaning a globe the ladder wagon was blown by the wind for some 90 yards on its wheels. The men fetched it back, and, having placed it in position, went to the top to fix the globe. Suddenly the ladder was blown over. Hughes was removed to the infirmary, but was dead on arrival. The other man (Herbert Ball) was badly injured. Alfred Wilkinson, a superintendent of the department, said he did not think the accident would have happened if the jack had been used and the ladder had been set on its feet instead of being left on the wheels. He thought there had been an error of judgment. A verdict of "Accidental death" was returned.

ROCHDALE.—Last Wednesday an inquest was held on Richard Richards (52), labourer, of 4, Slack Street, Rochdale, who was found terribly injured in the motor room at Messrs. Kelsall and Kemp's mill. It appeared that deceased was working on some repairs in the dynamo room, and was asked by a colleague to take a wire template from the dynamo room to the workshop in Penn Street. Shortly afterwards the assistant engineer at the mill heard the motor in the adjoining room start running, and immediately afterwards there was a shout for help. He went into the adjoining room, stopped the motor, and found deceased lying on his back with his head against the driving pulley and the wall. He suffered from a compound fracture of the base of the skull, and a crushed right arm, and died later from shock and hemorrhage. Mr. J. H. Chadwick, deputy coroner, said there was no satisfactory explanation as to how the accident happened, although it was suggested that the man was taking a short cut. He had no business to be where he was found, and had he gone the other way round, the accident would never have happened. "Death through misadventure," was the verdict.

WOLVERHAMPTON.—An inquest was held on Friday, last week, at Wolverhampton, concerning the death of Richard Thomas Akers (19), who was killed at the works of the Efandem Electrical Co. on 5th inst. Mr. Clarkson and Mr. A. C. Skidmore represented the Efandem Co., Mr. Randle J. Evans appeared for the relatives of the deceased, and Mr. A. Wolfe, H.M. Inspector of Factories, was also present.

Ethel Rose Williams, a girl employed by the Efandem Co., deposed to a conversation which she had with Akers prior to his death. She said he had called her attention to a wire over a door which was hanging down, and remarked that if he did not put it right some one might have a shock. It was shortly afterwards that the sister of Akers reported that he was on the floor looking funny. Witness had not seen the wire before Akers called her attention to it. Replying to Mr. Evans, witness said she should think the wire was hanging low enough to touch Aker's head when he went through the door.

John Molloy, a youth said he saw the wire hanging a quarter of an hour before the accident. To witness's knowledge it had been in the same position for about three days, and it was about a yard and a half from the ground.

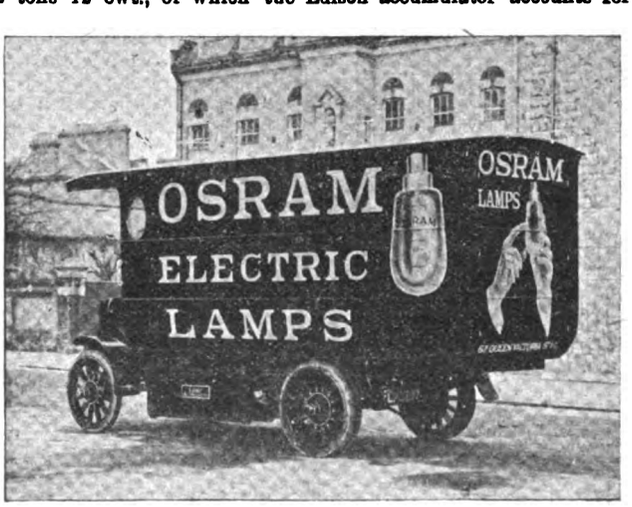
Frederick Thomas Ridgeway, electrician at the works, said the gale during the holidays blew a shed down, and when work was resumed on the Tuesday after Christmas he had all the fuses withdrawn, and the plant on that particular circuit rendered safe. For the wire in question to be "alive" the fuses must have been put back; but who had done this witness did not know. He had no idea that the wire had been hanging until his attention was called to it. It had been looked at. Two or three men had spoken to him about light, and he had told them they could not have any; he suggested that they should use torches. Witness subsequently discovered that the fuses had been replaced by some one.

After hearing medical evidence, the jury went to inspect the wire, and on their return the foreman said they would like to know who replaced the fuses.

The Coroner said that was a thing they would never know. Whoever did it exceeded his duty, and the one who took upon himself to do it caused the death of this unfortunate youth.

The jury found that "Death was due to electrocution, as the result of an accident."

An "Osram" Electric Vehicle.—We illustrate herewith an Osram electric vehicle which has lately been added to the fleet of express delivery motors employed by the G.E.C. for the delivery of Osram lamps to all parts of the United Kingdom. This van is handsomely finished in dark blue; the gross weight is 2 tons 12 cwt., of which the Edison accumulator accounts for



16 cwt. A load of 2 tons can be carried, the accommodation being sufficient for between 11,000 and 12,000 standard Osram lamps. The average speed on the flat is 10 M.P.H., and between 40 and 45 miles can be covered on one charge. Re-charging is effected by a dynamo at the Osram-Robertson Lamp Works in Hammersmith. In addition to rheostatic braking, a system of hand brakes is provided.

Patents and Alien Enemies.—As the result of an application lodged by Messrs. Ferranti, Ltd., licences granted to the Allgemeine Elektricitäts Gesellschaft in respect of Patents Nos. 21,027/03, 26,359/12, and 12,926/14, granted to Hamilton, have been avoided.

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Institution and Lecture Notes.—Institution of Civil Engineers.—On Tuesday last a paper on "The Electric Locomotive" was read by Mr. F. W. Carter, in which the author reviewed the various classes of locomotive that have been evolved, and discussed the comparative merits of the methods employed for transmitting the torque from the motors to the driving axles. The question of stability of the rolling motion of the wheels was considered in connection with the tilting of the rails and the coning of the wheels, and it was shown by novel methods of analytical treatment that, under certain conditions, a "nosing" tendency at high speeds might be anticipated, a remedy being found in the use of guiding wheels elastically centred to align with the main driving wheels. Recent data of tractive-resistance tests on the New York Central and Hudson River Railroad were given, showing conclusively that, for a particular type of coach, the additional tractive resistance per additional coach was a function of the speed, and was independent of the number of coaches, provided this was greater than two, and was a straight-line function of the speed within the limits of the tests. In the discussion which followed, Messrs. Merz, Thornton, Aspinall and Roger Smith took part, and the discussion was adjourned to January 25th.

Greenock Electrical Society.—On Friday last a paper was read by Mr. W. B. Smith on "The Economy of Electricity in a Small Household." It was shown that by the general use of electric heating appliances the consumer would ultimately benefit by the consequent general reduction of electricity charges, just as the lighting consumer had already benefited through the cultivation of a power load for central stations. The advantages and costs of electric cooking were fully explained, and figures were advanced from actual results obtained in houses in Greenock.

Institution of Electrical Engineers.—At a meeting of the Scott sh Local Section held in Glasgow on Tuesday last, Mr. J. R. Beard's paper on "The Design of High-Pressure Distribution Systems" was read and discussed.

A meeting of the Manchester Local Section was held on Tuesday last, when a paper was read by Prof. Miles Walker on "The Predetermination of the Performance of Dynamo-Electric Machinery," and a discussion followed.

At a meeting of the Newcastle-on-Tyne Local Section, on Monday last, Mr J. R. Beard read his paper on "The Design of High-Pressure Distribution Systems," and a discussion followed.

At the meeting of the Yorkshire Local Section on Wednesday last Mr. Beard's paper was read and discussed.

Educational.—University of London, University College.—A course of six lectures on the "Electrical Production of Nitrates for Fertilisers and Explosives" will be delivered by Mr. E. Kilburn Scott, M.I.E.E., A.M.Inst.C.E., on Wednesdays at 5.30 p.m., beginning on January 26th, 1916. The first lecture is open to the public without fee, on application to the Secretary, University College, Gower Street, W.C. The course is open both to members and non-members of the University, the fee being £1 11s. 6d.

Volunteer Notes.—Engineering Institutions' Volunteer Engineer Corps.—Headquarters, Chester House, Eccleston Place, S.W.—Orders for week commencing January 17th, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commandant.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Saturday, January 15th.—Uniform Parade, 2.45 p.m., Chester House.

Monday, January 17th.—Sections 1 and 2, Technical; Sections 3 and 4, Squad, Signalling Section and Recruits.

Tuesday, January 18th.—School of Arms, 6 to 7 p.m.

Thursday, January 20th.—Shooting for Sections 3 and 4.

Friday, January 21st.—Sections 3 and 4, Technical; Sections 1 and 2, Squad, Signalling Section and Recruits.

Sections for Technical Parade at Headquarters, London Electrical Engineers, 46, Regency Street, S.W.

Sections for Shooting Parade at Miniature Ranges.

Unless otherwise ordered, all Parades at Chester House.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Regiment (Volunteers).—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, January 13th, 1916:—

Week-end Parades.—Saturday.—The Battalion will parade at Baker Street Station at 2.30 p.m. and proceed by train to Dollis Hill, where they will detrain, proceeding by march route to Wembley Park.

Sunday.—The Battalion will parade at 9.30 a.m. at Liverpool Street Station (low level entrance) and proceed by train for entrenching duties, arriving in town, on the return, about 6 p.m. Members will make their own arrangements for lunch.

Musketry.—The Acton Range will be open on Saturday, the 15th inst., both morning and afternoon, for Inter-Platoon Competition practice. Shooting to commence at 11 a.m. and 2 p.m. Members when sending in their names should advise the Musketry Staff at what time they will attend, to enable necessary arrangements to be made. Members must parade in Uniform. Names must be sent into Headquarters not later than Friday midday.

As the days are short, it is hoped members will help the Musketry Staff by attending punctually.

A. G. Joiner, *Major and Adjutant*, O.B.C.

Social.—On the last day of the old year, Messrs. Crystelco, Ltd., of Bedford, entertained their employés. The works closed early, and at 6 o'clock the staff and the employés, numbering some 300, sat down to high tea. Mr. H. S. Deacon extended a welcome to all, after which the party moved to the entertainment hall, where a programme was carried out by London artistes, Mr. Reg. Wishart's mystery box trick being especially appreciated. At 9 o'clock the company adjourned for dancing, recreation and refreshment. On the stroke of midnight, hands were joined in one immense circle, and "Auld Lang Syne" was sung with feeling and enthusiasm, which brought the evening to an end. All the arrangements were carried out by the staff, under the direction of Mr. A. R. Powell and Mr. A. R. Harrisson.

French Prizes.—The French Academy of Sciences has awarded the Hébert prize for physics to Prof. Pupin for his important services to telegraphy and telephony and his method of harmonic analysis; the Hughes prize to M. R. Marcelin a young scientist of the first rank, who was killed in September, 1914; and the Gaston Planté prize to M. Marcel Moulin, for his researches in radiation, who was killed in September, 1914. Out of 37 awards, no fewer than 11 were to men who had fallen in battle.

Manchester Engineers' Demand Refused.—The Committee on Production announced on Monday that it had decided to refuse the application of engineers in the Manchester district for an advance of 6s. a week on time and 15 per cent. on piece rates. The Committee declares that no substantial case for an increase has been made out. Some 30,000 skilled engineers and about the same number of semi-skilled and unskilled workers are affected by the decision. Early last year the men received an advance of 3s. a week and 10 per cent. on piece rates.—*Manchester Courier.*

Appointments Vacant.—Shift engineer and three attendants, for Military Camp in North Yorkshire; shift engineer (£2), for Queen Mary's Military Hospital, Whalley; shift engineer, for the Walsall Corporation electricity department; charge engineer (£3), and junior engineer (£2), for the Southwark B.C. electricity department; station assistant and shift engineers, junior engineers and attendants, foreman of works, pumping engineers, station fitters, engine drivers, stokers, trimmers, linemen, wiremen, mates and labourers, for the Military H.T. electric power installations in the Northern Command. See our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Mr. H. F. Richens, late assistant distribution engineer at the Stockton-on-Tees Corporation electricity works, has taken up an appointment with Messrs. Naylor Bros. (London), Ltd., Southall, Middlesex.

The Wimbledon B.C. has increased the salary of Mr. H. Oswald, one of the engineers in charge at the electricity works, from £104 to £130 per annum as from January 12th, 1916.

Mr. Ernest A. Hilton, who is employed in the Manchester Corporation electricity department, was married at Marple last week to Miss Ellen Kay, of Bleak House, Ludworth. Among the presents were a silver cake basket and a biscuit barrel from the bridegroom's colleagues in the above department.

St. Helens T.C. has increased the salary of Mr. H. C. Duncan, commercial assistant at the electricity works, to £150 per annum, and that of Mr. B. T. Hawkins, electricity station superintendent, to £200.

Peterborough T.C. has applied to the War Badge Department of the Ministry of Munitions for war badges for the following members of the electricity works staff, whose services are considered indispensable for the proper operation of the generating station:—Mr. T. Rowland, chief engineer; Mr. R. Rowland, mains superintendent; and Messrs. W. Millington, J. Prescott, and S. Poole, shift engineers.

Mr. C. W. Shepherd has resigned the position of general manager of the Edinburgh and District Tramway Co. The board have accepted the resignation, and asked him to continue his services as secretary. Mr. J. D. R. Cox, of Messrs. Babcock & Wilcox, has been appointed general manager and engineer to the company. Mr. Shepherd has been in indifferent health for some time. He has been associated with tramway work for 32 years.

Reading T.C. has refused the general manager and engineer of the tramways leave of absence for immediate military service, but has raised no objection to his presenting himself for attestation in Section B of the Army Reserve.

At the Leeds City Council last week considerable discussion took place with reference to the recommendation of the Electricity Committee that the salary of Mr. C. N. Hefford, manager of the electricity department, should be increased from £600 to £800 per annum. Mr. Hugh Lupton pointed out that Mr. Hefford was appointed on probation three years ago on the understanding that if he did his work well he would receive a salary commensurate with the duties of his office. Mr. Hefford's predecessor received £900, and had afterwards received £1,000 at Liverpool, and this had later been increased to £1,500. An amendment was moved that the increase should not take place until the termination of the war, but this was defeated by 32 votes to 19, and the original recommendation was carried.

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Mr. HAMPTON E. BLACKISTON, district mains and sub-station engineer, South Wales Electrical Power Distribution Co. (formerly of the Cleveland & Durham Electric Light & Power Co., Nuneaton Corporation, etc.), was recently married to Olive Isabel, eldest daughter of Mr. and Mrs. A. J. Siedle, of Streatham.

General.—Mr. EDWARD VICKERS, for 14 years chief electrical engineer to Messrs. Walter Locke & Co., Ltd., of Calcutta, has returned to this country, and now represents Messrs. Luke, Stonebridge & Co., Ltd., electrical engineers and contractors, of Calcutta and Lahore. Manufacturers of electrical apparatus are invited to address him at Pinley Green, Warwick.

Mr. J. G. MENEER, late chief electrician at South Crotty Mines, Poole (Cornwall), who some time ago joined the Royal Flying Corps, has been promoted to the rank of first-class air-mechanic. He is at present at Farnborough.

It is announced that Professor W. H. PERKIN, F.R.S. (son of the late Sir Wm. Perkin), Professor of Chemistry at the University of Oxford, has accepted the post of head of the Research Department of British Dyes, Ltd., and the chairmanship of the advisory council of that company.

Mr. P. J. PYBUS, M.I.E.E., has been appointed by the Bradford Education Committee as external examiner in electrical engineering for the final examinations for the Technical College Diplomas and for the Technological Exhibitions, and Prof. W. H. WATKINSON, M.I.E.E., and Mr. JAMES WATSON, M.Inst.C.E., have been appointed external examiners in mechanical and civil engineering respectively.

In the ballot list for the next meeting of the Institution of Mechanical Engineers, the Rt. Hon. LORD MONTAGU OF BEAULIEU is nominated for election as an Associate. His Lordship's marvellous escape from drowning after the Hunnish attack on the *Persia* has spared for the roll of this engineering institution the name of one whose services have been as brilliant as the title that he bears is exalted.

Roll of Honour.—Regt. Sergt.-Major JAMES GILL, of the 23rd Battalion Rifle Brigade, who has been presented by the N.C.O.'s with a sword, held a position in the traffic department of the Blackpool Corporation tramways system prior to rejoining the Army.

Trooper LEONARD C. BUTTERWORTH, of Chadderton, aged 20, who has been killed in France, was an electrical meter tester in the employ of Messrs. Ferranti prior to the war.

Private JAS. L. HORNE, of the 1/6th Battalion Manchester Regiment, who was, prior to the war, engaged as an electrical engineer at Manchester, is reported killed in action, after being missing at the Dardanelles for some months.

Lieutenant H. C. JONES, of the 3rd (Toronto) Battalion, 1st Canadian Division, who has died in hospital in London from wounds received in action, was formerly with Messrs. Stothert and Pitt, engineers, of Bath.

Private SAMUEL HAMER, of Monton, who has been on active service with the 16th Lancashire Fusiliers, is reported killed in action. He was 26 years of age, and, prior to the war, was employed at the British Westinghouse works at Trafford Park.

Corporal C. M. DEAN, of the 7th South Lancashire Regiment, formerly employed at the British Westinghouse Works, Trafford Park and at the Peel-Conner Telephone Works, Salford, has died from wounds received in action.

Lieutenant NORMAN COUTIE LOWSON, Royal Engineers, Special Reserve, 7th Division, a son of Mr. James Lowson, senior partner of Messrs. W. C. Martin & Co., electrical engineers, Glasgow, has been twice mentioned in dispatches during the past six months, first for distinguished service in the field at the battle of Neuve Chapelle, and now more particularly in relation to the fight at Loos.

Obituary.—MR. RICHARD GRIGG.—We deeply regret to learn of the sudden death at Ottawa of Mr. Richard Grigg, Commissioner of Commerce in the Canadian Trades and Commerce Department, with whose reports on Canadian trade, prepared several years ago, our readers are familiar. Mr. Grigg was a native of Plymouth, and in 1907 was chosen to be head of the British Intelligence Service in Canada.

MR. A. ILG.—The *Times* states that Mr. Alfred Ilg, the engineer and confidential counsellor of the Emperor Menelik, has died at Zurich at the age of 62. He went to Abyssinia in 1878 to superintend the construction of roads, bridges, fortifications, telegraphs, etc.

MR. JOHN CAMERON SWAN.—The death has just occurred of Mr. John Cameron Swan, elder brother of the late Sir J. Wilson Swan. Mr. Swan was 89 years of age, and he is described as a prominent figure in Newcastle business and scientific circles for half a century. He was well known in the chemical trade as a manufacturer and merchant, and he had also been closely identified with manganese and other mining operations.

Will.—The late Prof. R. MELDOLA, F.R.S., left £33,767 net personalty.

CITY NOTES.

Anglo-American Telegraph Co., Ltd.—The following dividends are announced to the close of the year, 1915, viz.:—A balance dividend of £1 10s. per cent. upon the ordinary consolidated stock for the year, less income-tax at 2s. 11d. in the £; a balance dividend of £1 10s. per cent. upon the preference stock for the year, less income-tax at 3s. 2d. in the £; a first and final dividend of £1 10s. per cent. upon the deferred stock for the year, less income-tax at 2s. 8d. in the £. These dividends are payable on February 1st, and, together with those already paid, they will amount to £3 15s. per cent. on the ordinary consolidated stock, £6 per cent. on the preferred stock, and £1 10s. per cent. on the deferred stock for the year 1915. A bonus of 1s. 9d. per cent. is to be paid on the undivided ordinary stock, and one of 3s. 6d. per cent. on the deferred stock, free of income-tax.

Buenos Aires Lacroze Tramways Co., Ltd.—The report for the year ended June 30th states that, notwithstanding the higher value of coal, the cost of which has risen 40 per cent., the percentage of working expenses has been lower owing to economy practised. The gross receipts amounted to $6,100,652 m/n, a decrease of $321,820. The working expenses were $3,760,781 m/n, a decrease of $222,882 m/n, leaving as net profits on working $2,339,871 m/n.—*Financial Times.*

Dublin United Tramways (1896) Co., Ltd.—The directors have declared a dividend at the rate of 5 per cent. per annum on the ordinary shares for the past half-year. £5,000 has been placed to reserve and renewal fund, £18,000 allocated for renewal of rails, and £13,045 carried forward.

Direct United States Cable Co., Ltd.—An interim dividend of 2s. per share, less income-tax at 3s. 2d. in the £ (at the rate of 4 per cent. per annum), is announced for the quarter ending December 31st, 1915.

Greenwood and Batley, Ltd.—The directors report a profit balance of £47,226 to July, 1915, plus balance at credit at March 31st, 1915, £6,417, making £53,644. After placing sums to depreciation and reserve and paying the 7 per cent. cum. pref. dividend, a dividend is to be paid of 25s. per share on the fully-paid ordinary shares and of 12s. 6d. per share on the £5 paid ordinary shares, absorbing £23,738, leaving £7,906 to be carried forward.

STOCKS AND SHARES.

TUESDAY EVENING.

Stock Exchange markets are a little undecided. What rather unsettled the investment department was the issue, towards the end of last week, of French Treasury Bills of twelve months' currency, bearing interest of 5½ per cent., and so affording a yield of 6 per cent. on the money. This came as a further reminder of the urgency of the money question, and our own War Loan wavered, causing other sound stocks to lose some of their recent steadiness.

Taking 6 per cent. as the newly-established credit of the French Government, it will be noticed that a number of debenture stocks, and even preference shares, in our electrical price lists give a return of less than this on the money. Time was when French credit stood highest in the world, next to that of British Consols, but, judged by temporary quotations—and, after all, the comparison is on empirical grounds only—there are British industrials whose attractions in the eyes of the investor are greater than the bonds of our nearest ally.

The Home Railway market is rousing a little interest, though of the lethargic order, in the forthcoming dividends, amongst the first of which will be that of the Metropolitan Railway, the announcement being due on January 27th. In the market, it is thought that the company will pay about the same as it did this time last year—namely, 1 per cent., which would make 1 per cent. for the year, and afford a return of about 4 per cent. on the money. It is not supposed, of course, that the deferred dividend stock will come in for any distribution this time. The Surplus Lands will no doubt get their 2¾ per cent., and the yield on this stock comes to 5½ per cent. on the money at the present price of 50.

An unkindly joke in the market is to the effect that District ordinary stock will get the same dividend as usual. Incidentally, it may be recalled that the last time that this stock received anything at all was in August, 1882. There is still a little business being done in East London ordinary, on the basis of 3⅛. Underground Electrics have been active, and the income bonds shot up another 2¼ to 81½. For the £10 shares £2 was bid the other day, but the price tempted sellers and the shares have gone back a little to 38s. 9d.; while the "A" 1s. shares, after touching 6s. 9d., are 6d. up on the week at 6s. 6d. London and Suburban Tractions have been wanted at cheap prices, but did not come to market. There is nothing doing in London United Tramways 4 per cent. debenture stock, of which, however, there are buyers at 51 or thereabouts.

Anglo-American Telegraph deferred stock rose ⅛ on the declaration of the usual dividends, with an extra 1s. 9d. on the ordinary, giving 3s. 6d. to the deferred. This came as an unexpected surprise, while it underlines the suggestion made here on several occasions, namely, that the deferred stock is quite a good speculative investment of its class. The 6 per cent. preferred at par is also recommendable, from the point of view of security, but there is not much to go for in the way of probable appreciation in the price.

The Treasury is bidding 100¼ for New York Telephone 4½ per cent. bonds, this price applying to the sterling issue. The

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first price posted in the Stock Exchange was 103½, and there was a rush round to the Government Office to sell at this figure. The holders elaborately explained—afterwards—that they were neither surprised nor chagrined to find that the price of 103½ referred to dollar bonds only, and that 3 points had to be allowed in respect of the sterling issue. The Government bid was distinctly higher than that of the market, because the bonds were on offer at 100 last Thursday, while the Government offered 100½ on the following morning.

The Telegraph market as a whole is very steady. There is considerable scarcity of the Eastern descriptions; and while the jobbers are ready enough to quote prices, they smile rather pityingly when a broker comes to ask them to make a price in some of the various stocks with which they are not supplied. "We can buy of you," they say; "but we have none to sell." Marconis are strong on the anticipation that the company is about to issue a statement showing what payments the Government will make to the company for the use of its system since the outbreak of war.

Brazilian Traction shares are a dull spot in consequence of a relapse in the Rio exchange to under 1s. This question of exchange is worrying not a little some of the markets connected with Brazilian stocks, but others profess that it should be disregarded, inasmuch as the fluctuations are so frequently brought about merely by speculators on the other side of the Atlantic. This, of course, is likely enough; but, at the same time, a fall in the exchange does not encourage confidence in the holders of Brazilian securities. Mexican stocks and shares of various kinds are dull and depressed. British Columbia Electric Railway deferred stock is 5 points lower. The Anglo-Argentine Tramways group shows a disposition to droop, noticeable in small declines in the debenture stocks.

Metropolitan Electric ordinary went back ⅛ to 2¼, but otherwise there are no changes in the list of home electricity shares. County of London change hands with a fair degree of frequency on the basis of 10; and in some of the others there are occasional bargains about the figures quoted in our price lists. Speaking generally, however, there is no fresh animation in this department. May we add an expression of great regret at the loss which the market has just sustained in the death of Mr. H. B. Mudie, a well-known member of the House, who, before the war broke out, used to deal in electric lighting shares. Outside the Stock Exchange, he was best known as one of the leading exponents of Esperanto; and the news of his death in France came as a shock to his wide circle of friends.

British Westinghouse preference constitute the outstanding feature in the manufacturing group. The price has spurted 5s. to 2¼, and the company is said to be doing exceedingly well with its war contracts. A lively business has sprung up in the shares; while, on the other hand, the recent activity in British Aluminiums has somewhat subsided. Prices of other manufacturing shares keep firm, without attracting a great deal of attention, so greatly has public interest become absorbed at the present time in the market for rubber shares.

And the rubber market remains the most active in the Stock Exchange. The other day the price of the raw stuff reached 4s. 3½d. per lb., and the buoyancy increased until the animation wore the appearance of a boom in miniature. Despite Treasury regulations, there has been a lot of speculation during the past few weeks; and probably there were a good many men in the market not greatly displeased to see the price of the raw material slip back to 4s. per lb., which induced a few sales of shares, enabling the recent sellers to replace their stock at more reasonable figures than those lately prevailing.

In the armament group, it is noticeable how Vickers have just lately overhauled Armstrongs and passed them in price, though the difference between them is still a matter of a few pence only. There is a certain amount of life in copper shares, and the market is a good one for the time being.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month.		No. of weeks.	Total to date.		Route miles open.	
		£	£		£	£		Inc.
Blackpool-Fleetw'd	Jan. 1	1,233	— 86	52	88,964	— 320	8	..
Bristol	Dec. 31	45,977	+9,756	52	506,923	+5[illegible]92	80·5	..
Cork	„ 30	1,917	+ 128	52	26,045	+ 143	54·25	..
Dublin	„ 24	24,032	+ 594	51	311,437	+11,072	9·89	..
Hastings	„ 31	2,312	+ 112	52	89,729	— 212	19·3	..
Lancashire United	„ 29	6,352	+ 287	52	89,690	+ 5,399	42	..
Llandudno-Col. Bay	„ 31	734	+ 51	4½	817	+ 80	6·5	..
Tyneside	„ 22	1,925	— 133	25	14,925	— 664	11	..
Anglo-Argentine ..	„ 31	118,689	+4,080	52	2,667,728	—131,039	..	..
Auckland	„ 17	21,804	+1,390	42½	125,810	+ 908	25·42	1·66
Calcutta	Jan. 1	17,901	+1,871	..	..	— 1,597	..	..
Kalgoorlie, W.A. ..	Oct.	2,675	..	43	27,791	..	..	..
Madras	..	..	..	..	..	..	..	..
Montevideo ..	Dec.	31,035	+2,700	9	59,712	+ 4,026	..	..
Dublin-Lucan Rly.	Dec. 31	480	— 28	26	8,863	+ 59	7	..

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Jan. 11, 1916.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.				
Brompton Ordinary	10	7½	—	£6 18 4
do. 7 per cent. Pref.	7	7	—	5 0 0
Charing Cross Ordinary	5	3½	—	7 2 10
do. do. do. 4½ Pref.	4½	8½	—	6 0 0
do. do. City Pref.	4½	8 xd	—	7 10 0
do. 4 Deb.	4	7⅓	—	5 2 7
Chelsea	5	4½	—	5 17 8
do. 4½ Deb.	4½	87	—	5 3 6
City of London	9	12½	—	7 7 8
do. do. 6 per cent. Pref.	6	11	—	5 9 1
do. do. 5 Deb.	5	98 xd	—	5 2 0
do. do. 4½ Deb.	4½	85 xd	—	5 6 0
County of London	7	10	—	7 0 0
do. do. 6 per cent. Pref.	6	10½	—	5 17 8
do. do. 1st Deb.	4½	83 xd	—	5 5 0
do. do. 2nd Deb.	4½	88	—	5 8 0
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	1⅜	—	8 8 4
do. do. 6 per cent. Pref.	6	4½	—	7 1 2
do. do. 4 Deb.	4	75	—	5 4 0
Metropolitan	8½	2¼	— ⅛	7 15 7
do. 4½ per cent. Pref.	4½	8½ xd	—	6 18 6
do. 4½ Deb.	4½	85	—	5 6 0
do. 3½ Deb.	3½	70	—	5 0 0
St. James' and Pall Mall	10	6	—	8 6 8
do. do. do. 7 per cent. Pref.	7	6	—	6 16 8
do. do. do. 3½ Deb.	3½	70 xd	—	5 0 0
South London	5	2¾	—	7 5 6
South Metropolitan Pref.	7	1⅛	—	6 14 0
Westminster Ordinary	9	⅜	—	7 10 0
do. 4½ Pref.	4½	4	—	5 12 6
TELEGRAPHS AND TELEPHONES.				
Anglo-Am. Tel. Pref.	6	100	— ⅜	6 0 0
do. Def.	33/6	23½	+ ⅛	7 4 0
Chile Telephone	8	6½	—	6 3 0
Cuba Sub. Ord.	5	8	—	6 5 0
do. Pref.	10	15	—	6 13 4
Eastern Extension	7	12½	—	*6 8 0
do. 4 Deb.	4	80	—	5 0 0
Eastern Tel. Ord.	7	128	—	*6 4 0
do. 3½ Pref.	3½	66	—	5 6 0
do. 4 Deb.	4	81	—	4 19 0
Globe Tel. and T. Ord.	6	10⅜	—	*6 12 2
do. Pref.	6	10½	—	5 17 1
Gt. Northern Tel.	22	88	— ½	6 13 4
Indo-European	18	48 xd	—	6 15 4
Marconi	10	1⅝	+ ⅛	5 6 8
New York Tel. 4½	4½	100	—1	4 9 1
Oriental Telephone Ord.	10	1⅝	—	5 6 8
do. Pref.	6	⅞	—	6 17 2
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	8	6	—	*7 12 5
do. Pref.	6	4¾	—	5 3 1
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	12⅜	—	*6 7 0
do. 4 Deb.	4	79 xd	—	5 1 0
HOME RAILS.				
Central London, Ord. Assented	4	72½	—	5 10 6
Metropolitan	1½	25½	+ ⅛	4 18 0
do. District	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	1⅛	—	Nil
do. do. "A"	Nil	6/6	+6d.	Nil
do. do. Income	6	81½	+2½	*8 7 3
FOREIGN TRAMS, &c.				
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
do. 5 Deb.	5	95	—	5 5 0
Anglo-Arg. Trams, First Pref.	5½	4	—	6 17 6
do. 2nd Pref.	5½	8⅝	—	8 8 0
do. 4 Deb.	4	71⅝	—1	5 12 0
do. 4½ Deb.	4½	77	—	5 17 0
do. 5 Deb.	5	80½	— ½	6 4 0
Brazil Tractions	8½	51	— ½	6 17 8
Bombay Electric Pref.	6	10½	—	5 17 1
do. 4½ Deb.	4½	85	—	5 8 0
British Columbia Elec. Rly. Pfce.	5	61	—	8 4 0
do. do. Preferred	—	40	—	Nil
do. do. Deferred	—	35	—5	Nil
do. do. Deb.	4½	64	—	6 12 10
Mexico Trams	Nil	40	—	Nil
do. 5 per cent. Bonds	—	49	—	Nil
do. 6 per cent. Bonds	—	48	—	Nil
Mexican Light Common	Nil	29	—	Nil
do. Pref.	Nil	40	—	Nil
do. 1st Bonds	—	47	—	—
MANUFACTURING COMPANIES.				
Babcock & Wilcox	14	2⅞	—	5 15 0
British Aluminium Ord.	5	22/6	—	4 9 0
do. Pref.	6	18/-	—	6 13 4
British Insulated Ord.	15	10½	—	7 2 10
do. Pref.	6	5½	— ¼	5 11 7
British Westinghouse Pref.	7½	45/-	+5/-	6 13 4
do. 4 Deb.	4	69	—	5 14 10
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	11½	—	6 11 4
do. 5 Pref.	5	4½	—	5 17 8
do. 4½ Deb.	4½	90	—	5 0 0
Castner-Kellner	20	8	—	6 13 4
Edison & Swan, £8 pd.	Nil	9/-	—	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	60	—	6 13 4
do. do. 5 % Deb.	5	60	—	8 6 8
Electric Construction	6	14/-	—	8 11 6
do. do. Pref.	7	19/9	—	7 1 4
Gen. Elec. Pref.	6	9½	—	6 3 1
Henley	20	18½	—	*8 12 6
do. 4½ Pref.	4½	4½	—	5 6 0
do. 4½ Deb.	4½	92	—	4 17 9
India-Rubber	10	8½	—	*13 1 2
Telegraph Con.	20	8½	—	*8 1 0

* Allowance made for dividends being paid free of income-tax.

Deferred Cable Telegrams.—Owing to interruptions of cables and pressure of traffic, the deferred service has been temporarily suspended.

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DIRECT-CURRENT MOTOR MAINTENANCE.

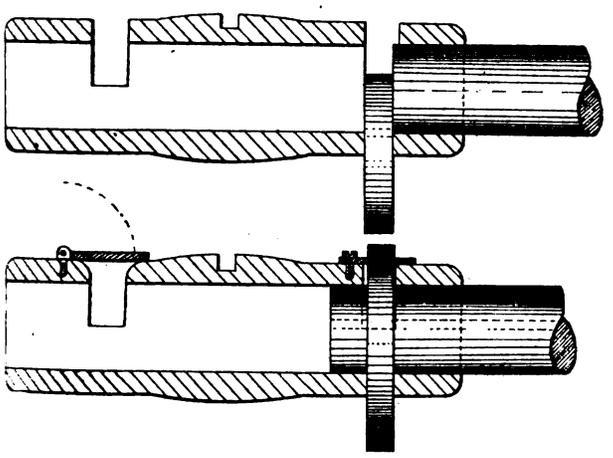
By S. LEES.

(*Concluded from page 7.*)

The writer does not recommend the indiscriminate scouring of commutators, and, speaking from experience, would say that, given average conditions of working, and everything else being equal, the application of the cleaning block should rarely be necessary. If required very fine quality carborundum cloth, or glass paper (cloth, if obtainable), may be used in a wood holder correctly shaped to fit the circumference of the commutator circle. Both of the preceding operations should be followed by a faithful clean-up of the whole machine.

When replacing an armature, after overhaul, say, the mistake is often made of overlooking the presence of the bearing oil-rings, which not infrequently suffer damage before the cause thereof is even suspected. On reference to fig. 18, it is evident that this happens through the ring being in the position shown in the sketch previous to the insertion of the shaft. To obviate such an eventuality a simple rest device, of which two forms are shown at fig. 19, may be fitted with advantage. A prolific source of seized bearings is failure of the oil-ring to travel. This may happen from various causes, chiefly, shortage of oil in the bearing well, the effect of which is to produce "whirling" of the ring, which becomes lodged on the top side of the bush, as shown in fig. 20. The simple expedient of chamfering (correctly) the sides of the ring slot, will effectually prevent the ring from permanently leaving its slot.

Too little attention seems to be given to the proper design of oiling rings. The common flat section type is bad, as it



Figs. 18 and 19.

has a great tendency to stick or become sluggish when working, especially with a heavy-bodied oil. A flat ring of the form represented at fig. 22 almost invariably hugs one side or the other of the ring slot. This is due to the greater capillary effect which is produced at this point than at any other part of the exposed shaft, the cause being the "pull" exerted by the captive film of lubricant already existent between the walls of the bearing shell (edges) and the shaft. The rising ring, coated with oil, is thereby attracted, the result being that the ring hugs or drags along the side of the slot, its rate of travelling being considerably below that which it would otherwise attain were the ring free from the retarding influence above described. Sometimes the ring will stop altogether, and in consequence the bearing heats up, and if allowed to continue thus, seizure follows. With oils which have an oxidising tendency a ring of this type may become stuck so fast as to refuse to move when the machine is started. A well-designed ring should be formed in one truly circular piece without detachable joints of any kind, and possess little inertia beyond that necessary to overcome the tendency to "whip" or whirl. At high rotative speeds a ring which is too light churns or breaks up the surface of the oil and creates "creeping" and throwing along the shaft, and increases loss caused by evaporation, but, what is most serious of all, the errant ring conveys little or no oil to the shaft.

Various forms of chain had formerly some vogue, but the chain has many inherent disadvantages, and nowadays it is seldom used except on slow-moving machinery. To ensure an uninterrupted supply of oil the ring should sweep through a path unobstructed by metal projections, and easily clear the bottom and sides of the bearing oil-well. Two good forms of ring are shown in section at fig. 21. A perforated ring (fig. 23) has greater holding capacity than a plain one, but with the former there is a tendency to "drag," especially with the heavy classes of oils. The writer has often wondered why so many makers still persist in turning out motors having bearings fitted with hinged or flap-doors opening outwards. Such a fitting, especially at the driving side, may easily prove a source of danger

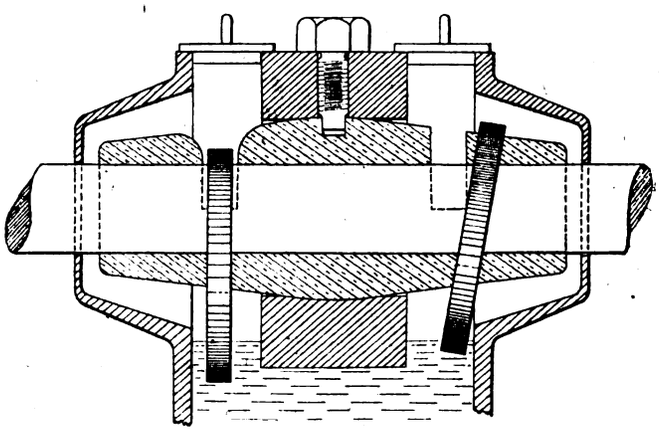


Fig. 20.

with the overhanging pulleys now so commonly used, and in dusty situations dirt accumulates on the lid, and when oiling time comes round, the bulk of the dirty matter oftener than not gets tipped into the bearing well. (This criticism is not meant as an advocacy for the pokey ungetatable order of bearing; by all means have bearings accessible, but at the same time reduce the possibility of entry of injurious matter to a minimum.) Oil openings or inspection apertures covered with large single-hinged lids or doors are bad practice, except, perhaps, for machines working under engine-room conditions. Adequate means should always be provided for thoroughly draining bearing oil-wells, and it is a wise precaution when cleaning out a dirty bearing to give the interior of the well a good flush out with paraffin before refilling with clean oil.

In some designs, the oil from the bearings insinuates itself inside the motor casing owing to the size of hole through which the shaft passes being unnecessarily large. A thick leather ring sandwiched between a couple of felt washers will effectually prevent this trouble, the device being fitted to the inside of the motor casing. Oil-thrower rings should always be so arranged as to come inside the bearing housing.

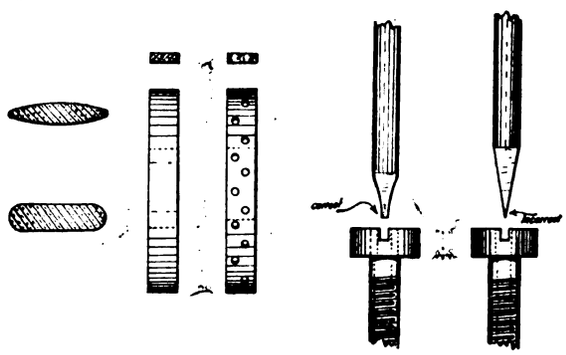


Fig. 21. Fig. 22. Fig. 23. Fig. 24.

Opinions differ considerably as to what is the best and most efficient form of ring, but a plain V section collar slipped on the shaft makes a very satisfactory and reliable device for this purpose; it has, also, the merit of simplicity, which is more than can be said of the many weird contraptions one frequently comes across. The practice of grooving the shaft itself, thread-fashion, is a foolish fetish, and, moreover, it does not prevent oil creeping.

With new machines the importance of clean bearings cannot be over-estimated. It is rarely indeed that intricate

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cored castings leave the shop entirely free from traces, at least, of moulding sand or other gritty substances. In addition to pickling and fettling, the usual practice of painting by brush does not always ensure the "fixing" of any sandy matter which may be lurking in, say, some rugged corner or unsuspected blow-hole. A better plan is to pour a sufficient quantity of *suitable* paint in the bearing-well, and after thoroughly swilling around, run off any surplus which may remain. The writer has had his quota of experience of bearing troubles arising directly from the presence of moulding sand. It is fairly well known that, whereas an ordinary ring-fed bearing will often work quite well for long periods even in the presence of gritty matter, a ball-bearing would be ruined probably very quickly; hence the advisability of seeing that such bearings are quite above suspicion before the machine so fitted is started,

Moulding sand, however, is not always to be blamed for seized bearings—on new machines, at any rate. A handful of clean waste, of average shop quality, often holds in suspension enough gritty and other foreign matter to cause not a little alarm to the intelligent and conscientious user. Again, the precaution of cleaning out thoroughly new bearings *on site* is not always appreciated properly. Almost invariably, after a machine has passed test, and previous to packing, the bearings are emptied of lubricant, but seldom indeed is provision made for exclusion of dust or dirt during transit to the customer. In shipping on and off rail, in slinging, &c., there are a score of different ways in which dirt, mud, and the like will, often unavoidably, become deposited in the bearings. The inside walls being more or less sticky the dirt adheres thereto, on flypaper principle, and if too much is taken for granted because the machine tested out satisfactorily, trouble sooner or later ensues; naturally, gritty matter is found, and a qualitative observation pronounces foundry sand, whereas, as likely as not, the disturbing cause will have had a more prosaic origin, probably a scraping of mud from a careless slinger's boot.

For obvious reasons some form or other of cable lug or thimble should always be used even for the smallest size of stranded cable. A good pattern of mechanical terminal device (proprietary) is on the market, which provides an efficient and neat attachment, especially for flexible cording; with the latter, efficient soldering is often a somewhat difficult matter where shop facilities are not obtainable. For heavy service the lug or thimble socket should always have at least one set-screw provided, not merely as a precautionary measure, but to ensure rigidity between cable and socket during the sweating operation.

A coat of white paint or enamel on the inside of a motor-shell is often of advantage, as it facilitates cleaning and elucidation of connections, especially where motors are located in dark and out-of-the-way places. As an aid to cleaning, a portable air-compressor is practically indispensable; and there are objections to the employment of hand-bellows or syringes.

In conclusion, by far the majority of electrical accidents occur through carelessness or neglect to take proper precautions in working. For instance, a properly-shaped screw-driver is somewhat of a rarity, and many mishaps have been caused through using an ill-shaped driver. In fig. 24 are shown correct and incorrect ways of forming a screw-driver nose. It is well, too, to remember that there is a limit to the versatility of the otherwise useful cutting-pliers. A stock of suitable insulated spanners is a good investment, and a pair of thin skin insulating gloves should never be despised, as they provide, at any rate, an excellent insurance against undesirable eventualities; and this rather special class of risk is not, as yet, comprehended in the now common insurance coupon-policy of the daily news-sheet.

To Develop Spanish Industries.—The Spanish Society for Promoting National Industries (El Fomento del Trabajo Nacional) is offering a prize of £200 for any new invention, process or improvement in the departments of electrical or mechanical engineering tending to the progress and advancement of the country's industries. Particulars of the offer may, we understand, be obtained from the Secretariat del Fomento, 4 Plaza Santa Anna, Madrid.

AMERICAN ELECTRIC COOKING CONDITIONS.

AN instructive report on the subject of electric cooking conditions in the Western States was presented at the Portland Convention of the N.W. Electric Light and Power Association, in September last. In the area to which the report refers there are 389,842 domestic electric lighting consumers, of whom 220,042 are using gas for fuel, and 2,481 electricity, leaving 167,319 homes which use some other form of fuel, and the authors consider ways and means of securing a large proportion of the latter as electric cooking consumers in the next few years.

The figures are interesting, as showing the approximate scope of future business in the area considered, also because it is evidently felt to be either unnecessary or undesirable to compete with the existing gas cooker business.

No doubt a similar feeling exists in many of our own cities, where the dual interests of gas and electricity are under municipal control, but the fact remains that in this country the gas cooker has monopolised this class of business for so many years, and so effectively penetrated into the houses of practically every class of consumer, that electric cooking must necessarily be—and even now is, in a small way—in competition with gas cooking here.

Much has been written and spoken in this country on the huge possibilities of the electric cooking load, but we doubt whether any British central station engineer possesses reliable data as to the existing cooking methods employed in his area, or, for the matter of that, as to the type of cooking employed by his own electric lighting consumers.

To return to the report: many of its conclusions cover ground familiar to our readers, as, for instance, the belief expressed that the ultimate residential rate will be one with a fairly high minimum bill, thus allowing the central station to furnish supply through one meter.

But the average American consumer must be blessed with a singular amount of patience and understanding if the typical rate cited of the Buffalo General Electric Co. is a sample of future tariffs, and for our part, we prefer the several types of "domestic" tariff adopted in this country, with all their oft-criticised shortcomings.

The Buffalo rate is as follows:—

8 c. per KW.-hour for first 60 hours' average monthly use of maximum demand.
5 c. per KW.-hour for next 120 hours.
1½ c. per KW.-hour in excess of 180 hours.
No maximum demand figured less than 250 watts. Maximum demand taken as 25 per cent. of total installation, not including irons, heating devices, cooking devices, fans, vacuum cleaners, and utility motors, not exceeding ½ H.P. in size.
Discount 1 c. per KW.-hour on primary rate. $1 minimum.

The subject of tariff making in its relation to the consumer and central station is an old story with us, and it is unlikely that we shall learn anything from our American friends in this respect.

Every tariff is in effect a compromise between the rival demands of a particular class of consumer and the central station; to attempt to individualise charges, in fact, to "make the punishment fit the crime," literally, as some people desire, is usually to court failure, for the true criterion of success in tariff making is the ultimate effect on the central station of the consumers *en masse*, and the tariff which is sufficiently involved to study the idiosyncrasies of the individual is too complicated for commercial use in this country.

It is considered in the report that electric cooking business can be secured with energy at 1½d. per unit, because of its inherent advantages and the less shrinkage of electrically-cooked foods, and many consumers using this rate insist that their monthly bills are no greater than when cooking with gas—presumably costing from 3s. to 4s. per 1,000 ft.; investigators who are also interested in the gas business, however, believe that electricity at 1d. per unit more nearly equals gas at the prices mentioned.

For heating water a rate of ·4d. to ·5d. per unit is considered necessary, though unprofitable and only justified because it may lead to the securing of the cooking load at a higher rate. The idea is to use low wattage heaters connected during the night or all day, except when the range is in use.

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On the subject of competition with gas, the views of the combination gas and electric men, set forth by one of them, should be appreciated on this side.

As to the reasons why there are very few consumers cooking with electricity, even where the 1d. electric rate is given in competition with a gas rate of 5s. 3d. ($1:25) a thousand cb. ft., he points out that the most important is "that people have become accustomed to cooking with gas and are equipped with gas stoves, water heaters, and other devices, and do not like to change from something they know to be satisfactory to something that is in an experimental stage." Again, the first cost of an electric range is cited as another drawback, and such apparatus is unlikely to be adopted, he considers, until the price is lowered considerably. A further reason given is the lack of an electric water heater which is as satisfactory as the gas water heater. Hot water being a household necessity and mixed apparatus being undesirable, he believes that cooking by electricity will be restricted until the right pattern of water heater is introduced.

As regards the first two reasons given, we may as well realise that the gas cooking habit in this country is due in great part to the low cost at which the consumer can obtain the necessary apparatus, which can be hired on most reasonable terms in the great majority of cases—terms so low, indeed, that one suspects future gas consumption bears a proportion of capital charges.*

The price of electrical cooking apparatus, on the other hand, is such as to effectively deter its general adoption, so that no body of public opinion in its favour is likely to result for sometime—although the number of individual opinions, very favourable to electric cooking, is growing rapidly. However, the gas-electric official goes on to admit that:—

> There are certain obvious advantages in cooking with electricity, as compared to cooking with gas, such as greater cleanliness in the use of electricity, the fact that electricity does not burn up any of the oxygen in the room, thus, making an electric kitchen a healthier place in which to work, and possibly more important than either of the above, it has been found by actual test that food cooked by electricity contains more of the original weight than when cooked by gas. In some cases the saving amounts to from 15 per cent. to 25 per cent. of the original weight. As an instance in broiling a steak the gas flame consumes considerable of the juice which has a very high nutritive value; with the electric broiler the juice is all saved, as there is no flame. With electricity the heating is under absolute control and exactly the right temperature can be maintained for any operation; with gas, no matter how careful the cook may be, there is bound to be considerable variation and the same condition of heat cannot be assured on all occasions.

He concludes that the gas business in general will not be hurt, but will be improved as electricity becomes more of a competitor, and with this the authors of the report agree.

In discussing "selling policy," the report advocates the necessity of the central stations doing the bulk of the selling of apparatus under present price conditions; that deferred payments should be allowed; and that costs of wiring should be averaged and included in the contract for the installation; although, as an introductory argument, it is suggested that the stations may find it advisable to absorb the wiring cost.

It is probable that before any great advance can be made in the adoption of electric cooking in this country, a co-operative movement on the part of the central stations for the purchase of apparatus will have to be introduced, with a view partly to introducing a degree of standardisation in apparatus, and discarding any special features which experience with gas cookers has shown to be quite unnecessary, and which consumers are unwilling to pay for, and partly to guaranteeing the manufacturers' output in return for such a reduction in price as will enable competitive hiring rates to be offered.

In a leaderette bearing on this matter, the *Journal of Electricity, Power and Gas*, which also abstracts the report, says that "before any great increase in sales can be expected . . . the cost of electric ranges should be materially reduced. This should be possible with standardisation of design, just as has been done in the case of vacuum cleaners, which sell for less than one-fourth the price quoted five years ago, and is being done in the case of electric washing machines."

We entirely agree with our contemporary as to the necessity of introducing some degree of standardisation as between the various makers of cooking apparatus, although the subject is beset with greater difficulty here, where things are made to last years, than in the States where very often "a short life and a merry one" appears to be all that is asked for and provided for, and where, consequently, improved standards can be more frequently introduced.

The only solid argument against standardisation—on the score of its hindering the introduction of improvements—is worn somewhat threadbare in view of the fact that the most acceptable general type of apparatus has already been settled for us by our gas friends, to whom we should feel indebted rather than otherwise for having ascertained definitely just what will satisfy the average user of to-day.

If we can agree to so much, and it is apparent that a majority of the makers of electrical cooking apparatus do agree, in principle, then the problem is narrowed down practically to an agreement on one or two standard sized cookers, and the construction of electric heating devices within certain limiting dimensions, and having standard methods of attachment, and we doubt whether such restrictions, if it be conceded that they are commercially desirable, will hamper technical development to any undesirable or appreciable extent. Probably the reverse will be the case.

While it is well to keep the ideal always in view, our practical efforts will inevitably be influenced and severely limited by the prosaic question of what we can afford to supply at the market price, the latter being fixed for us, within certain limits, by economic considerations. Excellent as are the results obtained by electrical cooking, this factor cannot to any appreciable extent influence progress, because it is not realised by the public generally, and, indeed, cannot be until the apparatus is obtainable on somewhat similar terms to those offered with competitive apparatus. To paraphrase the historic recipe of a celebrated cookery-book, "To cook electrically, you must first get your stove."

THE CORROSION OF METALS.

A GENERAL discussion on "The Corrosion of Metals" formed the programme of the December meeting of the FARADAY SOCIETY. Sir Robert Hadfield, President, who introduced the subject, was in the chair, and papers were read by Dr. C. H. Desch, who dealt with the effect of the physical nature of metals on the process of corrosion, by the President, Dr. J. Newton Friend, Mr. Leslie Aitchison, and Mr. S. Whyte, on various aspects of the corrosion of iron and steel, and by Mr. Arnold Philip and Mr. W. E. Gibbs, on the corrosion of brass. Amongst those who contributed to the discussion following the reading of the set papers were Prof. H. C. H. Carpenter, Dr. W. Rosenheim, Dr. E. K. Rideal, Mr. U. R. Evans, Mr. L. Pendrith, Dr. T. M. Lowry, and Mr. A. F. Dismore.

Numerous examples of non-corrodible metals and alloys and of interesting specimens of corroded metals were exhibited by Sir Robert Hadfield and Dr. Friend, and Mr. Robert Lennox had an exhibit of a variety of articles made of his well-known non-corrodible ferro-alloy known as "Tantiron."

General Considerations on Corrosion.—The importance of the subject is manifest, whether on the ferrous or non-ferrous side. With regard to the former, it is estimated that the world's annual losses of iron due to corrosion amount to hundreds of thousands of tons. To reduce this to a minimum is to conserve our national stores of coal as well as iron, so that the invention of a cheap and workable non-corrodible iron or steel is a work of considerable national value. In the non-ferrous field the matter is no less important when we consider the constant corrosion always taking place in condenser tubes, economisers, feed-water heaters, propellers, and a hundred other things in contact with fluids. A concrete illustration of the cost of preventing corrosion in a particular case will be of interest. To protect the boilers of the *Lusitania* and the *Mauretania* from corrosion, 84 pure zinc plates, each weighing some 20 lb., were used in each boiler, and these were renewed four times a year. This meant an annual cost of £8,400 per ship, at the present price of zinc.

* A recent *Gas World* analysis of a number of gas undertakings for the year 1914-15 shows average receipts from stoves and fittings—presumably from hire, hire-purchase, &c.—amounting to 1·21d. per 1,000 cb. ft. sold, against average maintenance costs amounting to 1·25d. per 1,000 cb. ft. sold.

Bradford is credited with receipts amounting to £917 and maintenance costs of £4,474; Salford, receipts £1,225, maintenance £9,531; Coventry, receipts £1,960, maintenance £4,842; Darlington, receipts £1,934, maintenance £3,246.

We do not, of course, know what proportions cooking apparatus bears to the total, but the principal underlying these transactions can be understood.

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Dr. Rideal, in the course of the discussion, defined corrosion as resulting from an irreversible change proceeding with a small velocity and taking place on the common surfaces between two or more phases, the products of which change are continually removed from the sphere of action. Provided the word "phase" indicates physical state (*e.g.*, state of strain or mode of crystallisation) as well as chemical composition, this definition suggests at once that corrosion is an electrolytic phenomenon, a result of numerous minute voltaic currents set up between the different "phases" on the surface of metals. This view would appear to be generally adopted, although, as will be seen later, there are differences of opinion as to what constitute the "phases" in the case of brass. As to the medium (or electrolyte on this theory), this may be the atmosphere, or some constituent of it, such as water vapour in pure air, or acid vapours in manufacturing towns, and special media such as gases in acid liquids. There is also corrosion by heating, but this is only a special condition of one or other of the above cases.

Methods of studying corrosion received a good deal of attention at the meeting. The ideal method is, of course, to test the material under normal working conditions, but this is too slow a process for ordinary purposes, and artificial corrosion has to be resorted to. In the case of iron or steel, simple immersion in water or acids has usually been adopted. In the case of brass, electrolytic corrosion—using the test piece as anode—in salt solution yielded instructive results, but it must never be forgotten that the results of a laboratory test must always be accepted with caution, unless it is certain that it imitates practical conditions. Another point strongly brought out in the discussion was the very different power of resistance to corrosion possessed by the same material under varying practical conditions. Thus an iron or a steel that will resist the Thames water has been found to be exceedingly corrodible in London air.

Another important aspect of the subject discussed, and it is often overlooked, was methods of measuring corrosion. Merely comparing losses of weight in laboratory experiments may be very misleading. It is necessary, as Dr. Desch pointed out, to distinguish the different forms in which the constituents are removed. The material, for example, may dissolve, the product of corrosion may be loose and flocculent, or adherent and protective; protective layers, indeed, of basic salts are quite an important factor in the resisting properties of metals. Again, corrosion may either take the form of pitting or of uniform surface action; obviously, a weight test in either case may lead one altogether astray. It is points such as these that render corrosion so difficult to investigate experimentally.

Corrosion of Iron and Steel.—Two main aspects were discussed, first, by Dr. Friend, the relative corrodibilities of iron and steel, and, secondly, by Sir Robert Hadfield and Mr. Aitchison, the influence on steel of the special additional metals now commonly employed—silicon, chromium, nickel, manganese, tungsten, vanadium, and others. Dr. Friend has come to the conclusion, and in this he was corroborated by some practical tests that Mr. L. Pendrith has been making, in conjunction with Mr. F. W. Harbord, that there is no simple answer to the question, which is the more corrodible, iron or steel? The answer depends both on the nature of the corroding medium and the standard of corrodibility to be adopted, and the problem really is, which is the best type of iron or steel for any particular purpose?

Sir Robert Hadfield's summary of the resisting properties of the steel alloys he has been working on for so long was most interesting. Confining ourselves to corrosion tests made in 50 per cent. sulphuric acid, it is noteworthy that the silicon and tungsten steels both have a minimum corrosive point, the former at 3·4 per cent. content, the latter at 2·2 per cent. On each side of these minima the rise in corrodibility is rapid. Nickel steels in this medium show a steady fall in corrodibility with increasing nickel content, while in the chromium steels there is a steady rise. These results show how important a factor is the corroding medium, for, in practice, nickel steels are not incorrodible, and although they often remain so until corrosion commences, they rapidly deteriorate after it has once set in. On the other hand, chromium steels in practice are highly resistive. As far back as 1892, Sir Robert Hadfield found that 10 per cent. chromium conferred on steel practical freedom from rust, and there is now on the market table cutlery made from what is known as "stainless" steel—because it does not tarnish in food or acids—containing from 10 to 12 per cent. chromium and 0·3 to 0·4 per cent. carbon. The mechanical properties of this steel, after suitable heat treatment, are also found to be excellent, and the possibility of using it for such purposes as dock gates is under consideration.

Mr. Aitchison's exhaustive experiments were in general agreement with those brought forward by Sir Robert Hadfield. The corrosion of steel in tap water, 3 per cent. sodium chloride and 1 per cent. sulphuric acid solution, increased with the addition of any third element up to about 5 per cent., with the exception of chromium, which conferred a permanent decrease of corrodibility (although it did not do so in 10 per cent. sulphuric acid). Generally speaking, high chromium steels were the only ones which showed to any real advantage over pure mild steels. The effect of varying amounts of carbon in pure steels was interesting, for it *decreased* the corrodibility up to about 0·5 per cent., increasing it above that point. This was significant, commented Dr. Rosenheim, for it was the second property of steel reaching a critical point at that carbon concentration. Mr. Aitchison subjected all his specimens, both before and after corrosion, to microscopic examination. It appeared that even in pearlite it was always the ferrite which was attacked, by the production first of etching pits, which spread gradually over the whole area. The carbide was always unattacked, and simply dropped away mechanically, but it acts as an aid to corrosion, by providing a definite cathode for the ferrite or for any solid solution present acting as ferrite. Twinning increased corrodibility. It was strange that one of the least homogeneous of the materials examined—a 20 per cent. chromium steel—was corroded least. Mr. Aitchison considers that the true secret of non-corrodibility lies in some property of the solid solution—perhaps its solution pressure—which is to be found as a consequence of its chemical composition, coupled with heat and mechanical treatment. The solution pressure of iron itself is never low enough to prevent corrosion.

Mr. C. F. Dismore, in the course of the discussion, claimed to be able to convert cast-iron, with a high carbon contact, into non-corrodible steel, by an electrolytic process which he had hit upon. This rather startling claim was received with a good deal of scepticism, and we must await further evidence before accepting it. If it were a mere skin effect it would be intelligible, but the claim went far beyond that.

The Corrosion of Brass.—In lieu of the usual theory that the corrosion of two-phase brass by sea-water is due to the action of electrolytic currents set up by minute couples of adjacent crystals of metals of different phase, Mr. Arnold Philip put forward for consideration the view that it is minute zinc-copper couples that act as voltaic cells. In auto-corrosion the current would flow from the zinc element, forming zinc chloride, to the copper forming caustic soda and depositing hydrogen. Thus polarisation will stop further action unless oxygen is present to counteract it. If it is, dezincification takes place, with separation or corrosion of copper. The theory is also shown to support the well-known fact that higher zinc content, such as in Muntz's metal, lowers the rate of corrosion, a fact otherwise difficult to explain, for a 70/30 brass is a single-phase, and 60/40 brass a two-phase system. Mr. Philip discussed at some length the cases of contact-corrosion and the corrosion of brass by external current, and he worked out expressions giving the relative magnitude of the action in those cases which, he said, agreed with observation.

Mr. Philip's theory was not kindly received. It was pointed out that if brass really were a mosaic of copper and zinc, corrosion would take place much more rapidly than it does. The evidence of the microscope and the equilibrium curve showed that the view that there is no chemical combination between the constituents of brass is quite untenable, and that it was highly improbable that zinc and copper could exist side by side in brass. Moreover, zinc in contact with copper should go into solution more easily than zinc alone, and the copper should not dissolve at all. This is not the case, and the E.M.F. of brass in sea-water resembled that of copper rather than zinc, while a mixture of brass and zinc, said Mr. Gibbs, had the same E.M.F. as pure zinc—a questionable statement, in our opinion. Mr. Gibbs himself, who, by the way, is at present acting as honorary investigator on the Corrosion Committee of the Institute of Metals, also, in his paper, dealt with the sea-water corrosion of 70/30 brass, and in this he arrived at the conclusion that a solid solution of zinc and copper is intermediate in character between a physical mixture and a chemical compound. There probably exists, he thought, a kind of "physical" combination in which the chemical character of the constituents is not changed, but only modified. Apart from its theoretical considerations, Mr. Gibbs's paper contained a great deal of valuable information on the influence of a number of important factors upon the rate and character of the corrosive attack of sea-water on brasses, and those interested are advised to refer to the original paper.

At the conclusion of the discussion, Mr. Elliott Cumberland gave a demonstration of his electrolytic process for preventing corrosion of all metals immersed in liquids. The method consists in introducing a higher counter E.M.F. than that causing the corrosive action, and it has proved itself to be the only effective method of overcoming the dezincification of condenser tubes. Continuous current is supplied from a 10-volt dynamo to pieces of iron suspended in the liquids, which act as anodes, the cathode being the metal protected. The anodes last from 18 months to two years, and the cost of the current, too, is inconsiderable, on account of the low voltage. The system has been installed in many steamships with, it is stated, highly successful results.

TECHNICAL EDUCATION.

THE continuation of the war is by no means preventing the consideration in different belligerent countries of the important problem of the supply of skilled labour after the conclusion of peace and the indirect part which education at the present time should play in the production of future artisans and professional engineers. As a newspaper correspondent stated a week ago, the professions, like other lines of life, will then have been deprived of much valuable material, and the question now is to give a good education to those boys with whom the future of England lies. In this connection attention is again drawn to the county scholarships which assist boys on from stage to stage until they reach a university. But the war has made heavy calls upon the teaching profession, and further demands in this direction are in early prospect. It is for this reason that the important conference of teachers and others interested in education, including representatives of the County Councils' Association and numerous educational associations, recently adopted a resolution expressing the opinion that as the national prosperity at the close of the war will largely depend upon the supply of young citizens well trained for the full discharge of national obligations, no curtailment of the provision

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of higher education should be made, evening school work should be continued, and the children of poor parents should be enabled to take advantage of such facilities by means of scholarships.

The question is also attracting attention in France and Germany. In the former country, although a scarcity of labour in general prevailed before the war and will become aggravated on its conclusion, most consideration appears for the moment to be devoted rather to the problem of the production of mechanical and electrical engineers than to the improvement of the training of youths, which is the more necessary, so as to form them into skilled workmen. In this connection M. J. H Jacobsen, discussing recently the proposed development of the French electrical engineering industry, asked whether the manufacturer who was endeavouring to apply the methods of intensive production was sufficiently seconded by his staff and workmen. The reply given by this French engineer was a negative in general. He, however, apparently absolves the workmen from any blame from a technical point of view, because their education is incomplete, and their social difficulties prevent them from acquiring the requisite qualifications on their own account, but nothing is said in regard to the degree of their diligence. The course of workshop instruction and study, in his opinion, should not only be free of any expense to apprentices, but, as soon as they begin to show the least efficiency, they ought to be paid so as to permit them to carry their practical education to a conclusion. We will not follow M. Jacobsen in his observations in regard to the staff beyond mentioning that one of his ideas is that the manufacturers can help the staff and at the same time assist themselves, but will now turn to Germany, where an important pronouncement was recently made, not by an educationist, but by the general manager of the large engineering undertaking known as the Augsburg-Nuremberg Machinery Works, in a paper presented to the Association of German Engineers, on "The Engineer as a Promoter of National Education." As was mentioned in this journal several years ago, Germany was then overflowing with highly-trained professional men of most classes, including engineers, and the only result at that time was the production of a superabundance of men for whom no profitable occupation was available. But the turn of these men apparently arrived with the preparation for and the course of the war. The idea of the general manager of the company in question now is that this process should be repeated on a grand scale for the whole of the country, so that every competent youth should become a highly educated and skilled workman, and that this form of education should be absolutely free. But let the general manager speak for himself:—

Dr. von Rieppel stated that German culture and civilisation would lead the economic life of the country to further prosperity after the termination of the war. It was, however, necessary for that purpose that the former hatred between parties and classes should not blaze up again, but that the present unity should be permanently maintained. Apart from religious differences, the division in the nation in the past existed principally between workmen and employers, that is between two classes dependent upon each other, and between whom stood the engineers by reason of their profession. In his opinion the dividing antitheses were founded solely and only upon different conceptions of the duties and rights of citizenship of the individual in relation to the whole community. To need self-comprehension the young citizen, irrespective of whether he would be a future employer or workman, must first be instructed in these rights and duties and in the problems of a system of State. The schools, however, scarcely devoted any consideration to this side of education, and in the widest circles there was a lack of understanding as to its importance. Although the war would clear away many preferences and prejudices, it would not do so in such a fundamental manner as to maintain unity over the conceptions of the leaders of parties and classes after peace came. The problem would consequently remain for them as to how they as engineers, without occupying themselves with politics, could support in their own circles the efforts to mitigate the antagonism of classes in the sense and spirit of the rules of the Association. The author considered that that was possible if they restricted themselves to the education problems comprised in the matter, which he regarded as (1) the equal possibility of education for all classes of the nation; and (2) education in citizenship. As to the first point, Dr. von Rieppel remarked that the opinion was gaining ground that the sharp division between elementary schools and intermediate schools could not be permanently maintained. The premature transfer from the former school to the latter, which was now stipulated at the age of nine or 10, must be discontinued; an organic connection must be established between the two schools. But the school fees must be remitted in order to facilitate the attendance at school of talented children of poorer fellow-citizens. The German elementary school occupied the first position in regard to system and compulsory extension over the country. On the other hand, the American school, with its greater versatility and the greater incentive which was given to the children for higher education, was better for the great masses of the population. In particular, the American school was superior to the German in the sense that it formed the basis for each further study, everyone having the possibility of climbing to a higher stage. The premature transfer of pupils of middle class families to the classical school, which now took place in Germany at the tenth year, brought about a keen division in the great masses of the population, and it was all the more unfortunate as it was regarded as a privilege of wealth. This division had the further unfavourable influence of causing the better educated children of the higher classes of citizens to be excluded from intercourse with the lower classes of the population. The sharp antitheses which existed were, therefore, not to be wondered at. The possibility only existed to an inadequate extent for the continued professional and citizenship education beyond the school obligation incidental to the elementary and continuation schools, whilst Germany occupied the last position in regard to public libraries. The nation had reached such a high degree of welfare that juvenile labour in industries was able to be entirely dispensed with up to the 14th year. But the higher grades of the national schools should be so improved that a transfer would be possible to the practical schools at the age of 14 without loss of time. This object could be achieved by slightly restraining the special instruction branches in the practical schools, and by advancing the instruction in the national schools. In this way, the German would obtain the equal of the American organisation by means of a kind of intermediate school. A large portion of the German classes of the population would thereby find the way open to higher aims still at an age when an opinion could be better formed as to the special talents of a child. If to this were added complete freedom of instruction in the national and practical schools or higher practical schools, a path in an upward direction would be opened to education in the lower layers of the population. This step, in the opinion of the author, would remove many grounds for dissatisfaction, and the attachment to the institutions of the State would be advanced. The particular German State which had the courage to establish an organic connection between the eight classes of national schools and the five classes of higher practical schools would be glorified for this action by the nation in future years.

It is impossible for us to follow at any length the observations made on the second point raised by the general manager. His argument, however, lies in the direction of showing that, after leaving the elementary schools for the continuation schools, the scholars should be instructed in the privileges, rights and obligations of citizenship, so that, instead of merely forming one-sided ideas on the subject and on the compulsory necessities of the economic life—fostered, as they are, by certain newspapers in the years intervening before they enter the army at the age of 20—they would fully understand both sides of the problem, and would become better citizens and better workmen. It is, therefore, contended that engineers and technical men in general should render assistance in the execution of this programme for the benefit of the community. Naturally, the scheme is merely a paper outline at the present time, although it has secured advocates in other circles. It would not, however, be surprising if something were done after the war generally to improve the technical education of the boys, quite apart from what will be accomplished, or is being carried out in connection with the education of soldiers partly disabled through the war. The Krupp Co., for instance, is already offering besides reinstating returned soldiers or re-employing them as far as possible—not for office work or as messengers, &c., but in the shops themselves—to grant financial assistance to competent men to attend classes in machine construction. We must, therefore, not overlook what is proceeding in other countries in order that we may be better prepared on the conclusion of peace for the great industrial conflict of the future, than we were for the disastrous war of the present.

THE DESIGN OF HIGH-PRESSURE DISTRIBUTION SYSTEMS.

BY J. R. BEARD, M.Sc., A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *December*, 1915.)

(*Concluded from page* 30.)

Most Suitable Distribution Voltage.—In settling the distribution voltage the primary consideration is that it shall be sufficiently high to ensure that the voltage variation at the boundaries of the supply area can be kept within a reasonable amount without putting an excessive amount of copper in the feeders. It is usually desirable that the voltage variation should not exceed 5 per cent. either side of the normal, *i.e.*, a total of 10 per cent., and from this about 2½ per cent. should be deducted for transformer voltage-drop, leaving a permissible maximum drop of 7½ per cent. in the high-pressure mains. Fig. 5 shows that under the same conditions the current density in the mains, and therefore the resistance voltage-drop per mile, is approximately independent of their section. The actual figures taken from fig. 5 are given in Table V.

As the power factor of most distribution systems is less than unity it is also necessary to take account of the inductive voltage-drop. This is not independent of the section, but given the current density from Table V and the frequency of the system it can be readily calculated from the size and spacing of the conductors. Fig. 9 shows, for several typical sizes of both underground and overhead mains at various voltages, the relative amount by which the inductive drop increases the total voltage-drop at various power factors. The calculations are based on a frequency of 50 cycles per second and on a constant current density, since the economical value for the latter is independent of the power factor. They also assume the use of ordinary 3-conductor mains; if

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arranged for split-conductor protection the inductive drop would be appreciably reduced.

TABLE V.

Type of main.	Amperes per square inch at maximum load.		Resistance voltage drop between phases per mile at maximum load.	
	With the economical loading.	With decreased loading corresponding to 5 per cent. extra cost.	With the economical loading.	With decreased loading corresponding to 5 per cent. extra cost.
Underground mains up to 11,000 volts	910	635	68·1	47·5
20,000-volt underground mains	1,190	800	88·8	59·9
Overhead mains up to 20,000 volts	800	540	59·9	40·4

It is evident that the maximum radius of distribution and area of supply at a given voltage will vary according to the power factor of the system and to the various factors which determine the inductive drop, but in order to give an approximate idea of the relative figures for the maximum radius and area at various voltages the curves given in fig. 10 take into consideration the proportion between the total number of switches required and the total mileage of mains, as the cost of switchgear increases with the voltage. Fig. 11 gives fairly safe figures for the annual cost per switch at different voltages on the basis of annual charges of 8 per cent. on the switchgear and the corresponding building accommodation, and these figures have been used in the following investigation.

Taking a system comprising 24 sub-stations evenly spaced as in fig. 8 (*a*), and allowing an average of 2½ switches per sub-station for controlling the step-down transformers, the total annual cost of switchgear and mains has been calculated for various distribution voltages and various sub-station loadings. In addition, the spacing of the sub-stations has also been varied so as to give several comparative proportions between the number of switches and the mileage of mains. From these results the series of curves given in fig. 12A have been plotted showing the most economical voltage under the varying conditions.

It will be seen by reference to fig. 6 that the annual costs of mains of varying sections lie approximately on straight lines, and it is therefore permissible, by plotting the curves in fig. 12A to a base of average demands, to make the results applicable to any arrangement of network whatever its type or extent. In order to find the most economical voltage for a given distribution of loads, the procedure would then be to

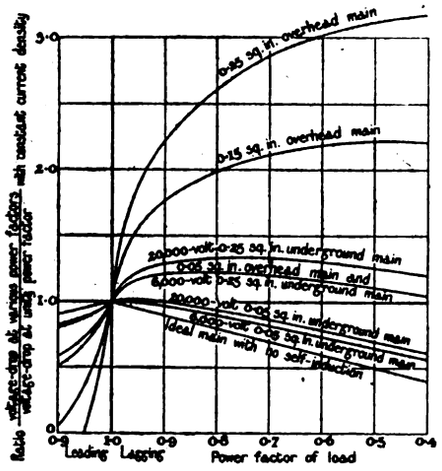
Ratio voltage-drop at various power factors / voltage-drop at unity power factor
with constant current density
0·25 sq. in. overhead main
0·15 sq. in. overhead main
20,000-volt 0·25 sq. in. underground main
0·25 sq. in. overhead main and 8,000-volt 0·25 sq. in. underground main
20,000-volt 0·05 sq. in. underground main
8,000-volt 0·05 sq. in. underground main
Ideal main with no self-induction
Leading
Lagging
Power factor of load

FIG. 9.—EFFECT OF INDUCTIVE DROP AT DIFFERENT POWER FACTORS FOR VARIOUS MAINS.

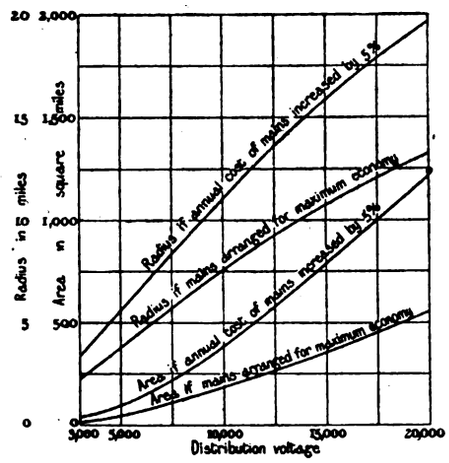
Radius in miles
Area in square miles
Radius if annual cost of mains increased by 5%
Radius if mains arranged for maximum economy
Area if annual cost of mains increased by 5%
Area if mains arranged for maximum economy
Distribution voltage

FIG. 10.—RADIUS AND AREA OF DISTRIBUTION AT VARIOUS VOLTAGES.

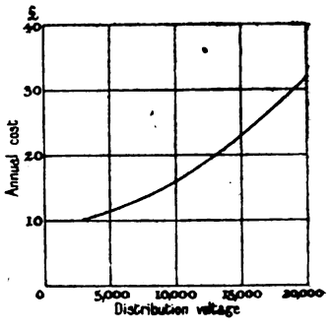

FIG. 11.—ANNUAL COST OF SWITCHGEAR PER PANEL.

have been prepared on the following assumptions:—Permissible voltage-drop, 7.5 per cent.; average power factor, 0.8; a network comprising equal lengths of underground and overhead mains; an average cross-section of main of 0.15 square inch; a frequency of 50.

It is interesting to note that, although it is more economical to run higher-voltage cable at an increased current density, the curves of both area and radius have still a steep upward tendency at 20,000 volts. This would be further accentuated if allowance were made for the fact that the average cross-section of main tends to decrease at higher voltages, with a corresponding decrease in the value of the inductive drop relative to the resistance drop.

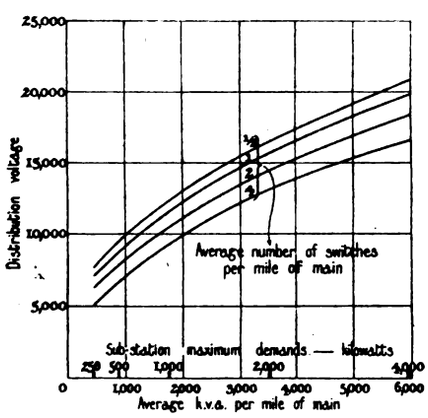
Distribution voltage
Average number of switches per mile of main
Sub-station maximum demands — kilowatts
Average k.v.a. per mile of main

FIG. 12A.—ECONOMICAL DISTRIBUTION VOLTAGE.

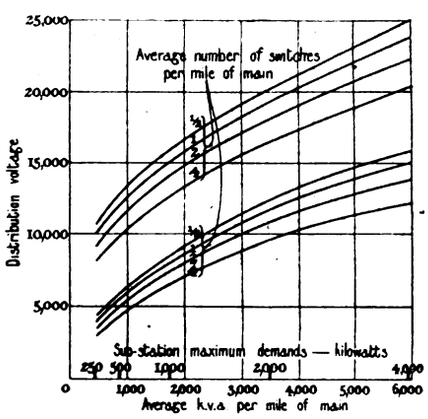
Distribution voltage
Average number of switches per mile of main
Sub-station maximum demands — kilowatts
Average k.v.a. per mile of main

FIG. 12B.—UPPER AND LOWER LIMITS OF DISTRIBUTION VOLTAGE FOR 5 PER CENT. INCREASED COST OF DISTRIBUTION SYSTEM.

It is, however, not sufficient to settle the distribution voltage on the basis of permissible voltage-drop alone. It is also important to choose that voltage which gives the cheapest distribution system, and from this point of view it may often pay to use a voltage much higher than that which is required by the conditions of voltage-drop. Generally speaking, the higher loads which have to be dealt with, the higher is the economical voltage; but it is also necessary to assume a voltage which it is anticipated will be about correct, to lay out the distribution system on this basis, calculate from this the average number of kilovolt-amperes per mile of main and the number of switches per mile of main, and then from these two figures find from the curves in fig. 12A what the most economical voltage would be. If the original voltage which had been assumed should prove to have been so incorrect that the arrangement of feeders and the number of switches would be appreciably altered by the adoption of the revised voltage, it may be desirable to lay out the system afresh with the revised voltage and afterwards check the results again with the curves in fig. 12A, the method being thus one of trial and error. As a rule, however, the first voltage assumed should be sufficiently close to the correct figure to enable the latter to be obtained by the first trial. The economical voltage obtained in this way must, of course, be always checked to ensure that it also meets the requirements of voltage-drop.

In order to give some idea of the extent to which the economical voltage can be departed from, the curves given in fig. 12B have also been calculated; these show the upper and lower limits of voltage corresponding to an increase of 5 per cent. in the cost of the distribution system. The limits are fairly wide, but, if they are exceeded, the extra cost of the distribution system increases at a cumulatively rapid rate. In practice it is advisable to adopt a voltage in the neighbourhood of the upper limit in order to keep down the voltage-drop as much as possible and also in order to make allowance for the increase in the density of load which will usually occur.

As might be expected, fig. 12 shows that the heavier the loads to be supplied and the more they are concentrated the higher is the most economical voltage. It should be noticed that the curves show no signs that at 20,000 volts the maximum economical voltage has been reached, provided the system loading is heavy enough, and hence for the larger systems of the future we may expect that for economical reasons alone the distribution voltage will be raised above 20,000 volts.

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These calculations only refer to underground mains; with overhead mains the economical voltage will be higher, since there is so little difference between their cost at various voltages.

In order to see what are typical figures in actual practice for the number of switches per mile of main and the average number of kilovolt-amperes per mile of main, the following table has been prepared for two typical systems for which the author has had access to the necessary data, and as a matter of interest the corresponding economical and limiting values for the distribution voltage have been deduced from fig. 12.

TABLE VI.

System voltage actually adopted	5,500	20,000
Number of switches per mile of main ...	2.63	0.725
Average maximum kilovolt-amperes per mile of main	450	3,500
Most economical system voltage	5,700	16,000
Upper and lower limits for system voltages with 5 per cent. extra cost of distribution system	9,500 3,200	20,000 12,000

In conclusion, the author wishes to record his obligations to the Newcastle-upon-Tyne Electric Supply Co., Ltd., and associated power companies on the North-East Coast, and to their consulting engineers, Messrs. Merz & McLellan, for permission to use much of the data on which the conclusions of the paper are based.

SOME DIFFICULTIES IN THE DESIGN OF HIGH-SPEED GENERATORS.

Prof. A. B. FIELD'S paper on this subject was discussed by the MANCHESTER LOCAL SECTION of the INSTITUTION OF ELECTRICAL ENGINEERS on November 30th, 1915. An abstract of the paper was given in the ELECTRICAL REVIEW for December 3rd, 10th and 17th, 1915.

Prof. MILES WALKER assumed that the author did not advocate a departure from the solid type of rotor in cases where the stresses were not as high as in large machines run at very high speeds. The rotor winding shown in fig. 8 had been proved to be perfectly satisfactory to use in ordinary shop practice, but for large rotors dealing with many thousands of ampere turns per pole at high peripheral speeds, a better winding could be put forward. [Prof. Walker then described a winding, details of which were given in our report of the London discussion.] The plan of getting the stator coils a long way back from the rotor was very good. If the slots were made 3 or 4 in. deeper than at present, it would be possible to get quite a wide space between stator and rotor coils; this permitted of sufficient leakage flux to cut down the stator current on short circuit and obviated the necessity of providing an expensive reactance coil, which caused a certain amount of loss. The extra depth of slot provided a good cooling surface which could easily be cleaned. The general mechanical arrangement was much preferable to the type of machine where everything was bunched near the rotor with only ventilation behind—here they had the ventilation in front on the rotor side.

Mr. F. A. KUYSER described a system of ventilation which eliminated some of the objectionable features of axially ventilated machines. In the case of an 8,000-K.V.A. 2,400-R.P.M. machine, axial vent chambers were provided in the usual way by means of holes punched in the core laminations. Nine radial air ducts, each ⅜ in. wide, were provided instead of one central duct. Each axial duct was, therefore, divided into ten equal sections, which were connected together by means of a system of axial tubes welded to the ventilation spacers. At certain places the connecting tubes were left out and semi-circular distance pieces used which allowed the air to escape from the axial ducts to the radial ducts. The air outlets were evenly distributed over the whole length of the core, an equal number of axial ducts delivering to each radial duct. In addition to the elimination of the large central discharge, another advantage could be obtained by arranging the air streams to secure a counter-flow action, the air streams in adjacent ducts having opposite directions of flow. This arrangement reduced the high temperature which occurred near the air outlet of axially ventilated machines and equalised the temperature over the whole length of the core. In connection with stator coil bracing and the type of armature winding for turbo-generators, the diamond type of winding illustrated in the paper had been extensively used in the United States. A disadvantage of this winding was the open slots, which introduced extra losses; if wide slots were used, magnetic wedges were absolutely essential. Concentric winding had the advantage that each bar could easily be replaced without disturbing the remainder, but, generally speaking, a breakdown necessitated complete rewinding. The semi-closed slots were also of advantage. Referring to rotor coil bracing, he gave an example of a 15,000-K.V.A. 1,500-R.P.M. 2-pole machine having a radial forged rotor of 46 in. diameter weighing 22 tons. The torque developed on short-circuit was, roughly, 15 times normal, and this produced a force of 15 lb. acting on each lb. of copper. The maximum deflection of the winding, which was 1¾-in. width copper, was .015 in. If only the fly-wheel effect of the turbo was taken into account the deflection was .008 in. These figures suggested that a substantial field strap would suffice to prevent damage after a short-circuit without extra bracing, and this was verified in actual tests on machines of 15,000 KW.

Mr. G. D. SEATON said there was no less than 100,000 KW. of high-speed generating machinery out of commission in this country. The speed did not seem to be the source of trouble, as in almost every case it was the stator that proved defective.

Mr. JUHLIN said the author's figure of 20,000 lb. for the stress inside the rotor was probably under rather than over the mark, and in order to secure the disks on a through shaft it was necessary to shrink them on with stresses considerably above the running stresses. It was also required that the disks should fit the shaft when running at maximum speed; otherwise the disks would float, which was not permissible. Fortunately, this country was well situated to obtain steel forgings of large and small sizes, and for that reason it was probably unnecessary to adopt a disk construction until very extreme sizes were encountered. British steel makers were prepared to supply very large rotors having excellent physical properties in both radial and tangential directions. American steel makers had not yet been able to guarantee such radial test pieces. The following details represented the procedure adopted by one of the leading British steel makers in the manufacture of large rotors:—An ingot of approximately 115 tons and 94 in. in diameter would be issued, 50 per cent. being cut off at the top end to ensure homegeneity of material. A 12,000-ton press would forge the ingot down to the required diameter, the ends being forged down in a smaller press. The reduction in area would then be about 2½ to 1, so that the work done was quite considerable. After rough machining the rotor would be thoroughly annealed, and in this process probably more was done to the quality of the steel than was generally appreciated. Regarding the internal stresses, which were very high unless the material was treated exceedingly carefully, it was to be noted that in the finished rotor there were radial ducts dividing the rotor into sections to a considerable depth, 6 to 8 in. These ducts would materially tend to release the stresses in the longitudinal direction. The slots for the coils and the ventilation ducts under the slots would to a certain extent release the stresses in the tangential direction, so that in the finished rotor the remaining initial stresses should be fairly well released. The critical speed could be calculated much more accurately in the case of the solid rotor, and the stiffness of construction permitted a smaller diameter for a given output, which would give a slightly better efficiency. It would also be possible to use self-contained blowers in many cases where, with the author's construction, the increased length would make it impossible. By placing the slip-rings outside the bearings, the distance between bearings was considerably reduced, and at the same time another objectionable feature, high peripheral speed, would be obviated; greater accessibility to slip-rings was also obtained. The ultimate cost of a rotor constructed of plates would probably be slightly less than the cost of the solid rotor.

Mr. A. E. MCKENZIE expressed appreciation of the 3-part wedge, and referred to the great difficulty of making a satisfactory job of a solid wedge perhaps 6 or 7 ft. long with the present high peripheral speeds giving a stress of about 1 ton per square inch at the surface of the key. Considerable trouble had been experienced owing to keys working loose, even after insertion with pressures of 20 to 25 tons per square inch. There were advantages undoubtedly in having external reactances, particularly when a fault developed on the windings adjacent to the machine terminals. In such a case, high internal reactance would be of little use in reducing the shock to the system. The Manchester electricity department had recently specified that all large machines should be built to withstand a short circuit at the main terminals, when running fully excited at normal speed, but under present conditions they hesitated to apply the test. He had recently inspected tenders for 15,000-KW. machines having the internal reactance so high that a short-circuit current value of only seven times the normal was obtained. He had seen several mechines having windings of tubular or rectangular form to enable air to pass through the conductor. The cooling would undoubtedly be more effective in these designs than where the cooling air came into contact with only a small portion of the conductor periphery. The circular conductor was much better to insulate than the rectangular type, which tended to cause fracture at the corners. He had known of considerable trouble in the past with built-up rotors; the solid rotors had, however, given no trouble whatever, and he would be sorry to have to revert to the older types. Temperatures of 120 deg. C. to 180 deg. C. were only possible wth mica-insulated machines.

Dr. G. W. WORRALL dealt with the use of fans on rotors, and advocated the use of external fans in nearly all cases; a better system of ventilation was obtained, and nothing was lost from the point of view of overall efficiency. Axial ventilation was preferable to radial ventilation, and ventilation systems should be arranged so that all air ducts could be thoroughly cleaned. He had experienced considerable trouble due to breakdown of end windings of rotors; it was almost impossible in building up machines to apply the actual pressures to windings which occurred in practice.

Mr. R. TOWNEND said that the type of rotor described by Prof. Walker had proved highly satisfactory. In all cases the temperature of the windings had been very low. Large

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losses occurred due to eddy currents in different parts of a turbo-alternator, amounting to 2 per cent. or more of the normal output of the machine; if this eddy-current loss could be reduced by one-half the efficiency would be increased 1 per cent., together with a considerable reduction in heating. The subject of stray losses in turbo-alternators was deserving of thorough investigation.

Dr. W. CRAMP said the author had shown that the first general limitation was the frequency, and the second was the material available. He cordially approved of the use of the term "yield point" instead of "elastic limit" throughout the paper, but there was no indication of what the author considered to be a safe stress with respect to a given yield point, *i.e.*, of the factor of safety employed. Another limit not mentioned in the paper beyond which any increase in peripheral speed might lead to uneconomical design was introduced by the fact that in a slotted rotor, when certain limiting densities were decided upon, there was a corresponding maximum slot area. The area of the slot multiplied by the space factor, by the specific weight of copper, by the square of the velocity, and divided by g R was a measure of the centrifugal force acting upon unit length of the tooth root. Equating this to the section of the tooth root multiplied by the safe stress corresponding to the material used would show whether the most economical design as dictated by electro-magnetic considerations was consistent with the peripheral speed and material proposed. He concluded that designers were approaching the limit when they would not have material which would carry the stress corresponding to the maximum copper which could be got into the slot. Regarding critical speed, he was quite in agreement with the author, but local designers did not take the same view. When he specified a turbo-alternator in which the critical speed was to be above the speed at which the machine ran, a well-known designer said there was no necessity for any such limit, as no one would pay for it. Presumably this attitude would now be abandoned. Regarding ventilation, the author showed preference for an axial passage under the winding slots with a radial discharge distributed over a fairly wide central portion of the rotor; many designers thought that pure axial ventilation was very much better when it could be accomplished. Regarding air-gap reluctance as affected by the stator slots, Mr. Carter's paper on "Airgap Induction" was a fine example of what might be carried out to a very much greater extent.

Mr. H. DUTTON, in a communication, described his experiences with some D.C. turbo-generators over a period of five years, and emphasised the necessity of perfect balancing at the operating speed. He deprecated short-circuiting tests, and pointed out that with step-up transformers between the generators and bus-bars, reactance coils appeared to be unnecessary.

The AUTHOR, in reply to Prof. Walker, said that the field winding described in the paper was not, in his opinion, the final solution of the problem; Prof. Walker's system had many advantages. A number of small slots were used, and by excellent cooling conditions a much shallower slot was permissible than in the system described in the paper. On the other hand, a number of small slots was a manufacturing disadvantage when dealing with heavy pieces. Mr. Kuyser's system of ventilation was interesting, but had the disadvantage of some blind-ended vents, with possible manufacturing difficulties. Mr. Kuyser had also referred to short-circuit tests on 2-pole 25-cycle machines; it was justifiable to take the risk of unbraced coils on 2-pole machines, but the risk appeared too great on 4-pole machines. Cases had occurred in which the shaft had been twisted, which gave some idea of the shock to the windings. In reply to Mr. Juhlin, ductility was required not at the thick part of the tooth, but at the root; wedges did not fit along their whole length, and at certain parts a tooth had to be stretched to throw the load upon another part, and so on. It was satisfactory to find steel makers in this country willing to accept orders subject to radial tests; steel makers in the States gave point-blank refusal. Bad joints in the rotor would show up by producing low critical speed. Outside slip-rings had many advantages, but the mechanical disadvantage of taking the leads through the shaft, in the author's opinion, more than counterbalanced the advantages. Regarding the costs, there was very little to choose between the solid and built-up rotor when complete. Replying to Mr. McKenzie, the author agreed that the advantages of air washing or filtration were enormous. Regarding hollow conductors, there were possibilities in the case of turbo-windings; many years ago such windings were used on transformers in the Niagara district, water circulation being used in the low-pressure windings. Some movement of rotor windings certainly did take place, but as it was slight it was easily taken care of; he did not consider this motion the cause of the breakdown referred to by Dr. Worrall. He agreed with Mr. Townend that the whole subject of short-circuit losses was greatly in need of investigation. In large machines the short-circuit losses were enormous, and their distribution was quite unknown. They were too big to be local, and were probably distributed all over the machine, otherwise the consequences would be more serious. In reply to Dr. Cramp regarding the factor of safety, the author said the machines were all tested at 20 per cent. over speed, and would hold together at 50 per cent. over speed. With reference to rotor slots, the tooth stresses were not a serious matter, since if they were a salient feature nickel steel could be used without any great increase in cost. Mr. Carter's work seemed to show that in general the question of air-gap reluctance would be accurately enough determined in these machines; the question of rotor face losses, however, was obscure, and Mr. Carter's work did not cover the case.

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

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18,047. "Manufacture of rigid pieces of metal insulated against electrolysis and corrosion." P. M. STEWART. December 28th. (Complete.)

18,049. "Electric fuses." V. HOPE. December 28th.

18,067. "Spark-plug holder or tester for internal-combustion engines." L. J. SOUHAMI. December 28th.

18,068. "Electric heating device." LANDIS & GYR, AKT. GES. December 28th. (Addition to and divided application on 15,685/15. Convention date, December 5th, 1914, Switzerland.) (Complete.)

18,069. "Electric heating device." LANDIS & GYR, AKT. GES. December 28th. (Addition to and divided application on 15,685/15. Convention date, February 16th, 1915, Switzerland.) (Complete.)

18,070. "Electric heating device." LANDIS & GYR, AKT. GES. December 28th. (Addition to and divided application on 15,685/15. Convention date, June 30th, 1915, Switzerland.) (Complete.)

18,084. "Telephone systems." H. S. TURNER. December 28th. (Divided application on 6,480/15, April 30th.) (Complete.)

18,103. "Filament winding machines." C. EISLER. December 28th. (Convention date, December 29th, 1914, U.S.A.) (Complete.)

18,114. "Method of electric welding." D. H. WILSON. December 29th. (Convention date, July 9th, 1915, U.S.A.) (Complete.)

18,115. "Alloy for arc welding." D. H. WILSON & S. M. RODGERS. December 29th. (Convention date, June 16th, 1915, U.S.A.) (Complete.)

18,137. "Dynamo-electric machines." S. H. MARTIN. December 29th. (Convention date January 2nd, 1915, U.S.A.) (Complete.)

18,166. "Electrical relays." S. G. BROWN. December 30th.

18,171. "Electric torches for pencils, pens, and the like." T. H. ESCOTT and A. ALLCOTT. December 30th.

18,189. "Alternating-current electromagnets." H. P. AMPHLETT. December 31st.

18,203. "Switch for eliminating dead-end effects in wireless receiving apparatus." C. S. LENZ. December 31st.

18,222. "Method for connecting carbon electrodes to one another." R. HADDAN (Soc. Francaise des Electrodes, France). December 31st. (Complete.)

PUBLISHED SPECIFICATIONS.

1914.

20,505. REGULATION OF ELECTRIC INSTALLATIONS COMPRISING ELECTRIC GENERATORS. Soc. Anon. des Etablissements L. Bleriot. October 3rd. (October 13th, 1913.)

22,609. REGULATING DEVICE APPLICABLE TO SELF-INDUCTION COILS OR TO WINDINGS OF TESLA TRANSFORMERS USED IN WIRELESS TELEGRAPHY OR OTHER APPLICATIONS OF HIGH FREQUENCY. L. Rouzet. November 16th.

23,938. PERMANENT MAGNETS FOR ELECTRIC METERS. British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). December 11th.

24,074. TROLLEY POLES OR BOWS FOR ELECTRICALLY-PROPELLED VEHICLES. G. Meyer. December 15th.

24,169. ELECTRICAL MEASURING INSTRUMENTS OF THE THERMAL TYPE. British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). December 16th.

24,238. GOVERNORS. British Thomson-Houston Co. & R. H. Collingham. December 17th.

24,335. ELECTRIC ARC LAMPS. G. A. Hughes. December 19th.

24,552. ELECTRICAL RESISTANCES. A. H. Curtis. December 23rd.

1915.

723. SAFETY DEVICES OR VACUUM RELAYS FOR ELECTRIC CIRCUITS. Siemens Schuckertwerke Ges. January 16th. (January 16th, 1914. Patent of addition not granted.)

760. WIRE, CABLE, AND ROD CUTTER. M. Parker (legal representative of J. Parker, deceased). January 18th.

1,751. SEBAQUEOUS SOUND-SIGNALLING APPARATUS. Signal Ges. February 3rd. (February 3rd, 1914. Addition to 3,934/13.)

3,241. CEILING-ROSES AND THE LIKE ELECTRICAL ACCESSORIES. R. T. Grocott. March 1st.

3,690. ELECTRIC IGNITING APPARATUS FOR GAS BURNERS. South Metropolitan Gas Co. & W. J. Buckett. March 8th.

5,371. MANUFACTURE OF ELECTRICAL CONDENSERS. Marconi's Wireless Telegraph Co. & C. Mitchell. April 9th.

5,969. THERMOSTATS. H. E. Moul. April 21st.

7,607. ARMOURING FOR SIMPLE-CORE ELECTRIC CABLES FOR ALTERNATING CURRENTS. A. Rosselli. May 20th.

8,449. ELECTRIC RIVET-HEATERS, WELDERS, AND THE LIKE. E. F. Giraud. June 7th. (June 20th, 1914.)

13,618. INSULATING AIR-TIGHT JOINTS FOR TERMINALS OF VAPOUR ELECTRIC APPARATUS. British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co.). September 24th.

15,083. PORTABLE ELECTRIC LAMPS. H. J. C. Forrester (J. W. Dunham). (Divided application on 2,489/15, February 16th.) October 25th.

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THE VOICE OF LABOUR.

MUCH has been said and written during the last fortnight about the attitude of Labour in this great crisis of the country's history. Complaint is made that trade union leaders do not represent the real feeling of the working man upon great national questions. In particular, it is urged that the card system of voting at Trade Union Congresses is misleading. Whether this is so or not, there can be no question that organised labour has manifested an unpleasant desire to act in its own interest rather than in the interest of the country.

Individual employers in the electrical industry—to take it as an example—will tell you that they know the vast majority of their men are loyal to the core. If the works manager is a "sahib" liked and respected by the employés of the firm, they will have unburdened themselves to him "on the q.t." He knows that once they are removed from the pernicious influence of the Socialist and the demagogue these men are fully prepared to make any sacrifice that may be necessary to win the war.

But, alas! The baneful influence of the so-called trade union leader still makes itself felt! After all, this kind of man lives by agitation. He is paid to agitate. Before the war he was paid to stir up strife between Capital and Labour or between class and class, and he earned his money. Let the working man realise that it is his paramount duty to put the interests of the country before the interests of his union and before his own selfish interest, and the power of the union to do evil is gone for ever.

Some of the demagogues who are largely responsible for the present attitude of Labour in the national crisis present a forlorn spectacle at the present time. As educated men, as men who have sown their political wild oats, they have begun to realise the harm which they have done in former years. In speeches made up and down the country they denounced Capital and extolled Labour. They asserted—and their assertion was cheered to the echo—that the rich were enemies of the poor. They coined phrases which helped to win elections for the Socialist. They managed to instil these doctrines into the mind of the working man as firmly as the doctrine *Deutschland über alles* was dinned into the children of the Fatherland. And now, since the great war began, they have seen the error of their ways. Some of them have sought, and are still seeking, to undo the past. They have seen that the rich men, whom they so roundly abused, have been willing to devote life and money to the service of the King, and profess themselves surprised and pained to find that the working classes will not do the same. But the teaching of the years is not to be so lightly discarded.

In a recent special supplement the *Times* dealt at some length with education and the war. It drew instructive comparisons between the systems of education adopted by the various Powers concerned in the conflict, and laid down certain principles which ought to guide us in the future.

There is one point upon which the English and German systems are as far asunder as the poles. In Germany, the child is taught from its very earliest years to think patriotically, to feel that for a man to lay down his life for his country is the finest thing on earth. In England, on the other hand, such a principle is seldom inculcated in the elementary school.

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We would essay to take up this question of education in its relation to war where the *Times* left off, and ask ourselves these questions: Did our system of education do anything to prevent the present war? Has it qualified the people to take part in the war?

As it seems to us, it were idle to limit a discussion on education to a consideration of that which takes place in elementary schools. The education of the working classes goes on long after the "highest standard" has been attained. It is continued by the demagogue and the Socialist, whose one purpose is to foster the belief that the sole object of the working man is to look after himself and his own interest. And notwithstanding that a very large number of workmen have thrown over good jobs in order to join the Colours, there is no doubt that there is a very considerable number still lagging behind. Many of these belong to a type created by the Socialist—a type which might never have been allowed to come into existence if our educational system had been framed a little more upon the German plan.

When, therefore, it is said that the voice of Labour is against this or that proposal which eminent statesmen say is necessary to win the war, it were idle to ride off on the pretence that trade union leaders are wholly without the support of their following. While it is necessary to bear this in mind, we believe that when the state of affairs at home and abroad is seen in its proper light, the working man, if dealt with personally, will not be slow to make any sacrifice which the country may demand of him.

NATIONAL BUSINESS ORGANISATION.

SHORTLY after the outbreak of war a movement was set on foot to establish an Institute of Science and Industry. Some more or less hurried preliminary measures were taken with the object of organising British industrial methods, and particularly with the view to ensuring the proper application of scientific knowledge in the production of manufactures. Perhaps there was not all the calm deliberation devoted to the project in its early days that one would have desired. There was a preliminary luncheon; a preliminary scheme was drawn up in which the founding of a new trade journal better than all others formed an important part; a number of free articles were offered to the Press; a meeting was called at the Mansion House but the original time had to be altered, and other scientific conferences held on the same day clashed with the event, so that the audience was very limited; the name of the Institute underwent a change, and the details of the scheme also underwent alteration. On April 9th, 1915, we stated in these pages that for many years we had all been talking about the necessity for closer co-operation between science, industry and finance, and that the time had surely come for something in the way of action. Hardly was the ink dry when we received a communication from the Institute of Industry and Science which led us to hope for some definite action to be taken and its nature disclosed at a dinner which was to be given "in about a month's time to the leading industrialists, scientists, and bankers." Deliberation was no longer wanting. Since that date we have endeavoured to possess our souls in patience, but the announcement, like so much else, was very hurried, and we have had to wait nine months. That may not matter very much under the circumstances, but it would have mattered very much indeed if we had had to wait for it in order that the nation might have made any progress toward securing that greater scientific and industrial co-operation that we have all been so eager to ensure. At the end of nine months we are entertained to luncheon at the Savoy, are regaled with a further paper by the Chairman of the Institute (not a chapter from a published book this time), and are permitted to enjoy a most excellent speech from Sir Edward Carson. For a revised and, we suppose, final statement of the objects that are to be pursued, we turn to the paper mentioned above, which would hardly be described as an after-dinner speech, but in the speech of Sir Edward Carson we find a timely reminder that many minds are at work along the same lines, and many movements are on foot. The six objects for which this Institute of Industry (of Great Britain and Ireland)—"Science" has now been dropped from the title—now stands will not be unfamiliar matters to readers of this and other technical and industrial journals; they are as follow:—

1. To secure the establishment of a Ministry of Industry with a properly qualified staff so that our foreign, Imperial and domestic commerce may be developed on the most modern and scientific lines.
2. To secure adequate Parliamentary representation in the House of Commons on behalf of national industry, finance, science and commerce, in order that a unified and practical policy may be adopted with regard to the development of National and Imperial industries, and that the disabilities under which manufacturers at present operate shall be removed.
3. To secure the establishment of an industrial bank or banks for the purpose of extending banking credits in so far as it affects industry in the development of home, Imperial and foreign trade.
4. To develop National and Imperial industries by the holding of annual exhibitions of the natural resources and industries of the United Kingdom, the Dominions, Colonies, and Possessions.
5. To stimulate and encourage standardisation in methods of production, organisation, and distribution. To promote and extend the application of scientific principles to industrial and general purposes. To invite the reading of papers and lectures on these subjects, and to communicate all such information to its members.
6. To stimulate and encourage the standardisation of our educational system. The demand of industry and commerce for the expert administrator and technologist must in the future become more exacting; the stability of our national industries, therefore, will depend upon the standard of knowledge prevailing in our factories and workshops. The Institute will co-operate with existing educational institutions, professional societies and trade organisations, in establishing a definite medium for the exchange of ideas between leaders of industry and education, whereby definite standards of courses of study and standards of attainment will be arrived at and mutually accepted as the guarantee of efficiency in each of the industrial professions.

Mr. J. Taylor Peddie described his Institute as being "in reality a British Economic League," and just as in the earlier days of hurry he found it necessary to reflect upon the Press of which he subsequently made use, so he now considered it politic to reflect upon other organisations created in the past for national purposes, few of which organisations, if any, had been able to give adequate expression to the needs of the hour. "They have a vague notion that something is wrong, but what it actually is they are unable to define." In the present case, however, "we have every reason to believe that we shall be able to carry them (the above six objects) into effect at an early date." But, it was added, "it entirely depends upon the support, financial and otherwise, which the British public, and particularly the manufacturers and trade organisations, are prepared to extend to us in support of our movement." Now, if these two statements mean anything they mean that the Institute of Industry has "every reason to believe" that the "manufacturers and trade organisations" will give such support to this particular movement, that we shall soon, through its instrumentality, have a Ministry of Industry, have engineering and scientific interests adequately represented in Parliament, have industrial banks established, have some big exhibitions, shall apply scientific principles to industrial purposes, incidentally hearing a few more papers on such matters, and shall standardise our educational system.

We have not space to spare to cover all the matters touched upon in the paper or address which, in our opinion, was altogether too lengthy, and too hurriedly prepared, for such an occasion, but when it is stated that the new Institute intends to co-operate with educational and

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professional societies and with trade organisations, we are tempted, as an electrical and engineering journal, to ask whether any of our particular institutions or organisations have expressed their desire or willingness to "co-operate." We were informed that we could "best assist" by concentrating our energies "through one organisation entrusted with the task of developing the new National Business Policy." . . . "Assist us in that direction by not only becoming members of this organisation, but by persuading your friends also to join."

The Chairman at the luncheon, (Mr. F. J. Nettlefold), informed the two hundred gentlemen present that all of the immense burden of work from the beginning down to date in connection with the Institute had been done by Mr. Peddie, who was too modest to claim the credit for himself. We can quite understand that these and other matters with which that gentleman has been concerned during the past twelve months would be quite sufficient to tax the time and resources of any ordinary mortal, but if he lives to see the attainment of those six objects through the instrumentality of his Institute he will certainly have deserved imperishable glory.

Undoubtedly the feature of the gathering was the speech of Sir Edward Carson, who said that, judging by circulars he received from institutions and societies similar to their own, that were cropping up all around them, he came to the conclusion that many minds were now naturally busy looking with considerable anxiety to the commercial and financial future of the country and the Empire as the outcome of the war. Some of these, he said, would be mere mushroom societies, and he advised them, if they meant to be effective, to concentrate and not dissipate their forces. This anxiety he regarded as a very healthy sign. It meant that the country had made up its mind that the treasure of men and money which it was now expending should not be spent in vain, and that in framing the terms of peace, and in pursuing industrial and commercial policies after the war, we were resolved that we should purge our system of everything which was inimical to our own interests or could be used by the hostile foreigner as a weapon against us.

After a few other speeches, a resolution was carried in which those present fully endorsed and approved of the objects and policy of the Institute, and recommended "all persons or companies interested in the industrial life of the British Empire to support the Institute by becoming members."

There is a feeling that the time has come for a strong organisation of the whole engineering industries of the United Kingdom to be formed. We further have in existence our own electrical trade organisations, and these see the need for a federation of all associations of their class in order to bring combined influence to bear upon particular problems and, in particular directions. Are we to understand that our firms should join the new Institute as well as, or instead of, their existing trade organisations? Or will those existing trade organisations meet the individual member's case by entering into "co-operation" with the Institute? We have no doubt that the various organisations will judge for themselves whether the Institute of Industry (of Great Britain and Ireland, Ltd.), deserving and ambitious as its objects are, is the organisation through which they will elect to "federate." Because some things may have been done in a hurry, the importance of the objects of the scheme is not affected, but the interests of engineering and electrical industries are too great for them to be subordinated to other interests.

Rubber.

The rubber market has had a wildly exciting time lately, but there has been some reaction from the best figures, and there is no doubt whatever that a good deal of the buoyancy was due to the initiation of speculative operations which do not deserve to be encouraged at this juncture. If this sort of thing goes on there will probably be Government intervention, as there has been in some other essentials for the successful conduct of the war, and the speculative confraternity might do worse than take this to heart. Rampant speculation is wholly out of place in these times of strain and stress. There has been a good deal of forward buying, and premiums have been easily obtained for February-March contracts. It is very difficult to obtain material from vessels arriving owing to the shocking state of congestion which still exists at the docks, and under all the circumstances it is hard to form an opinion regarding the future course of values. The reaction witnessed in prices has certainly been a good thing for the trade. There has been too much speculation going on everywhere, but there will always be people eager to take advantage of the difficulties of their country in order to make money for themselves, and it would be an excellent thing if this could be put down with a strong hand. There seems no warranty at present for anticipating any shortage of material, and, this being the case, there is no substantial justification for the rushing up of prices. The prospect points indeed to ever-increasing quantities of rubber becoming available, and it is the more remarkable, therefore, that the tendency of forward shipments should have been stronger even than that of prompt supplies. The world's demand will probably keep pace, under normal circumstances, with progressive output, but we certainly do not want a repetition of the rubber boom. Some people suggest that the withdrawal of American inquiries has been responsible for the reaction seen in prices, but, apart altogether from this, the setback was distinctly overdue. According to the last statistical returns, the stock in Liverpool was materially reduced in December, but that in London was added to, the net result at the two ports being an increase of 357 tons to 7,434 tons, against 7,349 tons last year. The United States is now receiving regular monthly shipments from Far Eastern plantations, which the United States Rubber Co. acquired some years ago at the cost of about 7 million dollars, and it is expected that the company named will get about 10 per cent. of its supplies this year from its own plantations in Sumatra. Some manufacturers in America are disappointed that they have not booked more business from the Allies, but the explanation suggested is that England, France and Russia are far better equipped to produce the large requirements of rubber goods needed than they have been to make army shoes and leather productions, in which their productive capacity is relatively less. A recent order was placed, however, for 200,000 pairs of hip boots, but this is nothing very important. The following shows the comparative statistics of shipments from the Federated Malay States during the past three years :—

	1913.	1914.	1915.	
January	2,131	2,542	3,473	tons.
February	1,757	2,364	3,411	,,
March	1,737	2,418	3,418	,,
April	1,626	2,151	2,777	,,
May	1,225	2,069	2,708	,,
June	2,005	2,306	3,403	,,
July	1,781	2,971	3,687	,,
August...	2,363	1,850	3,796	,,
September	2.000	2,879	3,984	,,
October	2,160	2.897	4,120	,,
November	2.062	2,889	4,636	,,
December	2,618	3,361	5,111	,,
Total	23,465	30,697	44,524	,,

From these it will be seen that last month established a new record for monthly exports, eclipsing the November figures (the previous best) by no less than 475 tons, and being only 341 tons below the total exports for 1910. The total for the year is also a record, surpassing last year's total by 13,827 tons. For the sake of comparison, it is interesting to record the aggregate export of plantation rubber from the Federated Malay States for the past seven years :—

1909, 2,641 tons; 1910, 5,452 tons; 1911, 8,792 tons; 1912, 15,506 tons; 1913, 23,465 tons; 1914, 30,697 tons; and 1915, 44,524 tons.

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THE MOVEMENT OF COAL IN HOPPERS.

An account of a research into the movement of grain, coal, &c., in the hoppers of bunkers and silos, published in the *Génie Civil*, contains particulars likely to be of interest to central station engineers who have under their charge bunkers filled with slack or other small coal. The experiments were carried out with the aid of a model representing a vertical section of a hopper, as shown in fig. 1; the front consisted of a sheet of glass, on which were ruled squares to serve as datum marks, and the side walls were of sheet steel, either straight or curved, and could be placed at various inclinations. The substance used for the experiments consisted of sand of two colours, which was

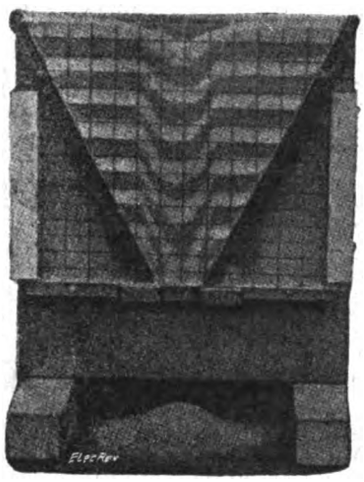


Fig. 1.—Experimental Model of Hopper.

charged into the hopper in layers, either vertical or horizontal, so as to indicate the progressive deformations of the originally parallel slices. The opening at the base of the hopper could be regulated to any desired width.

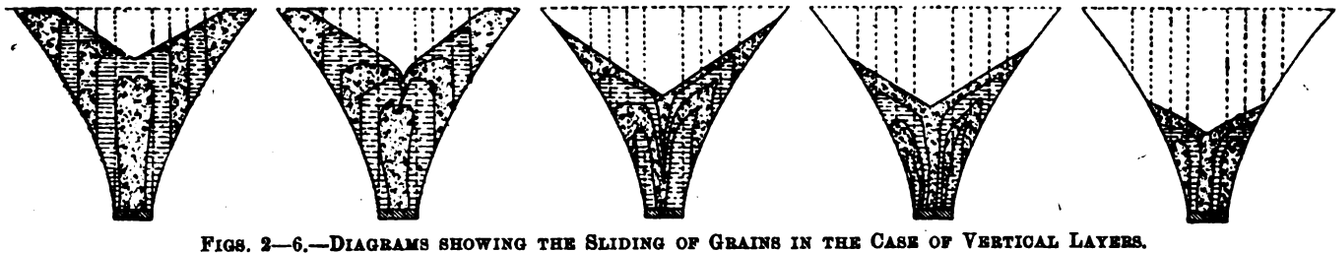
The accompanying illustrations, sketched from photographs of the experimental hopper, show clearly that it is always the uppermost layer which moves from the periphery towards the centre of the hopper, where it gradually sinks, whilst the next following layer tends to flow over it, and this holds good, no matter whether the orifice is large or small, the walls more or less inclined, straight, convex, or concave; the sand resting in the neighbourhood of the walls does not move until it becomes a surface layer, owing to the descent of all that has previously covered it. It is only when the walls are very sharply inclined that the whole of the mass of sand commences moving, and this is not a prac ical case, such a hopper being excessively high in comparison with its capacity.

Small coal, coke, &c., obeys the same laws, as one can easily prove by whitening with chalk the surface layer of the coal in a bunker, and noting the moment when the whitened pieces appear at the outlet.

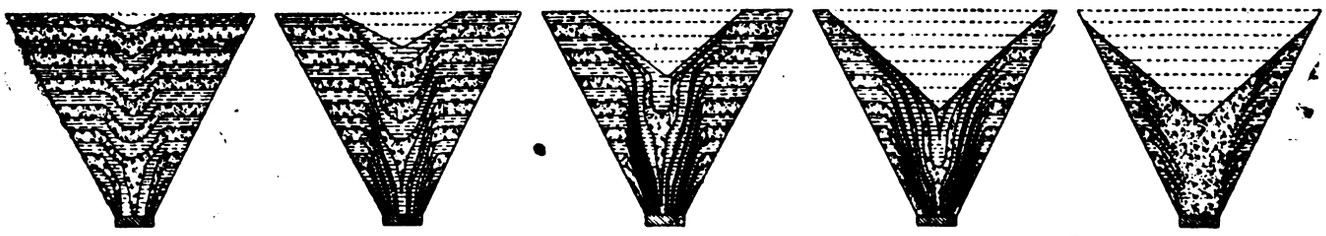
It has also been observed, when vertical iron pipes are driven deeply into the coal in a bunker, for the accommodation of thermometers to ascertain the temperature in the body of the coal, that these tubes remain *vertical* so long as the bunker is not in great part emptied, because the surface layer alone slides past them without dragging them with it, the mass of the coal remaining motionless and continuing to hold the pipes in their original vertical position, until the discharge of the coal eventually removes their support. The fact that the sloping walls of bunkers when empty show little evidence of friction further indicates that only the very last particles have slid upon them.

To summarise: The column of matter which stands upon the outlet is the first to be discharged; then the successive surface layers, and finally the parts that were at the bottom but against the walls and not immediately over the outlet.

To provide against the formation of voids in the mass, due to the jamming and arching of the larger pieces, which it is often awkward to get rid of, the best plan is to put the discharge valve at the very bottom of the hopper without any throat, and to give the outlet the full width of the base of the funnel; otherwise the pieces of coal find support in the dead angles at the bottom of the hopper and stay there, holding up those above them.



Figs. 2—6.—Diagrams showing the Sliding of Grains in the Case of Vertical Layers.



Figs. 7—11.—Diagrams showing the Sliding of Grains in the Case of Horizontal Layers.

THE PREDETERMINATION OF THE PERFORMANCE OF DYNAMO-ELECTRIC MACHINERY.

By Prof. MILES WALKER, M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers, *January 13th*, 1916.)

Almost every electrical designer has his own particular method of calculating a machine and arriving roughly at its performance. Some of these methods are exceedingly short, the figures covering not more than a sheet of note-paper; others are exceedingly elaborate, occupying some 10 or 15 sheets of foolscap.

Our ability to foretell the performance of an electrical machine, whether it be an alternating-current or continuous-current generator or motor, or a rotary converter, depends in the main upon our ability to calculate:—

1. The magnetising current;
2. The armature reaction;
3. The losses in copper and iron;
4. The temperature rise;

and, in the case of commutating machines,

5. The commutating conditions.

The last of these headings requires a paper to itself, so that this paper will only deal with the first four.

Whatever the machine may be—alternating-current or continuous-current generator, induction motor, or rotary converter—the methods of calculating these quantities are in the main the

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same. It is therefore possible to have one general method of calculation for all these machines; and if such a general method could be established it would greatly simplify the work of the student of design.

The methods of design described in text-books and in articles published in the technical journals, can be broadly divided into two classes:—

1. Those which take as the basis of the design the total flux per pole: and

2. Those which take as the basis the maximum flux density in the air-gap.

In many cases where the total flux per pole is taken as the starting point, the calculation proceeds on lines somewhat similar to those employed in the calculation of transformers. For instance, in calculating the electromotive force generated in the armature, one writes

$$E_g = K_t f S \Phi \times 10^{-8} \quad . \quad . \quad . \quad (1)$$

where f is the frequency, S the number of turns, Φ the flux per pole, and K_t a coefficient depending upon the field-form and coil breadth.

On the other hand, where the flux density in the air-gap is the initial quantity kept in view, the formula for the voltage generated in a single conductor takes the form

$$e_g = v B l \times 10^{-8} \quad . \quad . \quad . \quad . \quad (2)$$

where v is the velocity in centimetres per second, B the flux density in the air-gap, and l the length of iron in centimetres.

The first method has the advantage that, after fixing K_t, it only deals with the total flux, without troubling about the distribution of the lines of force in the air-gap; but this very feature limits its application to those cases where we are content to know the mean electromotive force generated. The first formula is, therefore, not so generally applicable as the second one, which gives us a more complete visualisation of what is happening under each pole.

It is possible to have a combination of these methods, which preserves the advantages of both. Suppose we have a rotor surrounded by the stator, as in an induction motor, but that the flux in the gap, instead of changing from point to point along the periphery, is of one sign and distributed uniformly, just as it is in a homopolar machine. If B is the flux density in the air gap, r the radius of the rotor in centimetres, and P_{ps} the speed in revolutions per second, then the total flux passing into the rotor will be $B \times 2 \pi r l$, and the total flux cut per second $B \times 2 \pi r l P_{ps}$.

Writing A_g for the total working surface of the armature (the area of the gap space) $= 2 \pi r l$, we have the electromotive force e_g generated in one conductor:—

$$e_g = A_g B P_{ps} \times 10^{-8} \quad . \quad . \quad . \quad . \quad (3)$$

or

$$e_g = A_g B P_{pm} \times (1/60) \times 10^{-8} \quad . \quad . \quad (4)$$

The expression $A_g B$ gives us the magnetic loading of the frame.

If now, instead of a uniform air-gap and a constant flux density, we have salient poles and a flux density varying from point to point along the gap, the formula for the average electromotive force generated in the conductor becomes

$$e_g = K_f \times A_g B \times P_{pm} \times (1/60) \times 10^{-8} \quad . \quad . \quad (5)$$

where K_f is a coefficient depending on the ratio of the pole-arc to the pole-pitch. This coefficient, K_f, is, in fact, equal to the ratio of the area of the curve representing the field-form to the area of the rectangular field-form which we should have if the pole-arc were equal to the pole-pitch and the air-gap were perfectly uniform. Where a number of conductors, Z_a, are connected in series, as in the armature of a continuous-current generator, the formula for the total electromotive force generated becomes

$$E_g = K_f \times A_g B \times Z_a \times P_{pm} \times (1/60) \times 10^{-8} \quad . \quad (6)$$

Here $A_g B$ is the ideal magnetic loading of the frame; that is to say, the magnetic loading which we could have if the pole-arc were equal to the pole-pitch. The coefficient K_f informs us what fraction of this ideal magnetic loading we have in the machine in question.

In the case of an alternating-current generator, the formula for the electromotive force can still take the same form as (6), but we must introduce a new coefficient, K_c, to take into account not only the area and shape of the field-form, but also the width of the phase-band of armature conductors, the taking of the square root of mean square value of the voltage, and the ratio of the number of conductors in series per phase to the total number, Z_a, of the conductors on the armature. Thus, for an alternating-current generator or motor we have

$$E_g = K_c \times P_{pm} \times Z_a \times A_g B \times (1/60) \times 10^{-8} \quad . \quad (7)$$

By the use of a suitable coefficient, K_c, this formula can be used for the electromotive force generated in any dynamo-electric machine; and for general use it has the following advantages in its favour:—

1. The formula contains the term B, representing the maximum value of the flux density in the air-gap, and for many reasons it is well to have this quantity continually before us.

2. The expression $A_g B$, the maximum flux density multiplied by the total area of the active surface of the armature, has a fairly definite maximum value for a given frame or carcass; so that if we are familiar with our frame we know by a glance at our calculation to what extent we are making good use of the material. For instance, if we have an armature of an alternating-current generator having a diameter of 150 cm. and a length of 30 cm., then $A_g = \pi \times 150 \times 30 = 14{,}160$; and if we know from experience that B in the air-gap cannot be made higher than 10,000 C.G.S. lines per sq. cm., the maximum value of $A_g B$ for that frame would be $1{\cdot}4 \times 10$

As this quantity, $A_g B$, is almost independent of the number of poles, the designer soon comes to know the value it should have for any particular frame, and is able to judge at a glance how far he is utilising the magnetic circuit.

3. The maximum flux density in the teeth can be found by dividing $A_g B$ by the total section of all the teeth. This is a shorter and more convenient method than that employed where the total flux per pole is taken as the basis of calculation. In the latter case it is necessary to make an estimate of the virtual number of teeth per pole, and this is not a simple matter when the pole is bevelled.

4. The coefficient K_t has a certain recognised maximum value for a certain kind of machine. Thus, for a three-phase generator, K_t may be equal to 0·4. If it has a lower value in any calculation under consideration (as may be the case where the pole-arc is a small fraction of the pole-pitch), the designer's attention is called to that circumstance.

5. If we multiply both sides of Equation 7 by I_a, the current in the armature conductors, we get a formula for the output, containing the two expressions:—

$A_g B$, the magnetic loading; and
$I_a Z_a$, the current loading.

Both these quantities being clearly before us during our consideration of alternative designs, we can observe how one decreases and the other increases in the fight for room which occurs between iron and copper.

Any general method of design should in its nuclear form be exceedingly short, and capable of reaching rough results in the course of a few minutes. At the same time it should be capable of developments which lead to more accurate results at any stage of the calculation. Moreover, a general system of calculation should be founded upon sound principles and not merely built upon empirical rules. A method of calculation which, though rough, is based on arguments that must be right from the very nature of things, helps the designer in the habit of forming rapid mental estimates; whereas an empirical rule, however often it may be applied, never gives its user the faculty of rapidly estimating with approximate accuracy, because it does not take into account all the factors that determine the result. A busy designer would never get through his work if he stopped to calculate everything. He guesses a great deal, or makes rapid mental estimates of quantities; he has not time to calculate. He is never justified in so guessing unless he knows with fair accuracy the limits of his possible error, and knows that with that error he would still have a machine which would comply with its specification. This faculty of guessing, when properly carried out, is really a process of rapid mental calculation based upon many machines calculated and tested in the past.

In most designing offices, calculation sheets are provided. The

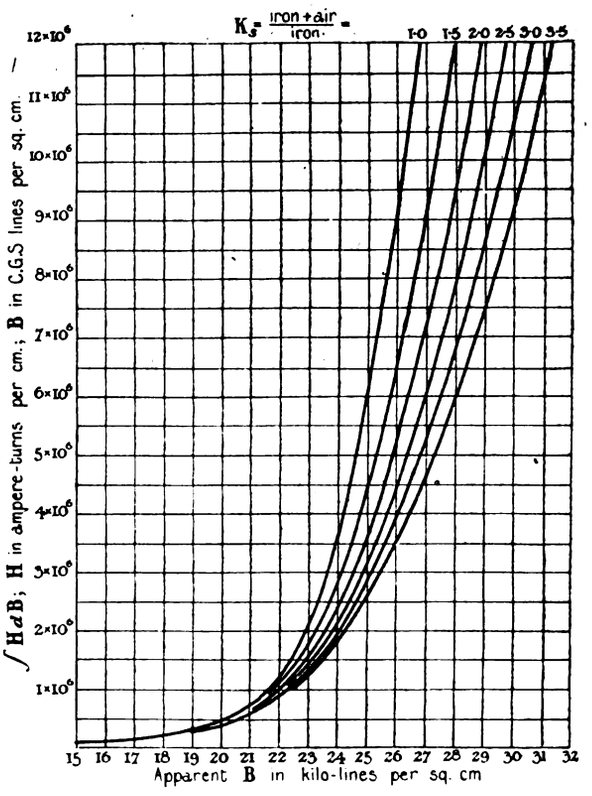

FIG. 1.

figures relating to each dimension of the machine and each important quantity are given a definite place on the sheet, so that they can be readily referred to. The process of calculating, then, merely consists in filling in the proper figures in the appropriate places, and this is done in a certain order, the slide-rule or a short calculation being used to step from one quantity to the next.

It is usual to have one kind of calculation sheet for a continuous-current generator, another for an induction motor, and another for an alternating-current generator, and so forth. If, however,

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one system of calculation is employed for all machines, one printed form can be employed for all; and there is a distinct advantage in this, because an improvement in method or an increase of rating can thereby be more readily extended from one class of machine to another.

The process of plotting the field-form of a salient-pole machine in cases where it is unnecessary to take account of the saturation of the teeth is fairly simple. In cases where the teeth of the field-magnet are tapered and highly saturated, the matter is somewhat more difficult. The following remarks relate to the case of a 2,700-K.V.A. three-phase turbo-generator, having a rotor 59 cm. in diameter and 115 cm. in length, with 32 slots spaced as if there were 42, each polar projection occupying the space of five slots which are uncut.

The method proposed by W. B. Hird* for dealing with taper teeth may be employed with advantage. Curves plotted somewhat after the manner proposed by Mr. Hird are shown in fig. 1. In order to allow for the magnetic flux which leaks along the slot and the ventilating duct, it is necessary to have a number of curves, each for a particular value of K_s, where K_s is the ratio between the cross-section of the iron plus the cross-section of the air, to the cross-section of the iron, at any particular section under consideration.

The first step in the process of drawing the field-form is to plot an "air-gap and tooth-saturation" curve; indeed, where the slotting of the rotor is not uniform all round, it is necessary to have such a curve for each kind of slotting. Thus, one of these curves is required for the part of the rotor which is uniformly slotted, and another curve is required for the polar projection, which may be regarded as one large tooth. These curves are shown in fig. 2 and are marked F and G.

The first step is to find the relation between the flux density and the ampere-turns expended on the air-gap. This gives us the "air-gap line" shown dotted in the figure. For the part of the air-gap adjacent to the polar projections, where there are no slots in the rotor but only ventilating ducts, the air-gap coefficient is only 1·02.

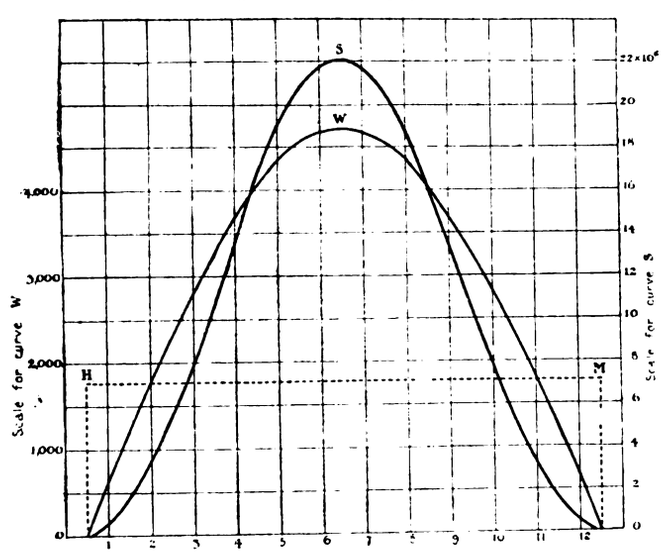

FIG. 5.

The air-gap line of this part would therefore be slightly above the thick dotted line in fig. 2.

For the purpose of finding the ampere-turns expended on the teeth, we shall consider three sections of the teeth: one, C, taken on the surface of the rotor; another, D, half-way down the teeth; and another, E, at the root of the teeth.

It is convenient to make the calculation of the ampere-turns on the teeth for three densities in the gap, say, B_g = 5,000, 6,000 and 6,500. It will be found that for B_g = 5,000 the ampere-turns on the part of the tooth lying between C and D are so small, compared with the ampere-turns on the part from D to E, that it is not worth while to apply Hird's method to the upper part of the tooth. It is sufficient to take the mean density, and find the ampere-turns per centimetre from the magnetisation curve of the iron. To find the ampere-turns on the part D E, we find the value of $\int H\,dB$ for the value of B_t at D, and the value of $\int H\,dB$ for the value of B_t at the section E; the difference, divided by the difference between the values of B_t, gives the ampere-turns per centimetre, and hence the ampere-turns for the part of the tooth from D to E; so that the total ampere-turns on the tooth are obtained. This is set off from the thick dotted air-gap line in fig. 2, and gives us a point on the "air-gap and tooth-saturation" curve. Similarly, for B_g = 6,000 and 6,500, the ampere-turns are found, and, adding these figures to the ampere-turns on the air-gap, we get the "air-gap and tooth-saturation" curve shown by curve F in fig. 2.

The saturation curve for the polar projection may be obtained in the same way, except that in this case it is necessary to take into account the leakage flux, which may be estimated by any of the known methods. The magnetisation curve for this part is shown by the curve G in fig. 2.

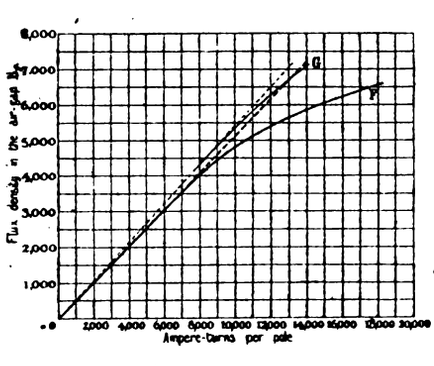

FIG. 2.

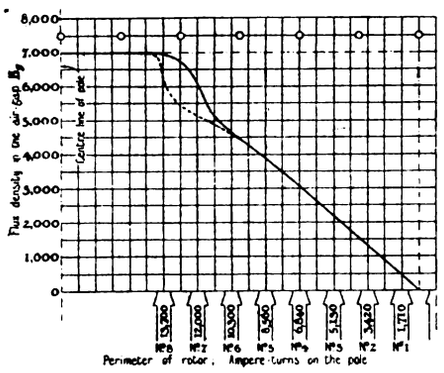

FIG. 3.

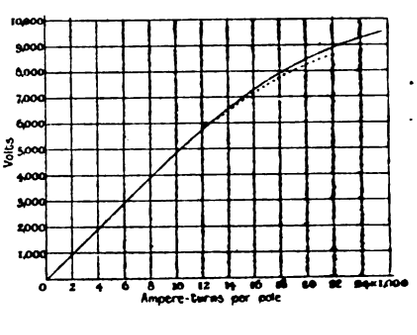

FIG. 4.

The method of obtaining the field-form at no-load, full voltage, is necessarily one of trial and error, because until we know the field-form we do not know accurately the value of K_s, and we cannot find K_s until we know the maximum ampere-turns on the poles. The usual practice is to guess the value of K_s from experience of previous machines, and from it to obtain an approximate value for the maximum flux density in the gap. From curve G we find the corresponding ampere-turns per pole. We now lay out the spacing of the slots in the rotor on the abscissa line as in fig. 3, and write down the ampere-turns per pole for the part of the iron encircled by the conductors in slot 8, slot 7, slot 6, and so on.

Referring now to Curve F, fig. 2, we are able to plot the values of the gap density opposite to each tooth. It will be seen that fig. 3 shows two curves; the inner dotted one gives the value of the flux density opposite to the tooth between slots 7 and 8, as obtained from fig. 2. This would lead to a field-form which is too narrow across the top. In order to avoid this, a steel wedge is put in the eighth slot, which avoids the super-saturation of the tooth between slots 7 and 8, and gives the field-form a broader top, as shown by the outer curve. The exact shape of this curve cannot be calculated; but the smooth curve shown in fig. 3 is sufficiently near the actual case for the purpose of finding K_s.

In order to calculate the total flux per pole it is convenient to use a coefficient which may be called the field-form coefficient, denoted by K_f, which gives the ratio between the area of the field-form and the area of the rectangle, the height of which is the maximum flux density in the gap and the base the pole-pitch. It is easily obtained in practice by running a planimeter around the curve in fig. 3, and then around the rectangle indicated by the dot and dash line. The ratio between these areas in fig. 3 is 0·625.

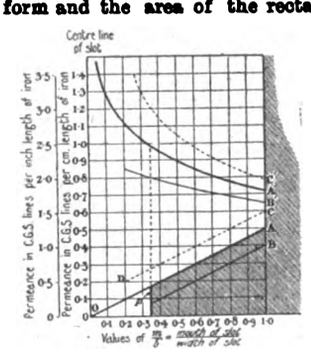

FIG. 6.

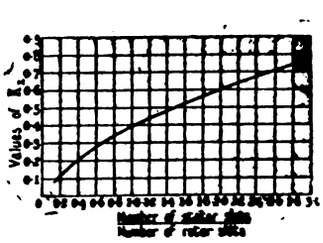

FIG. 7.

In order to plot the no-load magnetisation curve strictly one ought to go through the process of plotting the field form for a number of different excitations and find the voltage generated in each case. In practice, however, it will be found that with this type of field magnet the value of K_s does not change very much with change in the exciting current. We may for practical purposes take the voltage as proportional to the maximum flux density in the gap. If this is done we can plot the no-load magnetisation curve from the figures obtained for the ampere-turns on the central part of the pole for the voltages 6,000, 6,600, and 7,500. These are plotted in fig. 4. The dotted curve gives the increased

* "The Reluctance of the Teeth in a Slotted Armature," *Journal I.E.E.*, Vol. XXIX, p. 933, 1900.

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ampere-turns required to allow for the saturation of the polar projection at full load. To find the ampere-turns at full load and 0·8 power factor one has recourse to a graphic construction.

The method of calculating the value of K_c, when the field-form and the arrangement of the armature conductors are given, can be illustrated by working out this coefficient for the 2,700-K.V.A. turbo-generator the field-form of which is given in fig 3.

In this case we have a three-phase, star-connected armature, so that the voltage between two terminals is that generated in a band of conductors occupying two-thirds of the pole-pitch. It will in general be found sufficient to calculate K_c as if there were 12 slots per pole, since a larger number of slots per pole does not sensibly affect the result. The pole-pitch is divided into 12 parts, six of which are marked off by little circles in the half field-form shown in fig 3. We begin by taking values proportional to the flux density in the gap opposite any group of eight circles, which may be taken to represent the eight conductors lying in the band; the sum of these gives a figure proportional to the instantaneous voltage. When the field-magnet has moved through the space of one conductor, the voltage generated is proportional to the sum of a new set of values, and by a successive process of addition and subtraction, we obtain figures proportional to the voltage generated in the phase-band, which are plotted as shown in curve w, fig. 5; they give the wave-form of the electromotive force generated between the terminals of the three-phase star-connected winding.

The next step is to square the values of the ordinates of curve w, and plot them to some convenient scale, as shown in curve s. Now the value of K_c is the ratio of the virtual value of the voltage actually generated in the eight conductors, with the field-form shown in fig. 3, to the value of the voltage that one would get in a homopolar machine having a flux density equal to the maximum in fig. 5, with 12 conductors in series. In order to avoid any question of the scales to which fig. 5 is plotted, one may adopt the following plan: 12 conductors would have a generated voltage proportional to $12 \times 700 \doteq 8{,}400$. The square of this is $70{\cdot}56 \times 10^6$. Plot this squared voltage, as shown by the dotted line in fig. 5, to a scale $\frac{1}{10}$th of that used for the curve s. A planimeter run round curve s gives a reading 1,322; a planimeter run round the dotted rectangle gives 860; this multiplied by 10 gives 8,600. Therefore the ratio of the square root of the mean square value of the voltage which is generated in the eight conductors to the square root of the mean square value which would be generated in a homopolar machine having 12 conductors is $\sqrt{(1{,}322/8{,}600)} = 0{\cdot}392 = K_c$. This method is applicable to any arrangement of conductors.

In considering the armature reaction of a polyphase armature, we have to take into account not only the back magnetomotive force which it exerts, but also the back voltage that is generated in the winding by the leakage flux which passes across the slots and around the end-windings. A great deal has been written upon the method of calculating this leakage flux.

The calculation of the amount of effective leakage across the slots is most easily carried out by means of the formula $\lambda_d = \frac{1}{3} \cdot h_e/b$, where h_e is the depth of the slot after a deduction has been made for the thickness of the insulation between the copper and the bottom of the slot, and b is the breadth of the slot. By λ_d we denote the lines across the slot per centimetre of axial length of slot for unit magnetomotive force. To this must be added the leakage across the mouth of the slot.

Whether the slot is open or semi-closed, the permeance across the mouth of the slot can be found from fig. 6. This figure is so constructed that a designer can tell at once from inspection the effect of changes in the shape of the lips upon the permeance. The shape of the lip is indicated by shading, as shown in the figure, and the shading may extend either to the line O A as shown, or to the line D C, or to the line 0·2 B. The position of the small face p may be varied, so that the fraction (mouth of slot)/(width of slot) has any value between zero and 1. At whatever point we choose to draw p, it is only necessary to continue up the vertical line from p, as shown in the figure, until it cuts one of the curves C′, A′, or B′, corresponding to the depth of the lip, and we can at once read off the permeance λ_m per centimetre of axial length of slot. For example, in fig. 6 the lip is supposed to be of the shape indicated by the shading, the value of (mouth of slot)/(width of slot) being 0·375. If we carry up the perpendicular from p to the curve A′, we find that the permeance in C.G.S. lines per cm. length of iron is 0·98. Had the lip been of a deeper design, so as to extend up to the dotted line D C, we should have carried our perpendicular up to the dotted curve C′, and the permeance would then be found to be 1·2. If the lip is of a special shape, or has the angle of one of its faces different from that shown in the figure, it is easy to sketch on our figure a lip having the same permeance and having face angles enabling fig. 6 to be instantly applied.

When calculating the leakage due to the rotor slot, it is convenient to multiply the sum of λ_d and λ_m, obtained in the way shown in the last example, by the ratio (No. of stator slots): (No. of rotor slots). This enables the result to be added directly to the stator permeance, and the total leakage can be calculated from the number of ampere wires in the stator slot.

For roughly estimating the zig-zag leakage, a simple rule is given here, which works well enough in practice.

The reluctance of the path of the zig-zag leakage is in the main proportional to the length of the air-gap. The width of the path changes as the teeth change their relative positions. If we assume that the dimensions of the teeth and the mouths of the slots are such as one generally finds in practice, it is possible, roughly, to take into account the changing width of the leakage path by means of a coefficient, K_z, and we may write

$$\lambda_z = K_z \times \tfrac{1}{3} \text{ pitch of slot} \times 1/(\text{length of gap} \times K_\sigma),$$

where λ_z denotes the lines of zig-zag leakage per centimetre axial length of slot, for unit magnetomotive force applied across the mouth of a stator slot. The values of K_z which may ordinarily be employed in practice are given in fig. 7 as a function of the ratio (No. of stator slots): (No. of rotor slots).

If we now add together the permeances due to the stator slot, the rotor slot, and the zig-zag path per centimetre of axial length, and multiply by twice the length of iron, we arrive at an approximate figure for the permeance of the path of magnetic leakage from one pole, so far as the first three parts of the leakage above referred to are concerned. Leaving out of account for the moment the leakage due to the end-windings, we can get the leakage in the iron paths in C.G.S. lines per pole by multiplying the total permeance calculated above by the maximum ampere-wires per slot and by 1·257.

The only really accurate way of finding the value of the end leakage of an induction motor is by experiment on the winding in question. If we have two motors built on the same frame with the same type of winding, but one machine much longer than the other, we can, by measuring the short-circuit current on each machine, calculate with some accuracy what part of the leakage reactance in each machine is due to the end-windings. When once this has been ascertained it can be put on record and the figure used in similar cases. A simple method of finding roughly the amount of end leakage that may be expected on a given machine is given in the paper. The whole matter is so complicated by accidental circumstances that it is useless to attempt any accurate calculation.

The methods of calculating the copper losses in electrical machines are fairly well standardised. So far as the iron losses in the machine are concerned, it is impossible to determine these beforehand with any degree of accuracy. Experience shows that two machines, built to exactly the same drawings, and, so far as can be ascertained, with the same care, will have widely differing iron losses, owing to small accidents in the handling of the iron stampings. It is, therefore, not worth while to make a very elaborate calculation of iron losses; many engineers use a curve giving the combined hysteresis and eddy-current losses per cubic centimetre

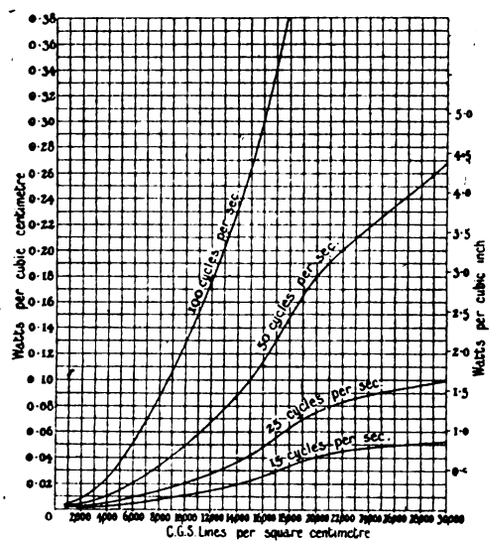
Watts per cubic centimetre
Watts per cubic inch
100 cycles per sec.
50 cycles per sec.
25 cycles per sec.
15 cycles per sec.
C.G.S. Lines per square centimetre

FIG. 8.—IRON-LOSS CURVES.

at different maximum flux densities. Such curves, to be of service, should be based on the average results obtained from running machines, rather than on purely theoretical considerations. The author has seen curves of this kind plotted on the assumption that the eddy-current losses increase in proportion to the square of the flux density, and the hysteresis losses in proportion to $B^{1\cdot6}$. Such curves will be found in practice to give too high values for the loss in the iron at very high densities, because the hysteresis loss does not increase as $B^{1\cdot6}$ at high densities. In fact, it has been shown that where the magnetic field is a rotating magnetic field, the hysteresis loss is zero for flux densities above 22,000; and even for an alternating field it becomes almost constant for densities greater than 22,000. In most electrical machinery the field is partly rotating and partly alternating, and we may certainly take it that the hysteresis loss does not increase at all at high flux densities such as are used in the teeth of continuous-current generators. It thus comes about that for low frequencies the curves giving combined loss take a shape somewhat like the curve shown in fig. 8, a curious inflection occurring at B = about 20,000. These curves are plotted for ordinary dynamo steel of a thickness of 0·04 cm. and subjected to as careful treatment as is consistent with ordinary shop processes. The losses shown in the curve are about twice as great as the theoretical losses calculated from the tests on samples having no burrs or short-circuits such as commonly occur in the built-up machines. Experience shows that curves of this kind will give, on the average, the losses with sufficient accuracy for commercial purposes.

Iron-loss tests taken on completed machines will generally show greater losses than are given by these curves, particularly at high flux densities. It would appear that when the teeth of a machine become saturated, the flux from the poles bulges out sideways and attacks the armature from the ends, making eddy currents in the end-plates, so that the loss sometimes increases in ratio greater

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than the square of the flux density. This end-plate loss should really be allowed for separately, as its amount will depend upon factors different from those taken into account in calculating the true iron loss. A good deal of experimental work still remains to be done before we can formulate a method of calculating these end-plate losses.

Where special silicon steel is employed, the losses may be reduced by 40 per cent. when working at a flux density of 10,000 per sq. cm., at a frequency of 50 cycles, the thickness of the iron being 0·05 cm.

Predetermination of Temperature Rise.—In a previous paper before the Institution, the present author, in conjunction with Mr. H. D. Symons,* gave certain rules for the predetermination of the temperature rise in various parts of electrical machines; since that time further experiments have been made, particularly in connection with the passage of heat from the walls of ventilating ducts to the air passing along the ducts, and also in connection with the cooling of field coils.

Experiments with ducts indicate that the specific cooling constant is dependent not only upon the mean velocity of the air through the duct, but also upon the character of the motion of the air. The cooling conditions for the same amount of air passed through the duct may be three or four times as great where there are considerable eddies as where the air moves in even stream-lines. This circumstance makes experiments upon the specific cooling constant in ventilating ducts somewhat difficult and inconclusive, and is the cause of the wide divergencies in the results obtained by different experimenters.

In order to arrive at more definite values, the author and Mr. W. H. Blythe made a number of experiments with various kinds of ducts over a considerable range of air velocity and under varying conditions. The results of these experiments are contained in a contribution presented to the Institution.

These results can be shortly stated as follows:—If we denote the flow of heat from the walls of the ventilating duct, expressed in watts per square centimetre per degree C. difference of temperature between wall and air, by the symbol h_s, then we find that over a wide range of speed $h_s = K_s v$, where v is the mean velocity of the air in the duct measured in metres per second, and K_s is a constant depending on the character of the duct. K_s is very much affected by the amount of baffling of the air in the duct. A circular duct 2 in. in diameter gave a value of K_s as low as 0·00083 when the air passed through with long steady stream lines, but the addition of baffles brought the value up to 0·0011. For ordinary flat ducts about ¼ in. wide it would seem that the constant K_s may be anything from 0·0005 to 0·0014, depending on the amount of eddy currents in the air in passing along the duct. Where the ducts are dirty, the value of K_s may be very much lower still.

The cooling of the iron of the stator is considerably helped by the conduction of the heat into the cast-iron frame, from which it is passed by radiation and convection to the surrounding air. It is generally impossible to make an accurate calculation of the amount of this conduction. The author has found that with ordinary box-type cast-iron frames, with the punchings dovetailed into the cast-iron, to allow 0·15 watt per square centimetre is suitable where a temperature rise of 40° C. is permissible.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

A Photoelectric Relay.

The sensitive photoelectric relay illustrated herewith, which may be used for various scientific and technical purposes, consists of a glass tube 6 cm. in diameter and 19 cm. in length, in which the aluminium plate D′ can be moved toward the wire net B by means of a magnet acting on the iron cylinder E. A little rubidium is distilled in the vacuum through the side tube F on the plate D′, which in this way can be uniformly covered with the alkali metal. Hydrogen will then be admitted and the surface of the alkali metal rendered sensitive by means of the glow discharge. The hydrogen will be replaced by argon until the sensitiveness is a maximum. The light of an incandescent lamp at a distance of 50 cm. passes through the two wire nets B and C and liberates the electrons in the position D from the rubidium-hydrogen. These electrons move under the influence of a small potential difference from D to B, where they enter the electric field between C and B, which is so strong that ionisation by collision takes place. Through this process the current between B and C becomes very large. The currents between D B and B C can be varied within wide limits by a variation of the pressure and of the distances between the electrodes.

In the course of experiments conducted in the physics laboratory of the University of Illinois, Urbana, the distance between B and C was kept constant, about 5 mm., while the distance between D and B was varied from 3 mm. to 30 mm. The primary or photo-electric current between D and B varied from 3×10^{-10} to 10^{-7} amp., and the secondary or ionisation current from 10^{-7} to 10^{-5} amp. The maximum secondary current was sufficient to close an ordinary relay. The secondary voltage required for the maximum current was 136 volts. A further increase of this tension produces a glow discharge which persists even when the primary current is interrupted. This apparatus thus acts as a relay, a weak primary current closing the circuit of a relatively strong secondary current.

* *Journal I.E.E.*, Vol. 48, p. 647, 1912.

Amongst other applications the device may be used for the detection of electromagnetic waves; a telephone relay for weak electric currents; a thermostat for the regulation of temperature within a very small fraction of a degree; and a light sensitive relay. In lecture experiments performed by means of this relay a beam of light has been made to ring a bell or to turn on a group of incandescent lamps.—Jacob Kunz, in the *Electrical World*.

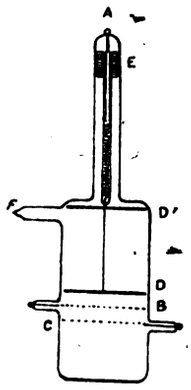

FIG. 1.—SENSITIVE PHOTOELECTRIC RELAY.

New Ultra-violet Lamp.

It is reported that a Mr. Simpson, who was experimenting with rare metals, recently discovered that the light emanating from an arc between certain ores possessed powerful therapeutic qualities, greater than those of the Finsen lamp, as it is richer in ultra-violet rays. Investigations are in progress at St. Bartholomew's Hospital, London, and the results obtained so far have been very promising.

LEGAL.

Re CEDES ELECTRIC TRACTION, LTD.

A DEBENTURE-HOLDERS' action by the Austrian Daimler Motor Co., Ltd., against the Cedes Electric Traction, Ltd., was mentioned to Mr. Justice Neville in the Chancery Division on Friday last, upon a motion by the plaintiffs for the appointment of a receiver and manager.

MR. DIGHTON POLLOCK, for the plaintiffs, said that the ground of the motion was jeopardy. A petition to wind up the Cedes Co. was down for hearing on Tuesday, and it would be necessary to find money to pay this week's wages.

MR. WARD COLDRIDGE, K.C., for the defendant company, said there was sufficient money at the bank to pay the full amount of the company's indebtedness and the wages, but the petition had created a difficulty in getting at this money. The company had important and remunerative contracts running.

HIS LORDSHIP appointed a receiver and manager with liberty to borrow enough to pay the week's wages if necessary; but he recommended the parties to lay their heads together and come to some agreement, so that the petition could be got rid of before Tuesday.

ALLEGED FRAUDULENT TRAMWAY CLAIM.

MR JUSTICE SCRUTTON in the King's Bench Division, on January 13th, entered judgment for the London County Council in a claim for damages by Henry Barker, of Tottenham, for injuries alleged to have been received in a tramway mishap. The jury held that the claim was a fraudulent one from beginning to end.

It was stated that a collision occurred between the car in which Barker was a passenger and another car at Ponder's End, on June 11th, 1914. The plaintiff alleged that a fellow passenger weighing 19 stone was thrown on to him, causing concussion of the spine and other injuries.

On the application of counsel for the defendants, Mr. Justice Scrutton ordered the papers in the case to be impounded for further consideration.

WYNSTANLEY, *v.* MACARTNEY, MCELROY & CO., LTD.

MR. JUSTICE SCRUTTON, in the King's Bench Division, on January 12th, gave judgment in this action, which was heard last term. He gave plaintiff £100 damages for the wrongful dismissal from the directorship. He gave judgment for the defendants for £800, £90 and £48 which the plaintiff had obtained from the company, while the defendants failed in their counterclaim for £35 and £192 and 200 Malta Tramway shares. As each side had partly succeeded, he would save them expense by holding that each should pay their own costs. Concluding, his Lordship expressed his great regret that a part of the burden of this litigation would fall on infant shareholders whose interests had been entrusted to unfaithful and incompetent people. He hoped means would be found to remove some of that burden to the directors, and especially to Mr. Frank Macartney, who, since his father's death, had much to answer for. He was quite unfit to hold the position of director of the defendant or any other company.

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MUNITIONS COURT CASES.

AT the Rochdale Munitions Court on the 6th inst., a labourer at the Rochdale electricity works asked for a leaving certificate, which he alleged had been withheld. He stated that he had been discharged on December 22nd, and had been unable to get employment elsewhere because he had not the certificate. The borough electrical engineer, Mr. C. C. Atchison, said the request for a certificate had not reached him, or he would have granted one. He agreed to give applicant a leaving certificate and a monetary grant for the mistake.

At the same Court another employé at the Rochdale electricity works—a turner—desired a leaving certificate in order that he might do work of a more particular character in the manufacture of munitions. He said he worked on a lathe only five hours a day, and, being a rheumatic subject, the steam and heat affected his health. Mr. Atchison said the works supplied electricity to important works. He was willing to release the applicant as soon as he could be replaced. The application was eventually withdrawn on the understanding that the certificate should be given within a month.

Before the Oldham Munitions Tribunal last week, Messrs. Ferranti, Ltd., lodged a complaint against five youths who "did not work diligently under the rules." It appeared that at 6 o'clock one morning the five youths were found by the night watchman playing cards by the light of a candle. They had been on the night shift, and should have gone away at 7 a.m. Three of the lads said they were not playing for money, another said he had merely stopped to watch the play, and the fifth said they were playing banker for money. The youth who said he had merely stayed to watch was let off, and the remainder were fined 5s. each.

Another case at the same Court concerned George W. Sugden, a crane-driver employed by Messrs. J. P. Hall & Co., electrical engineers. Sugden asked for a leaving certficate, his case being that when he started as a spare man, on November 9th, he understood that his commencing wages of 23s. were to be increased to 27s. if he agreed to take the job on permanently. He now found he would have to wait six months for a rise, and as he had an offer of 35s. a week, he wanted to leave to better himself. He complained also that his present work was injurious to his health and eyesight. Mr. Hall (for the firm) said that the man had been engaged entirely on important work. He was not a spare man at all, and his wages were started at 23s., and would advance to 27s. which was the standard. It was also alleged against Sugden that he had done things with a view to getting discharged, one instance cited being that he ran a load over some men who were working, which was contrary to the rules. Mr. W. Sellers (chairman) asked how a man could be indispensable who was only worth 23s. per week. Mr. Hall: He is one of the links in the chain forming an indispensable whole. There is no man indispensable if you put it that way. Mr. Hall added that they would have difficulty in replacing this man, and it would take a week or a fortnight to teach a man. Sugden's application was granted.

The question whether the electricians in a Govan shipyard should receive an allowance for the half-hour tea interval when ordered to work overtime was raised last week at a Local Munitions Tribunal in Glasgow. The case was raised at the instance of Messrs. Alexander Stephen & Sons, shipbuilders, Linthouse, who charged a number of their workmen with having, on December 22nd, infringed the rules of the Munitions Act by refusing to work after 7.30 p.m. unless they were paid for their tea interval, contrary to the practice of the establishment.

Mr. Biggart appeared for the firm, while Mr. A. Stewart, Electrical Trades Union, represented the men.

According to a Scottish paper, it was stated in the course of the evidence for the prosecution that the men, who were electricians, had declined to work overtime unless they were paid for the half-hour tea interval. After being informed that the matter would be referred to the Munitions Tribunal they still refused.—In answer to the men's agent, the foreman electrician, who had given the order to work overtime, said the men refused to work overtime unless they received payment for the tea interval. In the presence of witnesses the electricians were asked individually to work overtime, and witness had found out that the majority of them were perfectly willing to work, but said "they were on the horns of a dilemma," as they had been instructed by the Union not to work without payment for the tea interval.—MR. STEWART remarked that this matter was irrelevant to the case, but the CHAIRMAN held that it was an answer to a question.—For the defence, a workman said he was employed with a firm who did sub-contracting work for Messrs. Stephen, and he received payment for the tea interval.—MR. STEWART said this was a case for arbitration, and the workmen were prepared to go to arbitration on the question. They had endeavoured to have a conference on the subject with the employers, but had been refused. He thought the men should be dismissed, pending arbitration.

The Court found that the charge against the men had been proved, and fined each of them 10s., payable in two weekly instalments to be deducted from their wages.

TAYLOR & FARLEY *v.* THE WEST BROMWICH CORPORATION

THIS case was again before Mr. Justice Neville in the Chancery Division on Friday.

MR. WILLIAM MACKENZIE, for the plaintiffs, said that in this case his Lordship had granted an interim injunction over the day, restraining the Corporation from discontinuing or curtailing the supply of electrical energy for power to the plaintiffs. By an agreement made in 1912, the plaintiffs were entitled to a supply of electrical energy for five years, but recently the Corporation had sent a letter threatening to cut off the supply of energy during certain hours.

MR. WHEELER, for the defendant Corporation, said there was a difficult question of law to be decided on the contract, and this could best be dealt with at the trial. Until then the Corporation would give an undertaking in the terms of the order made over that day.

His LORDSHIP: I remember the case, and I think your clients are acting rightly.

MR. WHEELER: I will not discontinue or curtail the supply at any time during the night or day; but plaintiffs should give an undertaking that if defendants succeed at the trial they will pay for power supplied to them at the same rate as other consumers.

His LORDSHIP: I don't like that form of undertaking. Let it be in the usual form.

CECIL HODGES & CO., LTD., *v.* ELLIS & WARD.

IN the City of London Court, on January 17th, before Sir John Paget, Bart., K.C., Deputy Judge, an action which had been remitted from the High Court of Justice, was brought by plaintiffs against defendants, to recover £96 for an electric lighting installation at Bristol. Mr. Clements appeared for the plaintiffs, and Mr. Lincoln Reed for the defendants. Mr. Clements said in respect of the claim £69 had been paid into Court in respect of switchboards and electrical appliances, and there was no dispute about the delivery of the goods, but the defendants said they were entitled to set off £27, and counter-claim for £24, because certain goods were not supplied that ought to have been supplied, or work which ought to have been done had not been done. They further said they had to employ men and had to make temporary arrangements for power fuses and lighting fuses, and go to other expense in travelling from Bristol to London. Mr. Reed said a large number of ivorine labels ordered had not yet been delivered. Mr. Clements said the whole contract was based upon a quotation of December 11th, 1914. Full details of the contract were given, and in the course of the hearing Mr. Cecil Hodges, the managing director of the plaintiff company, was called. He said that they still had some labels to be sent. They did not get the instructions for them until a long time after they had the instructions for the boards. Great delay was caused by the Government war work, which was being done by the foundry people. They had not to do the drillings in the switchboards. He had never heard a word about the defendants having, as now alleged, to get temporary plant and make journeys to London, until the present proceedings. It was an oversight on his part not to tell the defendants that he could not execute the order within four weeks when the alterations were made. No doubt the defendants wanted quick delivery, and they did the best they could in the circumstances. The reason why 97 labels were not supplied was because they had been overlooked. Mr. Reed urged that after that admission plaintiffs could not recover at all because the contract was indivisible and plaintiffs had not fulfilled it. The Deputy Judge ruled against that contention. Mr. David Dalrymple, foundry manager, Wolverhampton, said he made the iron cases for the plaintiffs. The work was very much delayed because of important work. Mr. Ellis said it was very important that the labels should be put on the fuses, as everything was done by motor in the factory in question. It was all electrical work. At present they were incomplete. For the defence evidence was called to show that the plaintiffs had not carried out their work according to specification. The result was that the defendants had got the work done elsewhere at an expense which was now counter-claimed for. The Deputy Judge said he quite realised the importance of labels being put on the switches, and that the haphazard method adopted by the defendants with high-power machinery was very unsatisfactory. He held that the plaintiffs were entitled to recover £69 paid into Court, but no more. He gave them judgment for that amount on the claim, without costs, and he awarded the defendants £24, with costs on the counter-claim, that being the amount of expenses they had been put to in consequence of the plaintiffs not carrying out their contract.

CONSOLIDATED DIESEL ENGINE MANUFACTURERS, LTD.

THE summons in the liquidation of this company which asked for the appointment of an additional liquidator with Sir William Peat again came before Mr. Justice Astbury in the Companies Winding-up Court; the former hearing was in November.

MR. H. COZENS-HARDY, K.C., said the application was on behalf of three members of the committee of inspection of five, who were of opinion that the liquidation should not be solely in the hands of Sir William Peat. They made no reflection on the personal integrity of that gentleman, but they thought it was undesirable that he should remain in sole control. On the suggestion of his Lordship, a meeting of shareholders was held on December 1st for the purpose of expressing their wishes in the matter. On a large poll 207,333 votes were recorded in favour of the sole control by Sir William Peat, 30,000 in favour of an additional liquidator, and 135,000 in favour of his removal. That amounted to a majority of five to four in favour of Sir William Peat's continuance alone. If one firm's holding was deducted from the figures, the result would be seven for and eight against his continuance alone. It was said that there was a large claim against this firm, and that their votes ought to be deducted.

His LORDSHIP said he had received a message from the Official Receiver that Sir William Peat would have no objection to the appointment of a joint liquidator if his Lordship approved of that course.

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Mr. Martelli, K.C. (for Sir William Peat), said the views of the majority should be given effect to. They did not desire a change, and Sir William Peat did not object to an additional liquidator "if the shareholders desired it."

His Lordship, in giving his decision, expressed his surprise that Sir William Peat did not come to the conclusion in his own interests that there should be a co-liquidator. He, however, saw no kind of case for removing him, and he had no jurisdiction to adversely appoint a co-liquidator unless he re-summoned the original meetings in the winding-up. That he did not intend to do. He had no alternative, though he regretted it, but to act upon the decision of the small majority of shareholders and to refuse the application. As, however, it was a perfectly proper summons to bring, his Lordship ordered the costs of all parties to be costs in the liquidation.

In *re* Barton-Wright.

Before Mr. Justice Scrutton, in the King's Bench Division last week, application was made on behalf of a judgment creditor, Mrs. Beattie, for E. W. Barton-Wright, electro-therapeutic specialist, Oxford Street, to show cause why he should not liquidate a judgment debt of £224 by instalments. The evidence, as reported in the *Times*, showed that defendant was advertising in certain journals that the rush of patients had necessitated an increase in the number of his dressing rooms. The Court ordered debtor to pay £12 a month, but debtor said it was quite impossible—a remark which drew from the judge the remark, "Then you will probably go to prison if you do not pay!"

Tinol Soldering Paste.

On Monday an application was made in the Patents Court, set up to deal with the patents of alien enemies, before the Controller, Mr. Temple Franks, and the Deputy Controller, Sir Cornelius Dalton, by Messrs. Bi-Metals, Ltd., of 57, Lant Street, Southwark, who asked for rights to use the trade-marks of Tinol in connection with two German patents—Nos. 13,557 of 1903, and 17,624 of 1904—under which they had been given licence to manufacture by the Board of Trade.

Mr. Inskip, K.C., appeared for the applicants, and stated that the patent No. 13,557 was registered by Jacob Callman, of 65, Gitschinerstrasse, Berlin, and Rudolf Bormann, 26, Walterstrasse, Berlin-Rixdorf, and claimed a method for intimately associating finely powdered soft solder, such as tin or tin alloy, in a paste, with a deoxidising agent like zinc chloride, or ammonium chloride, or both, and a thickening body such as cellulose, which burns easily and leaves no trace.

The other patent, registered by Maximilian Leisel, of 10, Handelstrasse, Köln-am-Rhine, and Rudolf Küpper, 7, Grandorferstrasse, Bonn-Endenich, provided a substitute in electrical work for soldering with resin and tin. In addition to the aqueous solution of ammonium chloride, or chloride of zinc, or the double chloride for soft solder, it used borax, water-glass, or glass powder, for hard soldering, and met the three requirements of (1) a soldering metal in a fine state of division, (2) a flux which did not leave behind an oxide residue to impair the joint, and (3) a neutral liquid organic substance which did not evaporate until the soldering metal or the flux had done its work. The soldering flux-chloride, or borax, was mixed with glycerine, and the metallic powder or finely comminuted metal. The neutral liquid organic substance protected the metal from oxidisation.

Mr. Inskip explained to the Court that in October, 1914, the applicants were the English agents for a German manufacturing corporation. The Board of Trade had granted Bi-Metals, Ltd., the right themselves to manufacture under these patents, on payment of a royalty of 10 per cent. on the gross selling price. From the Patents Court had come the suggestion that they should take the trade marks as well, and they were now applying for them. As selling agents in this country before the war for the Küppers Metallwerke Gesellschaft m.b.H., of Bonn-am-Rhein, the applicants had the option to purchase the patent rights. That option had expired before the war, and they had then entered into negotiations to renew it. They, of course, had no relations with the German firm now.

Mr. Percy Good, a director of the applicant firm, was asked whether they had ever had any complaint of the efficiency of this method compared with the old mode of soldering.

The Witness answered that they had had one complaint since the war broke out. That was when, for the purposes of munitions, all the pure glycerine was required. Bi-Metals, Ltd., attempted to manufacture with crude glycerine, and found that it did not answer. Apart from the 2 cwt. or so made then, they had never had any difficulty. They at once communicated with the authorities and got leave to obtain all the pure glycerine they required. They continued to receive repeat orders from engineering and other firms which used the composition in all directions.

The Controller of Patents observed that very few trade-mark rights had been granted by that Court, because he considered it desirable that the marks should apply strictly to the articles with which they had been associated. Here, however, was a case apparently in which this condition was fulfilled, and as Bi-Metals, Ltd., were manufacturing in this country they wished to place the label on the tins of paste, as had been done before the war. The contents were identical. They would hear shortly from the Board of Trade as to their application.

ELECTRICAL PRECIPITATION OF SMOKE AND DUST.*

In an address recently delivered in New York, and reported in *Metallurgical and Chemical Engineering*, Mr. Linn Bradley stated that in the application of electricity to the recovery of valuable by-products a Californian, Dr. F. G. Cottrell, had done more to advance both the science and the art than any other individual.

The problems of removing from gases minute particles suspended therein were of great variety, and existed not only in thickly settled industrial communities but also in sparsely settled States. Requests for a solution of specific problems had been received from north-eastern Canada, Cuba, Mexico, Hawaiian Islands and Alaska, to say nothing of inquiries from across the seas. In New York City inquiries had ranged from the collection of diamond chips suspended in a small volume of air up to the collection of cinders and small pieces of coke from gases arising from boilers under which about 3,000 tons of coal were burned every 24 hours. It was obvious that the saving of values was the object to be attained by collecting the diamond chips, while in the latter case the cinders and coke particles constituted a serious nuisance in the neighbourhood.

Portland cement plants generally had severe dust problems, as they fed finely-ground materials into long cylindrical kilns near the point where large volumes of gas were rapidly emerging, and in such a manner that the gases picked up a large quantity of dust. Instances were known where the quantity of dust from a cement plant approached from 200 to 400 tons per day, which was scattered broadcast over the district surrounding the plant. At iron blast furnaces the finely-divided ore was charged in such a way that dusting was facilitated. Reports had been obtained which showed that the total amount of iron ore and coke lost in this manner amounted to a very large tonnage yearly, and this dust might be worth from $3 to $3.50 per ton. Calculation had shown that by removing the particles from the gases from one iron blast furnace, without cooling the gases, the value of the conserved heat energy might amount to about $25,000 per annum.

It was not unusual for a fair-sized smelter to waste 1,000 tons of sulphur daily by discharging it into the atmosphere in the form of sulphur dioxide, notwithstanding the fact that sulphur was a very necessary commodity.

Waste gases at smelteries and refineries also contained metals and other elements, the recovery of which often would be warranted for the additional revenue which they would produce; investigations at one smeltery showed that metals having a gross value of approximately $4,000 per day were being discharged into the atmosphere.

In large brass foundries perhaps 3 per cent. of all the zinc charged into the crucibles was burned off or volatilised and discharged into the atmosphere, thus constituting an economic loss aggregating many thousands of dollars per annum. In the production of metallic zinc from ore a considerable percentage of zinc was lost as fume.

At a sulphuric acid plant where a large quantity of acid was concentrated in stills, investigation showed that 2 to 3 tons of sulphuric acid were being wasted daily as mist. At another plant hydrochloric acid fumes had been killing vegetation in an adjacent park, but at present the trees and shrubs were thriving, as the acid fumes were being collected electrically.

In ventilating modern public buildings, and even up-to-date factory buildings, it was considered desirable to control the temperature and humidity of the air and remove all dust, bacteria, etc. In one recent installation it had been found that by circulating 50,000 cu. ft. of air per minute in a closed system, removing dust, etc., by electrical precipitation, the saving in steam which would be required for preheating this quantity of air in cold weather much more than paid a good return on the investment. Here the primary object was conservation of steam.

With a proper arrangement of pipes or plates and wires acting respectively as "collecting electrodes" and "discharge electrodes," it was possible to produce a discharge of electricity from the wires to the pipes or plates through gases present between them.

In electrical precipitations it was customary to employ very high voltages, such as, say, 75,000 to 100,000. With such voltages as these it was possible to subject a gas to such strains that it was changed from a non-conducting to a conducting medium.

Each of the particles of dust or fume collected a charge of electricity of the same polarity as the discharge electrode, and since two bodies charged with the same kind of electricity repelled each other, the particles were driven away from the wire and drawn toward the pipe or plate (collecting electrode). The more electricity upon a particle the greater was the force acting upon it, therefore in practice a strong discharge was maintained. Furthermore, the greater the voltage between the electrodes the stronger was the precipitating force; this made it desirable to operate at a voltage just below that where a spark or arc would form. Moving gases exerted a force upon suspended particles, and the greater the velocity the

*An article on this subject appeared in the Electrical Review of May 14th, 1915.

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greater was this force; hence, with a given precipitating apparatus, there was an upper limit to the gas velocity at which the suspended particles might be completely removed.

Direct current at high voltages was required, as alternating current at commercial frequencies was not suitable for this work. Large volumes of gases required, as a rule, more power than smaller volumes, but the power consumption was affected by other factors. Static machines did not furnish enough power for commercial installations and were not dependable. In commercial installations ordinary black iron pipes about 12 in. or 18 in. in diameter by 15 ft. to 20 ft. long were in general use, connected to a gas chamber at each end in a manner similar to that in a tubular boiler. With this arrangement gases and suspended particles might readily be distributed to the various pipes, and through them to another gas chamber, having been cleaned during such passage. The cleaned gases might be conducted to other places as desired.

The precipitating apparatus might be designed for either hot or cold gases, and for corrosive or non-corrosive materials, and the product might be collected either wet or dry as conditions might indicate. In treating gases containing particles of acid held in suspension, materials such as lead or stoneware were employed to avoid serious corrosion. Heat-insulating materials might be employed in the apparatus to lessen the loss of heat energy when desired. The gases might be either forced or pulled through by fans or other mechanical means, or if the gases were sufficiently warm natural draught might be employed. When treating gases which were explosive when mixed with air, they were kept under a pressure slightly greater than atmospheric until they had been cleaned.

The high-voltage direct current was obtained by transforming low-voltage into high-voltage alternating current and then converting or rectifying the latter into an intermittent, high-voltage direct current. The amount of power required in commercial installations was relatively low, generally being much smaller than that necessary for any other gas-cleaning system.

A unique advantage of electrical precipitation was its ability to collect even the most minute particles. Another interesting feature was that components of gases of different volatilities might be separated by what had been termed "fractional precipitation." In this method the gases were treated while at a high temperature to remove those materials which were then either solid or liquid, and then after further cooling the gases were subjected to another treatment in a separate precipitator. Arsenic trioxide of high purity had thus been separated from copper, iron, zinc and other materials. It would be possible to obtain water-free tar in gas plants by this means, and also it might be possible to collect tars of different compositions.

Many other instances could be given, and the author hoped that chemists, engineers and others would give more earnest consideration to smoke, fume and dust problems and endeavour to solve them, not only for the sake of better atmospheric conditions and for aesthetic reasons, but also for the values which were to be obtained when their solution was accomplished.

WAR ITEMS.

Trade after the War.—At a meeting of the Advisory Committee to the Board of Trade on Commercial Intelligence held last week, among matters considered were proposals for the safeguarding and promotion of British trade after the war; the more systematic collection and exhibition of samples of German and Austrian goods competing with British manufacturers in Colonial and foreign markets; and questions relating to the work of the Commercial Intelligence Branch of the Board of Trade. Further reference to the work of this committee appears on page 76.

Lord Derby will be present at the meeting which is being organised for January 31st at the Guildhall.

The London Chamber of Commerce had before it last week the report of a special committee on the subject of "Trade during and after the war." The main recommendations, according to the "Financial Times," are the following:—

1. That any measures which may be considered in connection with trade during and after the war should provide: (a) For preferential reciprocal trading relations between all parts of the British Empire; (b) for reciprocal trading relations between the British Empire and the Allied countries; (c) for the favourable treatment of neutral countries; and (d) for regulating, by tariffs and otherwise, trade relations with all enemy countries, so as to render impossible a return to pre-war conditions and for stimulating the development of home manufactures and the consequent increased employment of native labour.

2. That steps should be taken to prevent the dumping and under-valuation of enemy goods into British markets after the war.

3. That discriminatory taxes be levied on the tonnage of all enemy ships using the ports of the British Empire.

4. That the Government be urged to encourage the production and utilisation of raw materials and manufactured goods within the Empire under such legislative conditions as will prevent their being controlled by or on behalf of subjects of enemy countries.

5. That the naturalisation laws of the Empire be amended so as to prevent the abuses which have been disclosed since the commencement of the war.

6. That further legislation, especially in regard to enemy holdings in British companies or firms, is necessary to safeguard British subjects from the consequences of the policy of the German Government in organising its subjects residing in any part of the British Empire for commercial, industrial, financial and economic purposes in time of peace with a view to military aggression in time of war.

7. That His Majesty's Government be urged to guarantee for a period of years the continuance, by subsidy or otherwise, of new, or "key," industries established prior to and since the commencement of the war.

8. That with a view to promoting the development of British trade under altered conditions caused by the war, His Majesty's Government should appoint a Minister of Commerce of Cabinet rank, to whom certain of the functions of the Board of Trade and other departments should be relegated.

At the House of Commons last week Sir John Randles, M.P., presided over a meeting of the Commercial Committee. He said that he had accepted the invitation to attend the Congress of the International Commercial Committees of the Parliaments of Europe and Japan at the Sénat in Paris on the 6th, 7th and 8th March, to discuss the economical and commercial questions arising out of the war.

Platinum Prices.—According to an Ekaterinburg dispatch it is never easy to establish what the price of platinum is. No matter what the quotation may be in the Press, it is always understood by buyers that such price is rather nominal and is subject to negotiation. It was stated in a Petrograd paper a few weeks ago that, in view of the proposed platinum monopoly in Russia, the important platinum producers have begun to force up the prices considerably, in order that the platinum which they controlled, amounting to about 300 poods, might be disposed of to the Government on a basis satisfactory to them. The price of platinum, which not long ago was eight roubles per zolotnik, had rapidly risen to 11 to 12, and even more, roubles. Business generally in the Urals in platinum is doing somewhat better than immediately before the war. At Nizhni-Tura, buyers are offering 10 roubles for the crude platinum, and will buy any quantity. Before the war the highest price was nine roubles 80 copecks. At the mines there is some scarcity of labour owing to the high prices that it obtains elsewhere.

Goods of Enemy Origin.—The Board of Trade has issued a warning to importers stating that they are under an obligation to take all necessary steps to satisfy themselves that goods they propose to import are not of enemy origin. Failing evidence that they have done so, the goods, should they prove, as a result of examination on arrival, to be of enemy origin, will be liable to seizure even though accompanied by Consular certificates of origin. Importers who are offered goods (especially goods hitherto mainly derived from enemy countries) by firms abroad respecting which they have insufficient information are strongly advised to defer payment until the goods are delivered, and to make it a condition of payment that the goods are not only accompanied by certificates of origin in proper form, but are passed on arrival by the Customs authorities of the United Kingdom.

Australia and Future Trade.—Reuter reports that on January 13th, at Melbourne, the Associated Chambers of Manufacturers presented to Mr. Hughes (Federal Prime Minister) a series of resolutions framed with the object of preventing Germans from regaining their trade after the war. Mr. Hughes, in replying, said it would be incredible folly if victory secured on the field should leave Germany in possession of economic opportunities. The war must be carried on in the field of industry with a determination equal to that shown by the Allies on the field of battle. The Premier added that he was not in favour of trade with Germany "during the war, after the war, or at any other time."

Trade with Hong-Kong.—The Board of Trade is notified by the Colonial Office that, according to telegraphic information from the Governor of Hong-Kong, complaints are being received there that some merchants in the United Kingdom are declining to complete or undertake orders from Hong-Kong merchants on the ground that such merchants are not on the white list of persons and bodies of persons to whom articles to be exported to China may be consigned under the terms of the Proclamation of September 24th, 1915. It should be noted, however, that the Proclamation referred to does not apply to Hong-Kong; Hong-Kong is not affected by the white list regulations.

Petroleum Economies in Russia.—On the basis of the information submitted by the 1886 Company on the quantity of current supplied to the town mains from the Bogorod station, the Moscow Town Council has determined that on the average the company may use the current of the "Elektroperedachi" concern to the extent of one-fifth of the total consumption of the town, which would mean an economy for the town station of 88,000 poods of petroleum. The cost price of the current for the town station from the 1886 Company is fixed at 3.3 copecks per kw., and from the "Elektroperedachi" at 2.9 c. The difference in favour of the company per month works out at an average of 40,000 roubles.

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"Key" Industries.—The "Times" states that it is understood that the Advisory Committee of the Board of Trade have practically finished a report on "Key" industries—trades without which industries of national importance cannot be maintained. Our contemporary remarks:—"The publication of this interesting and important document may be expected shortly. Its contents may be unpalatable to many, but there can be no question that the public ought to know exactly what these business men have told the Board of Trade. Rugged facts are of more importance than polished sentences in our present position."

In a fuller statement on the matter appearing in the "Times" of Wednesday, it is understood that the Advisory Committee in their report advocate Government subsidies for certain industries, while protection by tariff is also approved by overwhelming majorities. Electrical apparatus and porcelain are among the trades concerned. A section of the report is stated to be devoted to the great need for scientific training and research.

Women in Power Stations.—Owing to increased business and to decreased staff, both due to the war, the Glasgow Electricity Department is experimentally employing women in power and sub-station work for record-taking and switchgear manipulation.

Enemy Capital Holdings.—The "Financial News" prints a copy of a circular which has been issued to the secretaries of all companies by the Registrar of Joint Stock Companies asking for information of an important nature. A form is enclosed whereon the recipient has to fill in, within a week, the name of the company and the nature of the business, together with the amount of capital in the company held by persons resident in foreign countries, separating, according to various countries, the capital so held.

Australia and German Shareholders.—Reuter's Melbourne correspondent reports Mr. Hughes, the Prime Minister, as saying at a banquet organised by the Metal Exchange, that the war was not only for national but for commercial supremacy. He had notified every company incorporated in Australia to wipe out within three months their German shareholders, whether naturalised or not.

Mr. Hughes leaves for England this month.

Prohibited Exports from France.—The French Government has issued an order prohibiting the exportation from that country of magnetos, accumulators, and battery plates.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Salaries in Power Stations.

So "Chief Assistant," writing in the REVIEW of January 7th, wants to saddle that sorely-tried gentleman, the Minister of Munitions, with some work that he might have done for himself years ago. He wants an adequate living wage and a guarantee that only competent engineers will be employed in electrical power stations. "Chief Assistant" grumbles that the Institution of Electrical Engineers, the Home Office, and Board of Trade have done nothing to help him, but he *hopes* that he will not be overlooked by the Minister of Munitions. Always it seems that a large majority of station engineers expect and wait for some other body to do for them what they can do for themselves.

The managers of the electric supply undertakings do not wait for the I.E.E., the Board of Trade, or the Minister of Munitions to help them; they organise themselves into very strong and formidable associations (quite apart from the Institution, of which most of them are also members) to deal with questions directly concerning them as individuals, to promote or oppose legislation, and generally to look after their own interests. For instance, quite recently there was a little healthy competition amongst the managers for charge engineers and switchboard attendants on account of enlistments, and others leaving to do munition work; salaries had a tendency to rise, and managers either objected to this or thought that, perhaps, the efficiency of their stations might become impaired—it matters little which. This competition was soon stopped by the managers coming to an agreement, through their Association, not to employ each other's charge engineers, etc., without mutual permission. The Munitions of War Act did not apply to the staffs of electrical stations, though the idea was borrowed from Section 7 of the Act. What is good for the managers is better for the staffs under them, and station engineers must follow the lead of their managers and build up a strong and formidable association.

There is at present a great deal of unrest in power stations all over the country. Station engineers' salaries have remained practically stationary, and there is little or no opportunity of bettering their positions by going elsewhere. The limit to the number of those allowed to join the fighting forces of the country has been reached—in fact, I might say, exceeded, as men are being released from military service to take up duties in new stations, and some in old ones.

The cause of the unrest in stations (of which "Chief Assistant's" letter is only a slight indication), besides the greatly increased price of commodities, is due partly to outside influences. Nearly every other section of employés in the engineering industry, with the exception, perhaps, of the technical assistants and draughtsmen, has obtained substantial increases in wages, combined with a great deal of overtime.

The junior technical men are the backbone of the engineering industry. They now know it, and *they have been ignored* by those who are profiting by their energy and zeal. It is easier to withstand a blow than to be ignored; the other sections of the industry cannot be ignored because of their organised strength.

Electricity supply engineers have no excuse, for since January, 1913, there has been an opportunity open to them to help themselves. The Association of Electrical Station Engineers was formed with the avowed object of obtaining better pay and conditions for electricity supply engineers.

If "Chief Assistant" is really serious in advocating an adequate living wage and the employment of competent men only in stations, and is willing to help forward the movement, I can assure him that there is plenty of work before him and any others who care to take the matter up. If electricity supply engineers expect to obtain real assistance from some other source than themselves they are doomed to disappointment.

The Munitions Department has agreed to see that standard rates are paid in all "controlled establishments," and there is no difficulty in getting other Government departments to see that their contractors pay the same. The fixing of agreed rates must be the work of employers' and employés' associations; the question of competency for any particular position is a difficult question, and to tackle it properly some such arrangement must be made as is applied at present to marine engineers. This would mean that legislation would have to be promoted and would entail a large amount of work, and it would cost a deal of money. The work could only be done and the money supplied by an association of the men concerned.

I feel certain that every station engineer knows in his own mind that a strong association is the only solution of the present situation, and I often wonder why so many stand apart and will not help.

The A.E.S.E. still exists, after three years, in spite of adverse circumstances, and has, after much controversy, formulated a definite policy. In various districts where there is a large membership, conditions and wages have been improved by negotiation direct, the Association having on one occasion only to ask the services of the Chief Industrial Commissioner. The whole of the work connected with it is voluntary; there are no paid officials whatever. A monthly journal is issued to members (the work in connection with which is also voluntary), and the Association is anxious to have the help of all in the industry. Those willing to take an active part in the work are wanted more than ever as the Association grows. The subscription is small—10s. 6d. annually—which can be paid half-yearly or monthly as desired. The official policy of the Association is not to resort to strikes, but to make every reasonable application, either by letter or deputation, to attain its objects. Should such efforts fail to obtain satisfaction within six months, then the Association reserves to itself the right to use any methods it thinks proper to enforce arbitration on the questions concerned.

If you approve, join the Association; if you disapprove, join also, and improve it—don't let apathy prevent you from taking any interest whatever. Follow the lead of your managers and build up a strong Association.

W. J. Ebben.
Hon. General Secretary, A.E.S.E.

Leyton, E., *January 10th*, 1916.

[We regret that we have been obliged to condense Mr. Ebben's lengthy communication.—EDS. ELEC. REV.]

Electric Engine Starters for Industrial Motor Vehicles.

—Since the fitting of an electric engine starting outfit on American pleasure cars became general, there has been considerable discussion as to the advisability of adding such equipment to industrial motor vehicles. An interesting contribution to the subject has just come to hand from the United States, where the engineering department of the Reo Motor Truck Co., of Lansing, Mich., recently carried out a series of experiments with its new 15-cwt. petrol motor delivery van. It is stated that the results obtained go to show that an engine starting outfit will more than repay its first cost in the saving of petrol effected during the first year of its use, owing to the engine being stopped instead of allowed to run while deliveries are being made. It is also claimed that it will have a marked effect on the cost of upkeep of the vehicle, due to the elimination of the wear and tear of a large amount of idle running. Finally, it may be stated that, as a result of the tests, it has been decided to adopt an electric engine starting set as a standard part of the equipment of the Reo vehicles.

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BUSINESS NOTES.

Consular Notes.—BRAZIL.—Considerable extension in the use of electricity in Pernambuco is foreshadowed by the American Consul in that town. The Pernambuco Tramways and Power Co., which some 16 months ago substituted the present electrical system for the long-used mule car system, propose to install an electric light plant. At present trolley wires are extensively tapped to provide street and store lighting. Additional power is also likely to be required for running the elevators in the many new business blocks building or proposed.

CUBA.—According to a recent American Consular report the business outlook in Cuba is very good. Prosperity is especially marked in the sugar trade, and many companies have taken advantage of the present good prices and easily obtained money to replace antiquated machinery with more modern equipment. The quantity of new sugar machinery, which is stated to be all coming from the United States, is referred to as "tremendous." Indications are that more equipment will be purchased during the coming year, the newer mills forcing the older ones, in self defence, to bring their equipment up-to-date. Rumours of new organisations to go into sugar-making may also be heard.

MEXICO.—The American Consul at Chihuahua reports that the power plant of the Cia. Agricola y de Fuerza Electrica at La Boquilla, near Santa Rosalia, Chihuahua, has now been completed and the current made available for use at Parral, in the operation of the cyanide ore treatment plant of a mining company. The current was turned on through the transformer station at Parral on September 28th. At present only 1,000 H P. is being used.

MANCHURIA.—The American Consul at Harbin, China, quoting the *Norosti Zhizni*, of October 21st, states that a British firm has made arrangements for establishing an electrical plant at Station Handashedzu on the Chinese Eastern Railway, about 170 miles east of Harbin. The capacity of the plant will be sufficient to provide several thousand consumers with electricity and to light the streets of the village.

Book Notices.—*Diesel Engines for Land and Marine Work.* By A. P. Chalkley, B.Sc. Fourth edition. London: Constable & Co. Price 8s. 6d. net.—Owing to the rapid progress in the evolution of the Diesel engine, this work, although first issued at the end of 1911, has been completely revised for the second time in four years. The new material is found mainly in the section dealing with Diesel engines for marine work, a direction in which much work is being done; the illustrations have been nearly doubled in number, new types are described, and an additional chapter on the design of Diesel engines has been inserted. The makers and users of this type of prime mover are fortunate in having at their service so comprehensive and so well illustrated a work on this subject, which occupies a special place in oil engine practice—as is indicated by the fact that an association of users of Diesel engines has been formed to discuss their peculiarities of construction and working. "The Diesel engine," says the author, "is perhaps the most scientifically designed motor in existence," requiring great exactitude in construction and the utmost care in erection, though once in operation it becomes a machine of the greatest reliability. Useful chapters on installing, running and testing the engine are included, and some interesting estimates of initial and working costs, based upon actual installations, are given.

A Text-book of Paper-Making. By C. F. Cross and E. J. Bevan. London: E. & F. N. Spon, Ltd. Price 15s. Fourth edition.—However interesting the details of the art of making paper to those engaged upon it, we cannot suppose that the average electrical engineering reader has leisure to study it except in so far as his profession brings him into contact with it. The points of contact may be multiplied as time goes on, but at present they are few in number, though of considerable importance; they include the electric lighting and driving of the paper mills, the electrolytic bleaching of the paper pulp, and the use of paper in various forms for the insulation of electric cables and apparatus generally, the last being, of course, by far the most important. It is curious that the authors hardly mention the lighting of a paper mill, although the necessity of judging colour correctly would seem to involve the use of electric lighting specially adapted for this purpose at certain stages of the process. A short section on electric power describes the distribution of electrical energy from a central power station to the motors driving the machinery as "the ideal conditions," to which the older mills are being converted. Steam is required for so many purposes in paper mills that the method of using it first in a turbine and afterwards for the manufacturing processes becomes very economical and convenient, and is highly recommended. As regards the third point of contact above-mentioned, the book will be of especial interest to cable-makers and other users of high-class papers, who, as was made evident in the proceedings of the I.E.E. some years ago, have found it necessary to study the constitution of their paper very closely. The book is extremely well printed and illustrated, and, needless to say, is printed on excellent paper.

The Electrical Engineer's Diary. S. Davis & Co. Price 3s. 6d.—This year the Diary is issued in two forms, bound in stiff boards and limp covers respectively. In addition to the usual mass of information which it contains, the following are new features:—A section dealing with industrial lighting in a highly instructive manner; a section on electrical cooking and heating, by Mr. R. S. Downe; a table showing the local lighting hours for every day in the year at 30 important centres in the British Isles. Other additions have been made, and the very useful lists of streets in the metropolitan area in which electricity supply is available have been extended to include certain outlying districts. It is a very useful production.

Willing's Press Guide (125, Strand, W.C.), is, as we have said before, a most handy publication for all who want the names, addresses, and a few other particulars, of newspapers, magazines, &c., conveniently arranged. It has reached its 43rd year, and continues to give full value for the money—1s.

Hazell's Annual for 1916 (Hazell, Watson and Viney, Ltd. London: 3s. 6d. net) will hold the prominent place that its lengthy and efficient record has made for it among the useful annuals which contain so much information that one requires to have at hand. This time it has, among other matters, a complete list of recipients of the Victoria Cross and a Roll of Honour of some hundreds of names of those who, in high circles, have sacrificed themselves in their country's cause during the past year. Statistical information regarding the Colonies and foreign countries, 10 pages devoted to aviation matters, and 20 relating to naval affairs, are given, in addition to the numerous sections dealing with trade, finance, shipping, railways, and so forth.

A copy of the *British Dominions Year Book*, 1916, has been received. It is published by the British Dominions General Insurance Co., Ltd., 1, Royal Exchange Avenue, E.C., and edited by Messrs. E. Salmon and J. Worsfold. It contains a wealth of matter regarding the affairs of the Empire, the Army and the Navy, the war, with maps, badges of rank in colour—indeed, in a few lines it is impossible to indicate the wide scope of the contents. In addition to all this general information, there are articles by many well-known writers, including one by Sir Leo Chiozza Money, M.P., on "A Business-like Empire;" one by Cyril M. Picciotto on "International Law in the Present War;" one on "British Opportunities in Russia," by Louis A. Rojansky; one on "The Economic Outlook for Germany;" and others on science and trade organisation, trade in war-time, and so on. The book is not on sale, but is for presentation purposes.

Colliery Manager's Pocket-Book for 1916. Edited by H. Greenwell. London: The *Colliery Guardian* Co., Ltd. Price 2s. net.—According to the statistics given in this handbook, in 1914 electricity was employed in 1,428 mines (a reduction of 42) to a total of 713,782 H.P., compared with 628,098 in 1913; of this 294,092 H.P. was on the surface, and 419,690 H.P. underground, being used mainly for hauling and pumping. There were four types of electric safety lamps in extended use and five others in small numbers, the total being 75,707 in 1914, compared with 37,823 in 1913—a very notable advance; magnetic locking was employed in 61,772 cases, and lead rivets in 13,787. The electrical section of the book consists mainly of the official memoranda relating to the regulations, and contains too little general information to be of much use; we should think that, in view of the increasingly important part played by electricity in mining nowadays, the section might be greatly increased with advantage. The pocket-book appears to be indispensable to the colliery manager.

The Practical Electrician's Pocket-Book and Diary for 1916. Edited by H. T. Crewe. London: S. Rentell & Co. Price 1s. net.—This is now in its 17th edition; by condensation and the omission of obsolete matter, room has been made for new sections dealing with electric pumping plant, drills, blowers, and lifting magnets, telephones and shaft signals, bells and indicators, and battery vehicles. It is a useful little book.

The Christmas number of the *Wileroid* (the journal of the Willesden Works employés of the British Thomson-Houston Co., Ltd.) excels even its predecessor, the first issue of the journal, in interest and mirthfulness. It contains lively articles from the front, a variety of essays of strictly local and professional bearing, and sundry miscellaneous items, many of which are very clever.

Lektrik Lighting Connections.—Messrs. A. P. Lundberg & Sons' well-known booklet (price 6d. net, 7d. post free), is now in its fourth edition and its 35th thousand; it occupies a field entirely its own, and must unquestionably be of great use to wiring contractors and wiremen. A lengthy list is given of the holders of certificates in the advanced grade of Messrs. Lundberg's examinations, and a new section on automobile controls has been inserted.

We have received a copy of Part I of "Russian Reading Made Easy," also one of "Russian Grammar Simplified." Both are issued by Hugo's Language Institute, Gracechurch Street, E.C.

"Post Office Electrical Engineers' Journal," Vol. VIII, part 4. January, 1916. London: H. Alabaster, Gatehouse & Co. Price 1s. net.

"*Journal* of the Institution of Electrical Engineers." Vol. LIV. No. 254, January 15th, 1916. London: E. & F. N. Spon, Ltd. Price 3s. 6d.—This issue contains Mr. J. E. Kingsbury's address to the Students' Section, and the following papers:—"Ignition of Explosive Gas Mixtures by Electric Sparks," by Mr. J. D. Morgan; "Electric Heating," by Mr. G. Wilkinson; "Resistance of Heat-treated Copper-Zinc-Nickel-Alloys," by Mr. F. C. Thompson.

"*Proceedings* of the Physical Society." Vol. XXVIII. Part 1. December 15th, 1915. London: The *Electrician* Printing and Publishing Co. Price 4s. net.

"*Journal* of the South African I.E.E." Vol. XIV. No. 5. December, 1915. Johannesburg: The Institute. Price 2s.

"Spons' Architects' and Builders' Pocket Price Book for 1916." By C. Young and S. M. Brooks. London: E. & F. N. Spon, Ltd. Price 2s. 6d. net.

Meter Prices.—THE BASTIAN METER CO., LTD., announce that the high cost of labour, raw material, carriage, and other items, has compelled them to revert to pre-war prices for their Bastian meters. The reduction announced in July, 1914, is, therefore, no longer in force.

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Catalogues and Calendars.—Diamond Coal Cutter Co., Wakefield.—Wall calendar with monthly date slips for 1916.

Messrs. Pirelli, of 144, Queen Victoria Street, London, E.C., have sent us a calendar for the year with a block of daily date slips with bold figuring on a metal background. Above the block there is a most pleasing design in appropriate colouring, in which a Pirelli tire is speeding the flags of the Allies on to victory.

From Messrs. Johnson & Phillips, Ltd., of Charlton, S.E., we have received a most welcome and handy vest-pocket diary and engagement book (black and gold) containing an insurance coupon. The company have also prepared for their friends a large desk blotting pad with a diary interleaved with blotting paper, also a block of spaces for daily engagements at the left hand side, while on the right there is a block of memoranda slips.

The Navy Employment Agency, of 25, Victoria Street, S.W., have favoured us with one of their "Clyde" calendars with date indicator—a device which we have found most useful. The agency was founded for the purpose of finding employment for men of the Royal Navy and Marines on their leaving the Service; amongst its *protégés* are engineers and electricians. It is an admirable institution, and though at present, owing to the war, it has very few men on its books, it is hoped that on the termination of hostilities our readers will, as far as possible, give employment to the men who have so zealously guarded our shores.

Mr. C. H. Jeffcoat, 18, Ranelagh Gardens, Hammersmith, London, W.—Illustrated leaflet relating to the "Lamlok" electric lamp-locking ring.

Messrs. Alex. Hawkins & Sons, London Road, Southwark, S.E., have issued a small and attractive wall calendar for 1916 with a coloured print entitled "First Aid to the Injured," beneath which are small monthly date slips.

Messrs. Austin Walters & Son, 57, Lower Mosley Street, Manchester.—20-page catalogue of "Signs for All Trades," showing a number of designs of electric signs for use outside cafés and restaurants, hotels and shops, garages and picture theatres; also a selection of artistic window signs, interior theatre signs, wood-letter signs, electric sign flashers, and electric time switches.

The Liverpool Electric Cable Co., Ltd., Bootle, Liverpool, have issued a serviceable wall calendar with a set of monthly date slips fixed beneath a bird's-eye view of the works.

Boston Gear Works, Norfolk Downs (Quincy), Mass.—90 pp. illustrated pocket catalogue and price list of Boston gears.

Messrs. Le Carbone, 17, Water Lane, Great Tower Street, London, E.C.—Circular tabulating particulars and schedule of qualities of their carbon brushes for dynamos and motors.

Bankruptcy Proceedings.—Herbert Page, electrical engineer, trading as Smeeton & Page, at 63, Queen Victoria Street, E.C., and residing at 32, Marlborough Road, Chiswick.—An application was made on January 11th, to Mr. Registrar Linklater, at the London Bankruptcy Court, for an order of discharge. Mr. Egerton S. Grey, Official Receiver, reported that the failure occurred in July, 1915; the bankrupt returned ranking liabilities amounting to £2,157, but the proved and provable debts totalled £2,292; the assets valued by the bankrupt at £176, had produced only £79, owing to the excessive value placed by the bankrupt on his office furniture, plant and stock-in-trade, which were subject to a claim for rent, and from which nothing could be recovered from the estate. A dividend of 6¾d. in the £ had been paid on proofs of debt amounting to £2,232. The failure was attributed to loss on trading, excessive drawings, and interest on borrowed money. As offences the Official Receiver reported (1) insufficiency of assets to equal in value 10s. in the £ on the amount of the unsecured liabilities; (2) trading with knowledge of insolvency; and (3) a previous arrangement with creditors. His Honour upheld the report and suspended the discharge for two years. Order entered accordingly.

Harry A. West, described as of 114, Chancery Lane, W.C.—At a sitting of the London Bankruptcy Court, held before Mr. Registrar Linklater, bankrupt applied for an order of discharge from proceedings instituted in September last. Mr. Egerton S. Grey, Official Receiver, reported that the proved and provable debts amounted to £1,015, and the assets had realised only 13s. 6d. The bankrupt was an insurance clerk with a salary of £370 per annum, and he was willing to set aside £75 a year for the benefit of the creditors. It appeared that in June, 1911, in order to set up his only son in business, the bankrupt purchased, for £175, the goodwill, stock and effects of an electrical engineer's business at 55, Old Dover Road, Blackheath, and, his son being a minor, the bankrupt purchased the business in his own name. He was in debt to the extent of £100 at the time, and borrowed £175 with which to pay for the concern. The business was unsuccessful throughout, owing in a great measure to the mismanagement of the son. The bankrupt borrowed further sums from time to time for the purposes of the business, and eventually the lender sued him for repayment, obtained judgment, and made him bankrupt. The Official Receiver reported that the bankrupt had been guilty of misconduct in relation to his affairs by obtaining from the petitioning creditor an advance upon the security of a charge over a certain interest to which his son was entitled, without disclosing the fact that such interest was already mortgaged. Insufficiency of assets to equal 10s. in the £ on the amount of the unsecured liabilities was also reported by the Official Receiver, and Mr. E. W. Hansell, on behalf of the petitioning creditor, opposed the discharge on the ground that the bankrupt had entered a frivolous and vexatious defence to an action. Mr. Storry Deans appeared for the bankrupt in support of the application, and consented to an order for his client to set aside £100 per annum for the benefit of his creditors. His Honour gave the bankrupt liberty to again apply to the Court regarding his discharge, when he had paid the creditors 10s. in the £. Order entered accordingly.

James Proctor Kyd Clark, electrical and mechanical engineer, Hythe Road, Willesden Junction, N.W.—At the London Bankruptcy Court on January 12th, an application was made before Mr. Registrar Hope, for an order of discharge. Mr. E. Leadham Hough, Senior Official Receiver, reported that the applicant failed in March last, with provable debts £1,951, and no assets whatever. He traded from 1895 till November 4th, 1914, at first with a partner, but subsequently in 1903 by himself. In 1902 they appointed a gentleman, of whose estate the petitioning creditor became administrator, their selling agent in Russia, and he so acted until his death in September, 1910. Disputes afterwards arose between the petitioning creditor and the bankrupt on the accounts between the parties, with the result that an action was tried and judgment given against the bankrupt for £1,672, and costs taxed at £273. In November, 1914, the bankrupt transferred his business to his manager in consideration of £200 cash and an undertaking to discharge liabilities of the business to the extent of £732, but not the debt to the petitioning creditor. The assignment to the purchaser comprised stock taken over at the price of £911; stock and work in progress taken over at £360; office furniture, £50; book debts amounting to £1,408, and taken over at £909; cash, £34; the lease and goodwill of the business and many other assets for which nothing was paid by the purchaser. The Official Receiver submitted that the sale by the bankrupt of his business was not *bonâ fide* on his part, but was made for the purpose of depriving the petitioning creditor of the benefit of any judgment which he might recover against the bankrupt. As offences were alleged (1) insufficiency of assets to equal in value 10s. in the £1 on the amount of the unsecured liabilities; and (2) misconduct in having denuded himself of assets in order to defeat the petitioning creditor's claim. Mr. Tindale Davis appeared for the petitioning creditor, and the learned Registrar, in suspending the discharge for three years, remarked that it was clearly a case of wrong-headed vindictiveness on the part of the bankrupt.

G. J. T. J. Parfitt, consulting electrical engineer, Keynsham.—Application for debtor's discharge is to be heard, at Bristol, on February 25th.

William Carey Wild, electrical engineer, 57, Rhodes Street, Halifax, Yorks.—The public examination of the above debtor was held on January 14th, at the County Court House, Prescott Street, Halifax, when the liabilities were stated at £126, and the deficiency at £55. The debtor stated that two years ago he removed to larger premises, thereby increasing his expenses, but since the outbreak of war his trade had fallen off. The debtor was allowed to pass.—February 2nd is the last day for the receipt of proofs for dividend, by Mr. W. Durrance, Official Receiver, 12, Duke Street, Bradford.

Dissolutions and Liquidations.—Ilkeston Motor and Electrical Engineering Co., Ltd.—This company is winding up voluntarily, with Mr. A. Boaler, of Nottingham, as liquidator.

Easton & Co., Ltd.—A meeting is called for February 15th, at 11, Ironmonger Lane, E.C., to hear an account of the winding up from the liquidator, Sir W. B. Peat.

Easton, Anderson & Goolden, Ltd.—A meeting is called for February 15th, at 11, Ironmonger Lane, E.C., to hear an account of the winding up from the liquidator, Sir W. B Peat.

Cicoy Magneto Co., Ltd.—Mr. E. H. Hawkins, 4, Charterhouse Square, E.C., has been appointed liquidator, to act jointly with Mr. W. G. Newman.

Royle Engineering Co., engineers, Croydon.—Messrs. H. W. Robinson and C. L. Lloyd have dissolved partnership. Mr. Robinson will attend to debts.

Electric-Light Switching Competition.—Messrs. A. P. Lundberg & Sons, of 477-489, Liverpool Road, London, N., inform us that their next competition or examination will be held next month. Full particulars, including the problems, may be had on application to them, no charge being made. We have, on various previous occasions, commented on the practical nature of the subject dealt with, and most of our readers will have noticed the periodical announcements of "results" in this Journal. Those who are still more or less in the dark as to what it is all about should find full enlightenment in the aforementioned "particulars." These will be sent to overseas applicants, as well as to those at home.

For Sale.—The Dunfermline Co-operative Society has for disposal its present power station plant and motor equipment, consisting of two 75-kw. sets, direct-coupled Belliss & Morcom engine and Crompton generator, switchboards and instruments, Babcock boiler, feed pump, &c; also 10 motors, from 2 to 30 h.p.

The L.C.C. invites tenders for the purchase of one 3,500-kw. steam alternator, 6,600 volts, 25 periods per second; the set consists of two engines, one on each side of alternator, complete with condenser and air pump. Halifax Corporation has for sale two 200-kw. Parsons' D.C. turbo-generators and three 100 kw. E.C.C. rotary converters. See our advertisement pages to-day.

Trade Announcement.—The Wilson Apparatus Co. announce that their business is now being carried on under the style of the "Globe Radio-Apparatus Co.," with head office at 18, Old Broad Street, London, E.C., where all communications should be sent. For the present the works address will remain at Finchley Lane, Hendon, N.W.

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Social.—On Friday, January 7th, the FOSTER ENGINEERING CO., LTD., held their annual fancy dress dance at the Masonic Hall, Wimbledon, S.W. About 180 persons were present, all, with about six exceptions, being in costume. A series of topical verses were set to a well-known tune by Mr. Lazenby, a director of the company. After supper the prizes were presented by Mrs. Lazenby.

Patent Restoration.—Letters Patent No. 9,339, of 1900, granted to G. de Bechi and R. W. Rücker, for "Improvements relating to the treatment of complex sulphate ores," has been granted.

Board of Trade Inquiries.—Recent inquiries received by the B. of T. Commercial Intelligence Branch are for names of British makers of the following:—Celluloid, suitable for accumulator cells; electric pocket lamps and bulbs; centrifugal pumps, made in lead, for pumping acid.

LIGHTING AND POWER NOTES.

Barnsley.—STREET LIGHTING.—The Electricity Committee has decided to restore half-lighting throughout the borough.

Brierfield.—The L.G.B. has refused to authorise the borrowing of further capital moneys for the electric lighting undertaking under the sanction previously given.

Burton-on-Trent.—PRICE INCREASE.—The T.C. has been informed that there would shortly be a revision of the electricity charges, both for lighting and power, owing to the increasing cost of fuel. It was anticipated that by March next the increased cost would amount to £2,000.

Canada.—By the purchase of the Gres Falls power site and the recent agreement with the Laurentide Power Co., the Shawinigan Water and Power Co. will practically control the most important water developments on the St. Maurice River, and will possess, it is stated, one of the greatest aggregation of power resources under one control in the world. The storage dam now being constructed at the mouth of the Manouan River will considerably increase the water facilities of the Shawinigan Co. The Gres Falls are about four miles below Shawinigan, and are capable of developing between 60,000 to 75,000 H.P.

Last month the Hydro-Electric Power Commission of Ontario placed in operation the generating plant at Eugenia Falls, on the Beaver River, 30 miles from Owen Sound, the installation consisting of two 2,250-H.P. Escher-Wyss turbines coupled to 1,200-K.V.A. generators. Power is generated at 4,000 volts and stepped up to 22,000 volts for distribution to Owen Sound, Shelburne, Durham and Mount Forest. The load on the first day of operation reached 856 KW., and at the present time 1,500 KW. represents the daily maximum requirements.—*Canadian Electrical News.*

Ceylon.—The final taking over of the plant and consumers by Government, from the Board of Improvement, Nuwara Eliya, the mountain capital of Ceylon, was to be effected on January 1st, 1916. The new generator and turbine, which were landed during the middle of the year, have now been erected; they were tested recently and are working satisfactorily. The question of lighting has been deferred.—*Indian Engineering.*

Chippenham.—STREET LIGHTING.—The T.C. has decided to call upon the Electricity Co. to complete the contract for the public lighting at Lowden without further delay.

Continental.—ITALY.—A grant of water on the River Verdura, with a view to the construction of a hydroelectric station and irrigation works, has been sanctioned by the Prefect of the Province of Girgenti, at the instance of the engineer, Giuseppe Patane, of Catania.

Downham Market.—PROPOSED E.L.—The local gas company has offered to obtain the necessary powers to supply electricity if wanted in the area. The Council is negotiating with Mr. Best, of Bradford, in regard to such a scheme.

Durham.—During the recent gale a large steel tower at the electric station, Yerrington Lane (County Durham), was blown down. The station stands close to the North-Eastern Railway Co.'s main line between Spennymoor and Ferryhill, and the structure which came down was about 80 ft. high. It just missed the railway by a few yards, whilst an adjoining signal cabin narrowly escaped.

Glasgow.—NEW PLANT.—At the last meeting of the Electricity Committee the engineer submitted a report relating to the existing generating plant, from which it appeared that he had only managed to meet the demands made for electricity during the present winter by overloading the generating plant at the Port-Dundas and St. Andrew's Cross stations, and by taking 3,600 H.P. from the Pinkston generating station of the tramways department; that he had still to connect three large factories, which are to be used later for the manufacture of engineering material; and that the margin of power for supply provided by the existing generating plant is much too small. The Committee, after considering its report, was of opinion that additional plant ought to be ordered without delay, and agreed to recommend that tenders for two 6,000-KW. turbo-alternator sets be obtained and submitted for consideration.

Gloucester.—The Electricity and Light Railways Committee reports that for November the output of electricity was 209,511 units against 187,009 in the corresponding period of last year. On the light railways for the six weeks ended December 29th, the receipts showed a decrease of £18 compared with last year, due mainly to increased wages.

Hereford.—LOAN REFUSED.—The L.G.B., in response to a repeated application for sanction to a loan for the provision of additional plant at the electricity works, has again refused, on the ground that the provision of additional plant at the present time is not a matter of pressing necessity, either on the grounds of public health or on account of war requirements. Under these circumstances no applications for new supplies or for the extension of any existing supply will be entertained. The sum required is from £8,000 to £10,000.

Horbury.—The U.D.C. has consented to the use of overhead lines in the district by the Yorkshire Electric Power Co., subject to the substitution of underground cables across Dudfleet Lane on receipt of six months' notice, and the company has accepted the condition.

London. — ST. MARYLEBONE. — The L.C.C. has sanctioned the borrowing of £3,800 for electricity mains and services. The Electricity Committee recommends that the charge to the Port of London Authority for the hire of two spare sets of 500-KW. turbines for cold storage purposes be £20 per week.

The Committee recommends the Council to protest against the Government introducing measures to effect the pooling of private-owned railway wagons, as the supply of coal to the electricity works would be made more difficult.

The revenue account of the Council's electricity undertaking for the September quarter, 1915, shows a gross revenue of £33,811, and expenditure £19,174, leaving a balance of £14,367 available for loan and special charges, an improvement of £347 compared with the corresponding period of 1914. The number of units sold shows a decrease of 5·9 per cent.; during the June quarter the decrease was at the rate of 9·6 per cent., and the improvement during the September quarter has reduced the diminution of sales over the half year to September 30th, to 7·93 per cent. on the 1914 totals. Since September 30th the daily output returns, with few exceptions, show a marked increase over the corresponding days of last year, the cumulative effect of which is to reduce the above percentages of 9·6 and 7·93 to about 3 per cent. for the portion of the financial year to date. The generation expenses were £7,581, as compared with £6,584 and £7,546 for the corresponding periods of 1914 and 1913 respectively. The average price paid for coal during the quarter was 20s. 2d., as compared with 14s. last year. The improvement in trading and the higher prices obtained, have enabled the enhanced coal prices, £1,705, to be met, the cost of allowances granted to employés on national service, £994, the cost of guarding the works, £123, and the extra cost of materials generally, and to leave a balance larger than last September by £347 to meet the capital and special charges for the year ending March next.

SOUTHWARK.—The accounts of the Borough Council's electricity undertaking for the year ended March 31st, 1915, show a deficit of £6,410.

POPLAR.—According to the report of Mr. Bowden, chief electrical engineer to the B.C., the net surplus on the electricity undertaking for the September quarter was £2,071, as against £1,286 for the June quarter, making a total for the half-year of £3,358. This figure compares with £2,408 for the corresponding period last year, and therefore shows an increase of £950. Mr. Bowden adds that on account of increased prices £2,835 extra was paid for coal; that the revenue was reduced by £600, owing to the Stepney Council not taking a stand-by supply this year; and that other extras paid amounted to £436, while the reduction in lighting rates represented a reduction of over £500 in revenue, in view of which the result is a remarkable one.

HAMMERSMITH.—STREET LIGHTING.—The Special Committee appointed to consider the question of the allowance to be made by the Electricity Committee in consequence of the restricted public lighting, recommends that £2,500 be deducted for the financial year ending March 31st next, and that an allowance at the same rate per annum be made subsequent and until otherwise ordered by the Council.

BERMONDSEY.—Having regard to the fact that the loans for meters, ordinary mains and for services have been overspent to the extent of £1,610, the B.C. is recommended to apply to the L.C.C. for sanction to, and the advance of, a further loan of £3,000.

FULHAM.—The Law and Parliamentary Committee recently claimed £875 from the coal contractors for loss occasioned by non-delivery of coal; the matter has now been settled by the contractors agreeing to reduce their account from £629 to £500, and to release their bonds.

PRESSURE TESTING STATIONS.—The Hammersmith Council at its last meeting decided to support the suggestion of the Hackney B.C. that the periodical inspection of pressure testing stations carried out by the L.C.C. should be suspended during the war. The Electricity Committee considers that the undertakings might be saved the testing fees, and the services of the official be rendered available for work of a more useful character

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King's Lynn.—Price Increase.—Owing to the increased cost of fuel, &c., the T.C. has advanced the charges for current for power by another 5 per cent.

Luddenden Foot.—A conference is to be held between the chairman of the U.D.C. and the borough electrical engineer of Halifax in regard to the supply of electricity.

Middlesbrough.—Fire broke out in the generating plant at Nunthorpe Hall recently, and before the arrival of the Middlesbrough fire brigade, £200 worth of damage was done.

According to Mr. R. H. Scotson, borough electrical engineer, the total estimated revenue of the electricity department for December was £3,268 as against £3,204 for December of the previous year, and the total estimated profit for the month was £2,069, compared with £1,857. An inquiry in regard to an explosion at an electricity manhole was left by the T.C. with the borough engineer and the engineer to the Post Office, whose main was concerned.

Mirfield.—The U.D.C. has applied to the B. of T. for consent to use overhead transmission, at 200 volts, for the purpose of supply under the order of 1899.

Newport (Mon.).—The Electricity and Tramway Committee reports that the Gas Co. demanded that an inquiry should be held by the L.G.B. on the question of the supply of electricity to Maeglas, which is outside the borough. The inquiry was held last week, with the result that the B. of T. has intimated that electricity should be supplied to the new works.

Northallerton.—Street Lighting.—It was reported to the U.D.C. that owing to restricted lighting, the street E.L. account for the past quarter amounted to only £46 against £178 in the corresponding period of last year.

Pendlebury.—A generating plant is being provided at the Acme spinning mill to provide power for driving that mill and the adjoining Albion mill. The Acme mill was the first spinning mill in Lancashire to be electrically driven.

Perth.—The electricity department came to the assistance of the city the other day on the occasion of a breakdown at the gasworks. In connection with the matter, Mr. J. Lambert, Corporation electrical engineer, has been asked to report upon the whole of the electric appliances in use at the gasworks, and advise specially as to the obtaining of duplicates to replace any parts that may go temporarily out of order or may be worn out.

Slaithwaite.—Prov. Order.—The U.D.C. has decided to apply for the date of the electricity order to be extended for a period of 12 months after the end of the war.

Southend-on-Sea.—The T.C. is recommended to arrange for the installation of a new automatic electric starting apparatus for the sewage pump in Hamstel Road. Messrs. Callender have written the Electricity Committee asking it to take delivery and pay for the cable ordered in connection with the proposed supply of current in the Leigh area, the delivery and payment having been delayed in compliance with the L.G.B.'s embargo on capital expenditure. In view of the largely increased price, which it would probably have to pay for the cable at a later date, the Committee has resolved to authorise the clerk to inform Messrs. Callender that the Council will take delivery of and pay for the cable in April next. The Committee decided that in the event of the Corporation being permitted by the L.G.B. to install one or more of the engines in the Leigh sub-station, application be made to the Board for authority to raise the cost of the cable under the sanction of December, 1914, authorising a loan of £18,000 for cables, &c. (the cost of the cable in question being included in such application), and that in the event of the Corporation not being permitted to equip the sub-station the cost of the cable be paid out of revenue.

Sowerby (Thirsk).—Street Lighting.—The Electric Lighting Co. has offered an allowance of £30 off the lighting account providing there is no alteration in the lighting conditions. It was pointed out that the contract was for three years, subject to the amount being allowed by the parish meeting, and the amount the meeting would have been asked to raise for the current year was £105. It was agreed to accept the company's offer.

Surbiton.—E.L. Transfer.—The U.D.C. has now received the sanction of the B. of T. for the transfer of the E.L. undertaking to Messrs. Callenders.

Swindon.—The T.C., having received an application for a supply of current to Broome Manor, for lighting and power, has referred the matter to the Electricity Sub-Committee. To comply with the request the overhead line will have to be extended from Broome sewage works, at an estimated cost of £275.

Swinton and Pendlebury.—The D.C. has decided that the agreement with the Lancashire Electric Power Co. for the supply of electricity shall be extended to the year 1923. It is stated that the effect of this will be to lower the price of current to the Council.

West Bromwich.—The T.C. has entered into an agreement with the Oriental Tube Co., Ltd., to supply a minimum of 80,000 units per annum for a period of years.

Wolverhampton.—Proposed Loan.—The Corporation proposes to borrow £1,780 for mains extensions in connection with the supply of electrical energy to local works.

TRAMWAY and RAILWAY NOTES.

Ashton-under-Lyne.—Wage Increase.—As the result of the recent arbitration between the Corporation and the tramway employés, increases of wages have been awarded to the men as follows:—Motormen and conductors receive an increase of $\frac{1}{16}$d. per hour, and shedmen ½d. per hour, the increases to date from October 4th. The motormen and conductors working on the Manchester section receive the following increases for the duration of the war:—1s. per week to employés up to 21 years of age, and 2s. per week to those above that age. The wages of inspectors were increased by 1s. 6d. per week.

Birmingham.—Female Labour.—The Tramways Committee reports that there were now 700 women acting as conductors on cars in the city, and, generally, their work gives satisfaction. About 50 professional and business men are acting as motormen on cars during the week-ends.

Bolton.—Female Labour.—The Tramways Committee has authorised the tramways manager to employ as many women car conductors as he deems necessary, and it has been decided to adopt a uniform similar to that used by the women conductors at Oldham.

Chesterfield.—The T.C. has decided to apply for the tramways undertaking to be a "controlled" establishment. An application for the women tramway conductors to be paid the war bonus given to male employés, has not been granted, as they commenced duties after the outbreak of war at the maximum rate of pay.

Continental.—Spain.—Railway Electrification.—The establishment of interurban electrical railways in Spain is hindered by unfavourable geographical conditions. The country consists for the most part of a lofty plain, sparsely populated, sloping towards the coast, and the railway network in conjunction with the cart roads suffices for the insignificant traffic. Only on the coast, which is thickly-populated, are there interurban railways. According to the report of a German engineer, Herr W. Reinart, in the *Elektrische Kraft und Betriebe*, the greater part of these, some 15 lines, with a total working length of 295 km., are of 1 metre gauge. One of these railways, running from Pampeluna to Sanguesa, 18 km., is worked by single-phase current, at 6,000 volts and 25 cycles; all the others employ continuous current at 500-600 volts, with the exception of the Viga-Mondariz line, 42 km. in extent, which is still under construction, and which will employ continuous current at 1,200 volts. Another line intended for working with continuous current at the same pressure, the Barcelona-Sabadel-Tarasa, is now under construction; and three lines running out of Bilba, of an aggregate length of 80 km., will work with current at 500 600 volts. Of ordinary electric railway lines the Gergal-Santafé-Mondigur (near Almeria), with a gauge of 1·66 m., is the only one in use. It is engaged almost wholly in the transport of ore on a gradient, and with a view to utilising regenerative methods, the three-phase system has been chosen. The trains are drawn by two locomotives of 52 tons weight each, with two 160-H.P. motors each. A more important long-distance line, whose electrification was under consideration just before the outbreak of the war, is that which connects Huelva with the famous Rio Tinto copper mine; this line, devoted almost exclusively to the carriage of ore, is 80 km. long, and has a gauge of 1·30 m. For its working it is intended to use three-phase current at 3,000 volts and 50 periods; the locomotives are fitted with two motors of 600 H.P. each. A Commission nominated by the Spanish Government is at the present moment occupied with a scheme for an express electric line from Madrid to the French frontier, whose termination will probably be at the new Somport tunnel, which passes through the Pyrenees.—*Revista Tecnica d'Elettricità.*

Italy.—The Società Anonima dei Tramways Florentine has applied for authority to build and work new electric tramways from a point in the city to La Lastra.

Application has been made for a concession for the construction and working of a short line of metre-gauge electric tramway to connect the town of Todi with the Todi-Porte Nara railway station.

Switzerland.—The Swiss State Railway authorities have decided to commence the work of electrifying the Gothard Railway, a start being made with the Erstfeld-Bellinzona section of the line. For the current year provision has been made for the expenditure of £120,000 on the work; of this, £56,000 is for the Amsteg power station, £52,000 for the Ridom station, and £12,000 for rolling stock and the construction of a short trial section. The provisional estimates provide for the expenditure of £380,000 in 1917, £540,000 in 1918, £440,000 in 1919, and £60,000 in 1920, the total cost being thus £1,540,000.

Dudley.—Tramway Accident.—On Sunday evening last a serious tramway accident occurred on the Dudley—Wednesbury route, owing to a car carrying 30 passengers running away down hill, without the driver, and subsequently jumping the points and overturning across a footpath. Sixteen passengers were injured, and one of these has since died of injuries received. Apparently the car was at a terminus which was on a slight gradient, and, the brakes having been applied, the driver went to meet a Birmingham car, by which his tea was sent up. The conductor, who remained on the car, changed the trolley-pole, and,

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thinking the driver was at his post, rang the bell and released the brakes. The car then started, and he commenced to take fares, being unaware of the position of things until his attention was drawn to the matter by a passenger; his subsequent efforts to apply the brakes were too late, as the car left the track and overturned, as mentioned. This accident resembles very closely that which occurred at Barnsley on December 2nd, 1914, and on which Col. von Donop subsequently reported, his findings being given in our issue of February 5th last year.

Edinburgh.—A Sub-Committee has been asked to report fully on the state of the tramways undertaking, in preparation for the Corporation taking it over; the question of procedure when the lease expires will also be considered. Mr. Newington, city electrical engineer, is to report on the advisability of electrically lighting the cars.

Glasgow.—A sum of £490, including a grant of £50 given by the T.C.'s Departmental Committee, has been collected in boxes in the cars on the Glasgow system, for supplying seasonable comforts for the ex-members of the department who joined the 17th Batt. of the H.L.I., which is mainly composed of Corporation ex-workers. A number of parcels have already been sent to France, and, under a novel scheme which has been introduced, a considerable portion of the fund has been invested in wool, with which the wives of the men, the women employés of the department, and others, are engaged in knitting comforts for the men in the trenches.

L. & S.W. Railway Electrification.—According to the *Daily Express*, Mr. H. Holmes, superintendent of the L. & S.W. Railway, states that the new service of electric trains between Kingston and Waterloo will be brought into operation on Sunday, January 30th.

Middlesbrough.—RAILLESS TRACTION.—The non-delivery of the cars is responsible for the delay in the opening of the railless traction system which will connect up Middlesbrough with the Eston district lower down the Tees bank. Owing to Government contracts, the delivery of the cars is not expected for two or three months.

Stretford.—Complaint has recently been made of the inadequacy of the car service to Trafford Park from Manchester and Salford. The question was raised at a meeting of the Stretford D.C. last week, and the clerk was instructed to draw the attention of the Manchester and Salford Corporations to the matter, and to express the hope that an improved car service might be arranged.

U.S.A.—The first actual tests of the Chicago, Milwaukee and St. Paul Railroad Co.'s new electrified mountain divisions have just been made by officials and directors of the system, who toured the completed sections of the 400-mile electrified district in three special cars drawn by one of the new 260-ton, 3,000-volt electric locomotives. After making passenger-train tests, running at all speeds up to 70 miles an hour, the officials witnessed tonnage tests, in which locomotives used on passenger trains, equipped for heavy hauling instead of speed, pulled 2,500 tons at a uniform speed of 16 miles an hour. It is expected that the all-steel trans-continental trains of this company will be operated electrically over the continental divide at an early date. While the cost of the work has been $20,000,000, the saving in fuel, in increased hauling capacity, in maintenance of speed schedules and in mechanical upkeep will be so large that a return of 20 per cent. a year on the investment is anticipated. The regenerative braking device in the equipment of the electric locomotives proved under the tests to be completely successful.—*Electrical World.*

TELEGRAPH and TELEPHONE NOTES.

Cables in Code.—The Postmaster-General announces that the Rubber edition of Broomhall's "Imperial Combination Code" has been added to the list of codes authorised for use in foreign telegrams, except in telegrams to Argentina, Brazil, Paraguay, Uruguay and Honduras.

Marconi v. Telefunken.—The Standard Oil Co., of New Jersey, has decided to remove the Telefunken wireless apparatus from 22 of its ships, and to substitute the Marconi system, with American operators. A contract has been made with the Marconi Wireless Telegraph Co. of America to this end, and is regarded by the Marconi Co. as a very important transaction.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—February 18th. Melbourne, Brunswick and Coburg Tramways Trust. Six radial trucks.*

April 15th. P.M.G. Common-battery multiple switchboard, or automatic or semi-automatic switchboard, and associated apparatus. See "Official Notices" December 31st.

BRISBANE.—February 28th. Deputy P.M.G. Gas engine, generator, battery, power board, &c., for the Post Office, Townsville, Queensland. (Schedule No. 370.) High Commissioner's Office, 72, Victoria Street, S.W.

MELBOURNE.—February 16th: 51 electric staff instruments. February 23rd: Two commutator slotting machines, for the Victorian Railway Commissioners.*

February 2nd. Agent-General for Victoria. Fuse distribution boxes and fuses, for the Victorian State Railways. See "Official Notices" January 14th.

SYDNEY.—February 7th. Metropolitan Board of Water Supply and Sewerage. For No. 1 pumping station at Ultimo. Two centrifugal pumps and electric motors (4,000 gallons per minute each), switchboards, starters, &c. Contract No. 1,301.*

February 28th. Municipal Council. Tenders for induction regulators. Specifications (11s. 6d.) from the Electric Light Department, Town Hall, Sydney.

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-KW. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.

Croydon.—January 24th. Corporation. Stores for the Tramways Department. Particulars from the Manager, Tramways Department, Thornton Heath.

Doncaster.—January 24th. Relaying portion of the permanent-way, Nether Hall Road, for the Corporation Tramway Department. Mr. R. E. Ford, Acting Borough Engineer (returnable deposit of £1 1s.).

Dublin.—January 21st. Corporation. Arc lamp carbons. See "Official Notices" January 14th.

Eccles.—X-ray apparatus at the Eccles and District Hospital, for the Board of Management.

Halifax.—February 14th. Corporation. Twelve months' supply of electric lighting fittings and accessories, cables, telephone wire, meters, &c. See "Official Notices" to-day.

London.—ISLINGTON.—January 21st. B.C. Twelve months' supply of engine-room stores, electrical fittings, meters, cables, &c. See "Official Notices" Dec. 31st.

BERMONDSEY.—February 10th. B. of G. Twelve months' supply of electric lamps. Forms of tender from Mr. E. Pitts Fenton, Clerk to the Guardians, 283, Tooley Street, S.E.

FULHAM.—The Electricity and Lighting Committee recommends that no annual contracts be entered into for the supply of electrical and engineering stores, but that the borough electrical engineer be authorised to purchase in the open market when required.

HAMMERSMITH.—The Electricity Committee recommends the B.C. to invite tenders for 12 months' supplies of electric light sundries, insulated wires, packing and jointing materials, joint-boxes and connections.

New Zealand.—AUCKLAND.—February 23rd. City Council. Centrifugal pumping electric motors, and automatic starting and controlling apparatus, for the four city pumping stations. Specifications from the office of the Water Board, Town Hall, Auckland.

DUNEDIN.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.

RAETIHI.—March 14th. Town Board. 40-H.P. hydro-electric generating set, switchboard, &c. Plans and particulars from Messrs. H. W. Climie & Son, Raetihi.*

WELLINGTON.—March 8th. Public Works Office. One 3,000 KW. generator and one 4,300-H.P. water turbine, at Lyttelton, for the Lake Coleridge electric power scheme. Specifications, &c., may be consulted by British firms at the office of the High Commissioner in London for New Zealand, at 13, Victoria Street, S.W.

Pembroke (Dublin).—February 7th. U.D.C. Twelve months' supply of electrical goods. Specifications from the Town Hall, Ball's Bridge, Co. Dublin.

Spain.—Tenders have just been invited by the municipal authorities of Narros del Castillo (Province of Avila) for the concession for the electric lighting of the town.

Swansea.—February 7th. Electric light installation, Brynmill School, for the Borough Education Committee. Mr. A. W. Holden, Clerk, 9, Grove Place (returnable deposit of £1 1s.).

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Auckland.—The U.D.C. has accepted the tender of Messrs. D. Latham & Co. for the E.L. installation at the new engine house at the waterworks, at £36.

Barnsley.—The Electricity and Lighting Committee has accepted the following tenders:—

Willans & Robinson.—Turbine, £2,590; condenser, £2,150.
Dick, Kerr & Co.—Alternator, £1,980.
B.I. & Helsby Cables, Ltd.—H.T. and L.T. feeders, £2,241.

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Bath.—The D.C. has placed a contract with Messrs. Chamberlain & Hookham, Ltd., for meters for the ensuing year.

Cape Town.—The tender of the South African General Electric Co. has been accepted by the Corporation for a British Thomson-Houston turbo-alternator, for £12,160; also the tender of Messrs. Sykes & Co., at £3,050, for a rotary converter.

Dewsbury.—The Electricity and Tramways Committee of the T.C. has accepted the tender of Messrs. Heenan & Froude for an air filter, at £187.

Glasgow.—The T.C. Tramways Committee has accepted the following offers for scrap:—Copper, and armature coils, Messrs. P. & W. MacLellan; brass, and rubber-insulated cable, Messrs. R. M. Easdale & Co.; dry cells, Messrs. J. Jackson & Co.

Government Contracts.—List of new contracts for December, 1915:—

WAR OFFICE.

Electric cable and wire.—B.I. & Helsby Cables, Ltd.; Hooper's Telegraph and I.R. Works, Ltd.; Johnson & Phillips, Ltd.; Liverpool Electric Cable Co., Ltd.; Midland Electric Wire Co., Ltd.; Siemens Bros. and Co., Ltd.; Western Electric Co., Ltd.
Electric cells.—Siemens Bros. & Co., Ltd.
Electric lighting sets.—Fyfe, Wilson & Co.; Parsons Motor Co., Ltd.
Distribution boards, switches and fuses.—Kartrei Engineering Co.
Engines and generators.—Austin Motor Co. (1914), Ltd.; Keighley Gas and Oil Engines, Ltd.
Switchgear for transformers.—British Thomson-Houston Co., Ltd.
Generating sets and parts.—Austin Motor Co. (1914), Ltd.
Works services.—Electric lighting at R.F.C. Camp, Thetford: Mann, Egerton & Co. Electric lighting new hut hospital, Dublin: Ellis and Ward, Ltd. Electric lighting installation at Houghton Regis Camp: Grindlestone & Co. Electric lighting at hutted camps, Duddington and Dreghorn, Eastfield and Westfield.—Grindlay, Ross & Co., Ltd.
Power houses at Crombie and Rosyth.—W. Finlayson & Sons.

POST OFFICE.

Additional automatic equipment at Leeds Automatic Exchange.—Automatic Telephone Manufacturing Co., Ltd.
Insulators.—J. Bourne & Son; Taylor, Tunnicliff & Co.
Condenser paper.—Brittains, Ltd.
Battery zinc.—Eyre Smelting Co., Ltd.
Galvanised-iron wire.—R. Johnson & Nephew, Ltd.

H.M. OFFICE OF WORKS.

Engineering services.—Admiralty electric wiring: W. O. Rooper & Co.

London.—The London General Omnibus Co. has, we hear, just placed a large repeat order for electric lighting sets with Messrs. C. A. Vandervell & Co., Ltd.

Messrs. Pope's Electric Lamp Co., Ltd., have secured a renewal of their contract for carbon and metal-filament lamp requirements for 1916 from the Nelson Line of steamers. Owing to the large demand for Pope electric lamp shades, a further stock is being printed, and applications for them should be sent immediately.

HAMMERSMITH.—In order to augment the stock of coal at the electricity generating station, the Electricity Committee recommends the acceptance of the offer of Messrs. Cory Bros., Ltd., for a supply of 90 tons per week, to June 30th next, of ¾-in. Hucknall High Hazel coal, alongside Chancellor's Wharf, at 21s. 6d. per ton.

BERMONDSEY.—The following tenders have been received by the Borough Council for the supply of motors for the crusher plant:—

Supply and erection complete:	Motor revs.	Price.	Price without spare armatures.
J. Evans & Co.	950	£689	£312
General Electric Co., Ltd.	900	551	491
Cost of fitting spare armatures not included:			
Crompton & Co., Ltd.	1,000	541	491*
No erection, and spare armatures not fitted:			
Brit. Westinghouse Co., Ltd.	1,000	580	525
Brit. Thomson-Houston Co., Ltd.	1,020	561	508
Siemens Bros. & Co., Ltd.	1,000	545	494
Alternative tenders:			
J. Evans & Co.	950 / 1,100	786	709†
General Electric Co., Ltd.	900	815	727‡

* Plus 15s. per yard run of cable. † Enclosed pipe-ventilated motors. ‡ Totally-enclosed motors.

The Council is recommended to accept the tender of the General Electric Co., Ltd., at £551, plus 15s. per yard run of cable, estimated at £33. In its report on the subject the Finance Committee stated that it was informed that when the General Purposes Committee decided to recommend the Council to accept the tender of the General Electric Co. it did so upon its being reported to it that it would be the lowest tender, as it was thought that Messrs. Crompton & Co.'s tender did not include the cost of changing the spare armatures. It has since been ascertained that Messrs. Crompton's estimate did include such cost, as provided for in the specification. The Committee therefore, to save time, recommended the acceptance of Messrs. Crompton's tender.

The Electricity Committee has accepted the tender of the B.I. and Helsby Cables, Ltd., for three 5 units, complete with bus-bar, for mounting in Callender pillar, and one 3 unit, for £29.

Stretford.—The U.D.C. has accepted the tender of Messrs. W. T. Glover & Co., Ltd., at £356, for the supply of 400 yards of paper-insulated, lead-covered cable; also the tender of Messrs. Veritys, Ltd., at £53, for a 10-H.P. motor.

Swindon.—The T.C. has accepted the tender of the Acetylene Illuminating Co., Ltd., for an acetylene gas plant for use in connection with the repair of the tramway track, at £41.

Taunton.—Messrs. Chamberlain & Hookham, Ltd., have received a contract from the Council for meters for the year.

Windsor.—The T.C. has accepted the tender of the Pulsometer Pump Co., Ltd., for an electrical pump, at about £200.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Friday, January 21st. At 5.30 p.m. At Albemarle Street. Lecture on "Problems in Capillarity," by Prof. Sir J. Dewar, F.R.S.

Thursday, January 27th. At 3 p.m. At Albemarle Street, W. Paper on "Fuel Economy from a National Standpoint," by Prof. W. A. Bone, F.R.S.

Greenock Electrical Society.—Friday, January 21st. At 7.45 p.m. At the Temperance Institute, 19, West Stewart Street. Paper on "Direct-current Machines," by Mr. J. A. Kinnaird.

Institute of Mechanical Engineers.—Friday, January 21st. At 8 p.m. At Great George Street, S.W. General meeting.

Association of Mining Electrical Engineers (West of Scotland Branch).—Saturday, January 22nd. At 4.30 p.m. At the Royal Technical College, Glasgow. Paper on "Electrical Shaft Winding," by Prof. D. Burns.

(Notts and Derbyshire Branch).—Saturday, January 29th. At University College, Nottingham. Paper on "Unusual Breakd.wns in Colliery Electrical Plant," by Mr. R. Devine.

Manchester Association of Engineers.—Saturday, January 22nd. At the Grand Hotel, Aytoun Street. Paper on "Cast Iron: The Strength and Properties of Castings," by Mr. E. L. Rhead.

Salford Technical and Engineering Association.—Saturday, January 22nd. At 7 p.m. At the Royal Technical Institute. Presidential Address. Musical social evening.

Post Office Telephone and Telegraph Society of London.—Monday, January 24th. At 6.30 p.m. At the I.E.E., Victoria Embankment, W.C. Paper on "Public Administration and Finance," by Mr. F. C. Cook.

Institution of Civil Engineers.—Tuesday, January 25th. At 5.30 p.m. At Great George Street, S.W. Discussion on Mr. F. W. Carter's paper on "The Electric Locomotive."

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, January 25th. At 7.30 p.m. At the Engineers' Club, 17, Albert Square. Paper on "The Principles of Modern Printing Telegraphy," by Mr. H. H. Harrison.

Liverpool Engineering Society.—Wednesday, January 26th. At the Royal Institution, Colquitt Street. Paper on "Recent Developments in Telephony," by Mr. G. C. Marris.

University College, London.—Wednesday, January 26th. At 5.30 p.m. At University College, Gower Street, W.C. First lecture on "The Electrical Production of Nitrates for Fertilisers and Explosives," by Mr. E. Kilburn Scott.

Leeds Association of Engineers.—Thursday, January 27th. At 7.30 p.m. At 5, Park Lane. Paper on "Electric Heating: Its Present Position and Future Development," by Mr. G. Wilkinson.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, January 28th. At 7.30 p.m. At Bolbec Hall, Newcastle-on-Tyne. Ordinary general meeting.

NOTES.

The B.T.H. Co., Ltd.—With reference to an article that appeared in the *Sunday Chronicle* on "Germans and the Electrical Industry," a couple of months ago, in which the writer, one "John Briton," made certain references to the British Thomson-Houston Co., Ltd., a further article appeared in the same paper on Sunday last, in which the writer says:—

"When I wrote last on the German influence in the electrical industry, some two months ago, I gave an account of the extraordinary ramifications of the great German Trust, called briefly the A.E.G., of Berlin, and in this connection, before I go further, I desire to clear up an unfortunate misunderstanding. Among the 'Allied and subordinate' companies, of which I gave a list, I mentioned the British Thomson-Houston Co., of Rugby. I did not say that this company was owned or controlled by the A.E.G., but this inference has been drawn from my article, and I therefore desire to say that it is unfounded.

"The truth is that the B.T.H., of Rugby, is mainly controlled by the General Electric Co., of Schenectady, which in its turn is a descendant of the Thomson-Houston Co., of America. The Thomson-Houston Co. in its day sold its European patents to a number of companies on this side of the Atlantic, some of which in due course were absorbed by the A.E.G. and some by the G.E. Co.

"The British Thomson-Houston Co. belongs, as I have said, to the latter category. It is true that the A.E.G. purchased the German rights under the patents of the G.E. Co. and the B.T.H. Co. in exchange for the American and British rights under its patents, but I am glad to be able to state that the German company has no control over, or interest in, either the American or British company, and I regret if any other meaning has been read into my article, and if any harm has been done to the B.T.H. Co. thereby. I am also able to state that the A.E.G. has no control over the electric lamp business in this country, but on the contrary, by reason of British patents it was obliged to purchase from British companies all such lamps as it sold here."

Trading with the Enemy.—The New Bill.—As we go to press the text of this Amendment Bill is being published. Among other things it gives the Government power to wind up enemy businesses under certain circumstances. We shall refer to the matter next week.

Inquiries.—Makers of appliances for the manufacture of storage batteries are asked for.

Appointments Vacant.—Electricians and motor mechanics are wanted for military camp power-houses (South of Ireland district), at 40s. to 45s. +.

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The Development of Italian Hydro-Electric Works.—The conference to which we briefly referred in our last issue took place in Milan, in the offices of the Società Imprese Elettriche, in the presence of Senator Facheris and a number of members of the Lower Chamber, and from a report of the proceedings now to hand, it would appear that the responsibility for assisting Italy to develop the water powers of the country for industrial purposes in general rests with the Government. Signor Ettore Conti, the engineer who had been invited to give an address on the subject, first referred to the great importance attached at the present time to the question of the electrical industry in relation to national independence and the economic defence of the nation. In view of the European conflict, he stated that the Italian industry must fight on the side of the army, and in order to attain the object which had been predetermined in the Italian war it was also necessary to strive in the economic field, so as to secure that industrial independence which had been endangered by the hegemonical dream of the Central Empires, in the sense of endeavouring to translate it into reality first by trying to surpass from an economic point of view, and then by supporting this by force of arms. The independence of Italy would be achieved, in his opinion, by the adoption of a right policy with regard to Customs and transport services, the diffusion of professional education, the regulation of credit, and above all by the pursuit of an enlightened national policy in respect of the utilisation of water powers. Dealing then with the problem from various standpoints, the lecturer first discussed the subject of the conversion of the railways to electric traction. It would be impracticable to transform the whole of the railway mileage so as to work it by means of power obtained from hydroelectric works, as such a scheme alone would require 1,000,000 H.P. But it would be possible to increase the present electrically-operated mileage of 210 to 1,200 miles within a period of 10 years, and at an expenditure of £4,000,000. It would also be practicable for a considerable portion of the power required by the industries of the country to be obtained from electricity instead of coal, and electricity could also be employed as motive power in agricultural operations and for the extraction of nitrogen from the atmosphere for fertilising purposes.

The question of the sale price of electricity next engaged attention. On this point Signor Conti stated that the price per KW.-hour was 9·6d. 30 years ago. It was now sold to large industrial consumers at from ½d. to ¾d., and at $\frac{1}{10}$d. per KW.-hour in special cases. He was firmly convinced that it would be possible to establish hydroelectric works which would be able to dispose of energy at from $\frac{1}{10}$d. to ½d. per KW.-hour, and when that object was achieved the iron and steel and chemical industries in Italy would no longer be exceptional industries. After having reviewed the existing legislation with regard to the electrical industry, the speaker submitted that nothing had been done in this way to encourage the national industry. If the electrical industry was to be developed on a grand scale, so as to render possible the erection of large stations and consequently the supply of energy at cheap rates, the Government would have to avoid delays and solve the problem fully, bearing in mind the legitimate and modest wishes of industrialists, whilst at the same time the State revenue would rapidly increase to the advantage of the country. The lecturer met with a very cordial reception, and the discussion which ensued largely turned upon the means to be adopted in approaching the Government with a view to the adoption of immediate measures so as to permit existing hydroelectric works to be enlarged without delay by the construction, in the first place, of new reservoirs with the object of coping with the scarcity of coal.

The members of the Lower Chamber present expressed themselves convinced of the urgency of the problem, and a Committee was appointed to draw up a petition to be presented personally to the Government. In the meantime the address is to be printed in pamphlet form, and copies will be sent to all the deputies in order to secure their support in favour of this movement. A considerable time will be required before any practical advantage can be derived from the granting of facilities by the Government in the near future. That the Government will assist the electrical industry, as well as other industries, to secure independence from the Teutonic yoke seems very probable.

Fatalities.—METHIL.—At Kirkcaldy, Fife, on Friday, Sheriff Armour Hannay and a jury conducted an inquiry into the circumstances of the death of Alex. Martin, apprentice electrician, residing at Methil, who died on December 11th, 1915, in the No. 2 Pit, Leven Collieries, owned by the Fife Coal Co., from an electric shock.

George Meredith, foreman electrician, said the boy Martin, who was 15½ years of age, had been with him for about a year. On the day in question he had instructed the lad to replace a lamp on the west side of the pit bottom. All apprentices were warned not to touch high-tension panels. Witness stated that he did not think it possible to apply to that particular panel the locking apparatus suggested by the Inspector of Mines. The door of the panel had been levered open by the deceased, who was a lad keen on his work, and was undoubtedly curious. Joseph Laurie, the motorman, said deceased came to his room and said: "Here are two lamps for you." Witness then heard Martin open the door of the panel, and shouted: "Watch what you're doing now." Deceased replied: "It's all right, I have the gloves on." Witness then said: "See and mind." Witness received no answer, and on looking over to see what deceased was doing he saw Martin standing with his back against the panel and his mouth open. Witness took off the switch, and the lad fell back in his arms and never recovered. There was a mark on his forearm like a burn. George Gordon Fraser, chief electrical engineer to the company, said the panel was quite safe. There were sufficient notices of danger. The lad knew and had been warned of the danger. No matter what locking device was used, there would be danger in the human element. The Sheriff suggested that the jury add a rider to their formal verdict recommending that more stringent precautions and regulations be adopted in regard to apprentice electricians, and that the mines inspector should be invited to consider, along with the management, what electric device for protecting such panels could be adopted. Mr. Macgregor, the coal company's representative, addressing the jury, pointed out that no matter what device was adopted, so long as boys were boys and did not obey their superiors, accidents were bound to arise. A formal verdict was returned, the jury adding a rider as recommended by his Lordship.

A motor-car collided with an electric standard on the Victoria Embankment, London, on 17th inst. The standard was broken off 12 ft. from the ground, and one man was killed.

Volunteer Notes.—ENGINEERING INSTITUTIONS' VOLUNTEER ENGINEER CORPS.—Orders for week commencing January 24th, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commandant.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, January 24th.—Sections 1 and 2, Technical; Sections 3 and 4, Lashings and Trestle Bridging, Signalling Class and Recruits.

Tuesday, January 25th.—School of Arms, 6 to 7 p.m.

Thursday, January 27th.—Shooting for Sections 1 and 2, and Signalling Class.

Friday, January 28th.—Sections 3 and 4, Technical; Sections 1 and 2, Lashings and Trestle Bridging; Signalling Class and Recruits.

Saturday, January 29th.—Uniform Parade, 2.45 p.m.

Sections for Technical Parade at Headquarters, London Electrical Engineers, 46, Regency Street, S.W.

Sections for Shooting Parade at Miniature Ranges.

Unless otherwise ordered, all Parades at Chester House.

E. G. FLEMING,
Company Commander and Acting Adjutant.

3RD BATT. (OLD BOYS) CENTRAL LONDON REGIMENT (VOLUNTEERS).—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, January 20th, 1916:—

Week-end Parades.—The Inter-Platoon Competition will be fired at the Acton Range on Saturday next, the 22nd and 23rd inst. This will take the place of the usual week-end parades.

"*Derby*" *Recruits* will parade at Wembley Park, on Saturday and Sunday next, at the usual times.

Musketry.—The Acton Range will be open on Saturday morning, the 22nd inst., for Inter-Platoon Competition practice. Members to parade at 11 a.m. Names to be sent to Musketry Staff not later than Friday mid-day.

The Competition will commence on Saturday afternoon, the 22nd inst., at 1 p.m. The competing Teams are Platoons Nos. 2 and 3, Blackheath and North London.

The Competition will be continued on Sunday, the 23rd inst. The Teams—Platoons Nos. 5, 10, 13 and 14—are to Parade at 11 a.m. Teams—Platoons Nos. 4, 7, 12 and 15—to Parade at 2 p.m.

Men to Parade punctually, in uniform, with bayonets.

Non-competitors may attend to witness Competition.

A. G. JOINER, *Major and Adjutant*, O.B.C.

Institution and Lecture Notes.—The Institution of Electrical Engineers.—We are informed by the secretary of the Institution, Mr. P. F. Rowell, that the Council has passed the following resolution:—

"The Council are of opinion that Clause 41 of the Articles of Association provides sufficient means for the expulsion of undesirable persons (whether alien enemies or not) from the Institution, consistently with making the thorough investigation of the circumstances of each case which is essential in order to avoid the risk of doing grave injustice to individuals."

The Council has also under consideration the question whether the Institution should obtain further powers for the expulsion of alien enemies.

[We pointed out on December 31st that Article 41 contained adequate powers for the expulsion of alien enemy members, and in our last issue we surmised that the Council would not take action in the matter, having already returned an evasive reply to inquiries on the subject. Whether anything will be done depends entirely upon the members of the Institution, as Article 41 can only be brought into operation by the action of individuals, and the Council, it will be observed, is not committed to any policy whatever.—EDS. ELEC. REV.]

Metropolitan Association of Electric Tramways Managers.—A meeting of the members of this Association was held on 14th inst., at the Municipal and County Club, Whitehall, when the following were present:—Messrs. Ullmann (East Ham), chairman, Schofield (Leyton), vice-chairman, Moffet (West Ham), Harvey (Ilford), Mackinnon (London United), and Goodyer (Croydon), hon. secretary. Letters were received from Messrs. Fell (L.C.C.), Bruce (L.C.C.), Murray (Walthamstow), Stokes (Bexley), Hammond (Metropolitan Electric), Williams (Erith), and Mason (South Metropolitan), who were unable to attend. Various matters of interest were discussed.

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Chinese Power House Bombed.—A Central News dispatch from Hong-Kong, states that on January 14th while the chief engineer of the Kwang-Tung Electric Supply Co. was entertaining some friends, including the British Consul, at a bridge party, an unknown miscreant threw a bomb into the company's power house. All the windows were smashed, and two or three coolies were killed.

Lead Poisoning in Accumulator Works.—During the month of December, 1915, twelve cases of lead poisoning in electrical accumulator works were reported to the Home Office under the Factory and Workshop Act, the total cases for the year being 64 as against 41 for 1914.

The Prussian Government and Electricity Works.—The Spanish newspapers have recently recorded complaints made in some political circles alleging that certain new laws have become dead letters—dead in the sense that they have never been promulgated since they were passed, and have, as it would seem, almost become forgotten. But a still stranger case has just been brought to light in Germany, where a joint decree, made on May 26th, 1914, was published for the first time in the middle of January of the current year. The decree, which is signed by the Prussian Minister for Trade and Industry, the Minister for Public Works, and the Minister for Internal Affairs, relates to the supply of electricity, but it is not connected with the scheme reported to be in prospect for the nationalisation of the supply industry. The object of the decree is to secure a greater measure of production for the public interests in regard to overland central stations, the establishment of which has not required the sanction of Parliament—but which has been merely subject to private agreements and the consent of officials representing the Government authorities. In future, however, certain restrictions are to be imposed, and the promoters of overland stations are only to obtain the right of expropriation, the use of Government ground property (waterways of first importance, domains, forests and railways), after the Government officials for the districts concerned have settled the requirements to be stipulated in the general public interest.

The decree points out, in the first place, that the requirements cannot be prescribed from a general standpoint, as the requisite experience is lacking, particularly as the conditions coming into consideration are so varied that it is impossible to deal with all cases in a uniform manner. Hitherto the right of expropriation has been made dependent upon the non-existence of a monopoly in the delivery of materials and plant for installations. In appropriate instances the undertakers have been placed under the obligation to furnish energy to everyone in their area of supply in so far as this could be effected without endangering the economy of the undertaking, and this condition will also be adhered to in the future. Efforts must be directed, the Government officials are instructed to secure that the supply of districts yet unprovided with electricity shall not be undertaken arbitrarily by one or another undertaker, but that it shall be proceeded with in the most economical manner. The appropriate supply of a district may be prejudiced for a long time by the erection of small works of limited capacity, whilst at the same time large and efficient works, if they supply only the more profitable parts of a great area, would also prejudice the equal treatment of favourable and unfavourable districts that is requisite for the systematic supply of the whole of the area. This can also take place in the case of municipal works extending their supply to parts of the outlying districts, for which a different supply under circumstances would be more suitable for the whole.

It is now proposed, as occasion may arise, to bring the influence of the State to bear in this direction in the case of existing works by only permitting them to make use of State lands according as the opportunity offers, when they give legal undertaking to the Government officials for the district not to exceed, without the consent of the latter, the line of demarcation representing the whole of their present area of supply. In the case of those works which possess the right of expropriation for a specified area without this undertaking being imposed, this measure will also apply in order to prevent them from supplying beyond their particular areas without the sanction of the Government officials. The proposed establishment of new works will be subject to inquiry as to whether their erection should be opposed or as to how the line of demarcation for them shall be drawn. Both in the case of existing works and of new stations the conditions can be imposed that neighbouring districts shall also be supplied even if they promise to yield a lower return. A further important object is to prevent the existing tendency for the development of private supply monopolies from further growing, which has also to be taken into consideration in fixing the line of demarcation, whilst efforts must be made to obtain a right of determining whether works which have been established by local authorities or with the substantial participation of such authorities, shall in future come under the control of private undertakings. The decree, which is apparently addressed to the Government officials in each district, further suggests the possibility of influencing the fixing of charges for supply in so far that the charges must be re-examined at certain intervals, and a reduction demanded as occasion may arise. These instructions are neither regarded as exhaustive nor are they to be considered without distinction in every case, the duty of the State, the decree concludes, being to keep the development on sound lines, but not to hamper it.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—Mr. J. DUGDALE, the Oldham Corporation tramways manager, has strained the ligaments of one of his legs while on a visit to Rotherham, and is laid up there.

Mr. D. LLOYD has resigned his position as engineer to the Abertillery U.D.C., he having received an appointment under Messrs. Partridge, Jones & Co.

Messrs. YOUNG and YELDHAM, of the Swansea Corporation electricity staff, have joined the Forces.

The Barnes U.D.C. has granted Mr. G. C. LAW, assistant electrical engineer at the electricity works, a gratuity of £50 for additional services rendered since the outbreak of the war to December 31st last.

Mr. WALTER F. LONG, the city electrical engineer at Cape Town (a position which he has occupied for nearly 14 years), has resigned in order to take up an appointment as general manager of the Cape Town Tramways Co. Mr. S. J. CLUNAS, who has been station engineer for some years, and has acted as deputy for Mr. Long during his absence, has been appointed acting city electrical engineer.

General.—Mr. R. G. BLAKE, a young electrical engineer, employed by Messrs. Deveraux & Moody, Newcastle, has been presented, on behalf of the Carnegie Hero Trust Fund, with a silver watch, and on behalf of the Royal Humane Society with a certificate on vellum, for having rescued a boy who was drowning in the Tyne.

Mr. D. H. MORRIS, Glasgow manager of Messrs. Lowdon Bros. & Co., has been given a commission in the R.N.V.R.

Mr. J. T. TAYLOR, late representative for Messrs. Pirelli, Ltd., has now joined the staff of the British Thomson-Houston Co., Ltd.

Second-Lieutenant A. R. COURTENAY (late acting-manager of the publication department, General Electric Co., Ltd.) has sailed for the Mediterranean. After about two months' active service in France with the R.N.A.S., Armoured Car Aeroplane Support (R.N.V.R.), he transferred to the Army Service Corps, and he is now a Second-Lieutenant in this Corps.

The Herbert Frood Co., Ltd., of Chapel-en-le-Frith, ask us to state that Mr. W. E. DIXON is not now in their service.

Mr. HAROLD BOUCHER, who has been acting as electrical engineer on one of H.M. Hospital Ships, has just returned from the Dardanelles, and been appointed electrical engineer to the Norman Flight Co., Bognor.

The *London Gazette* contains the following notice:—Territorial Force. London Electrical Engineers. The undermentioned to be Second-Lieutenants:—Sapper G. S. H. Cox; Private A. D. Hedgcock, from the H.A.C.; and Lance-Corporal G. A. Wadham, from Royal Fusiliers.

Mr. A. P. KELSEY, one of Messrs. Falk, Stadelmann & Co.'s country representatives, has joined the Royal Flying Corps.

Roll of Honour.—Private ARTHUR BOOTH, of the Ashton Territorials, who has been wounded in action, was an electrician employed by Messrs. Armstrong, Whitworth and Co., Manchester.

Private WM. ROYLE JENKINSON, of the 13th Cheshire Regiment (Wirral "Pals"), who has fallen in action in France, was, until his enlistment after the outbreak of war, engaged as an electrical engineer with Messrs. Lever Bros., Ltd., Port Sunlight.

Private ALBERT W. CAPELL, of the Rifle Brigade, who was, prior to his enlistment, on the staff of the British Thomson-Houston Co., Ltd., at Rugby, has been killed in action in France. He returned to the Front two days before Christmas after recovery from fever.

The death is reported, in action in France, of Private FRANK JONES, of the 1st Buffs (East Kent Regiment), formerly on the staff of the Isle of Thanet Tramways Co.

Mr. KENNETH GEIPEL, of Messrs. Wm. Geipel & Co., who has been serving in the Royal Engineers at the front in France, has been wounded, and is in hospital in this country.

Obituary.—MR. GEORGE TUCKER.—We regret to record the death, which occurred on Saturday last, at his residence in Lordship Road, Stoke Newington, of Mr. George N. G. Tucker, of the *Electrician* Printing & Publishing Co., Ltd. Mr. Tucker, who was in his 64th year, was associated with the *Electrician* in one capacity or another from 1878, the year in which the present paper first made its appearance, down to the time of his death. He became principal proprietor of the paper about ten years ago. Between the years 1878 and 1888 his interests naturally centred chiefly around submarine and land telegraphy. Mr. Tucker was responsible for the publication of "The Electrician" series of technical books, in which the researches and studies of many brilliant writers are contained, among such authorities being Heaviside, Ewing, Gore, Carter, Lodge, and Mrs. Ayrton. Mr. Tucker also founded the *Electrician* Electrical Trades Directory and Handbook (the Blue Book), and he took a personal interest in its production. He seldom missed the Electro-Harmonic concerts, even in recent years, and only failing health prevented his attendance up to the last.

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CAPTAIN COLTHURST VESEY.—The directors of the Dublin and Lucan Electric Railway have placed on record their deep regret at the death of Captain Colthurst Vesey, D.L., vice-chairman, who had been associated with the concern for 18 years. Captain Vesey was also a director of the Dublin United (Electric) Tramways Co.

MR. W. C. BLENKARNE.—We regret to record the death of Mr. W. C. Blenkarne, senior London traveller for Messrs. Falk, Stadelmann & Co., Ltd., who was well known in the lighting trade throughout London, more particularly in the Southern districts, where of late years he had represented the above firm. The deceased gentleman was for a long time interested in a London glass works, but he abandoned this on joining the staff of Falk, Stadelmann & Co., Ltd., in 1891, whom he represented until his death on the 12th inst. He had seen longer service with the firm than any other London traveller.

MR. R. C. FREWER.—The death has taken place, after an operation, of Mr. Robert Chas. Frewer, who had been on the staff of Siemens Bros. Dynamo Works Co., of Stafford, for 25 years. He was 48 years of age.

Wills.—The late Professor VIVIAN B. LEWES left £13,353.

SIR A. W. RUCKER'S estate amounted to £40,465.

NEW COMPANIES REGISTERED.

South Wales and West of England Wireless Training College, Ltd. (142,641).—This company was registered on January 6th, with a capital of £5,000 in £1 shares, to carry on a college or school for training and instruction in wireless telegraphy and telephony, and electrical and other engineering, and to adopt agreements (1) with the South Wales Wireless Training College, Ltd., and (2) with J. R. Schofield. The subscribers (with one share each) are: W. N. Jones, Dyffryn, Ammanford, colliery proprietor; D. Radcliffe, Pen-y-lan, Cardiff, shipowner. Private company. The number of directors is not to be less than two or more than seven; the subscribers are to appoint the first. Qualification, £250. Registered office: Market Buildings, St. Mary Street, Cardiff.

Parsons and Hodges, Ltd. (142,731).—This company was registered on January 15th, with a capital of £3,000 in £1 shares, to take over (1) the business of an electrical, mechanical and general engineer and contractor carried on by A. J. Hodges, at Regent Street, Leamington, in succession to W. Parsons & Co., Ltd., and (2) the similar business carried on by A. E. Mason, at 63, Parade, Leamington, as Receiver for the debenture-holders of Brown & Parsons (1913), Ltd. The subscribers (with one share each) are: W. Parsons, 63, Parade, Leamington Spa, electrical engineer; A. J. Hodges, 26, Strathearn Road, Leamington Spa, electrical engineer. Private company. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first. Solicitor: G. Williams, Bank Buildings, Cradley Heath. Registered office: 63, The Parade, Leamington, Warwick.

Atkinson, Lloyd and Co., Ltd. (142,724).—This company was registered on January 15th, with a capital of £500 in £1 shares, to carry on the business of electrical engineers, manufacturers, agents, and contractors. The subscribers (with one share each) are: J. E. Atkinson, 120, Moss Lane, Swinton, Manchester, electrical engineer; S. Lloyd, 28, Duchy Street, Seedley, Manchester, electrical engineer; R. F. Peacock, 26, Scarisbrick Road, Levenshulme, Manchester, electrical engineer. Private company. The number of directors is not to be more than three; the first are J. E. Atkinson, S. Lloyd, and R. F. Peacock. Solicitor: W. I. Hawken, 71, Market Street, Manchester.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Burt, Escare and Denelle, Ltd.—Particulars of £7,500 debentures, created December 22nd, 1915, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's property, present and future, including uncalled capital (if any). No trustees.

A memorandum of satisfaction in full on December 30th, 1915, of debenture stock dated April 14th, 1911, securing £3,900, has been filed.

Coatbridge and Airdrie Electric Supply Co., Ltd.—Further charge on the Coatbridge and Airdrie undertakings and the company's undertaking and property, present and future, including uncalled capital, and benefit of certain agreements, contracts, etc., dated December 30th, 1915 (supplemental to charge dated October 17th, 1906), to secure £4,600. Holders: County of London Electric Supply Co., Ltd., Moorgate Court, Moorgate Place, E.C.

David Anderson and Co., Ltd.—Particulars of £5,500 debentures, created July 21st, 1915, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £100. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Issue on December 17th, 1915, of £3,200 debentures, part of a series of which particulars have already been filed.

Ellis and Ward, Ltd. (107,215).—Capital, £10,000 in £1 shares. Return dated September 28th, 1915. 6,703 shares taken up; £703 paid; £6,000 considered as paid. Mortgages and charges: Nil.

Credenda Conduits Co., Ltd. (126,340).—Capital, £50,000 in £1 shares. Return dated July 7th (filed November 18th), 1915. All shares taken up; £30,000 paid; £20,000 considered as paid. Mortgages and charges: Nil.

Hong-Kong Tramway Co., Ltd.—A memorandum of satisfaction to the extent of £300 on October 26th, 1914, of trust deed dated July 1st, 1903, securing £105,000, has been filed.

Electric Reduction Co., Ltd. (54,724).—Capital, £50,000 in £1 shares (16,200 pref. and 33,800 ord.). Return dated December 7th, 1915. 16,200 pref. and 28,800 ord. shares taken up; £1 per share called up on 13,000 pref. and 5,000 ord.; £18,000 paid; £27,000 considered as paid on 3,200 pref. and 23,800 ord. shares. Mortgages and charges: £25,000.

M. & G. Truck and Engineering Co., Ltd.—Particulars of £1,500 debentures, created January 5th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £1,400. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Resisto-Electrical Manufacturing Co., Ltd.—Issue, on October 11th, 1915, of £900 debentures, part of a series of which particulars have already been filed.

Monte Video Telephone Co., Ltd. (27,208).—Capital, £160,000 in £1 shares (87,000 pref.). Return dated November 10th, 1915. 86,492 pref. and 72,680 ord. shares taken up; £159,172 considered as paid. Mortgages and charges: Nil.

Newtons, Ltd. (48,936).—Capital, £40,000 in £10 shares. Return dated October 5th, 1915. 3,265 shares taken up; £18,650 paid; £14,000 considered as paid. Mortgages and charges: £14,000.

Pirelli, Ltd. (103,068).—Capital, £8,000 in £5 shares. Return dated September 13th, 1915. £8,000 paid. Mortgages and charges: Nil.

Cape Electric Tramways, Ltd. (54,636). — Capital, £500,000 in £1 shares. Return dated November 24th, 1915. 491,222 shares taken up; £91,222 paid; £400,000 considered as paid. Mortgages and charges: £391,300.

Frederick Braby and Co., Ltd.—Capital, £400,000 in £10 shares (2,500 pref.). Return dated September 2nd, 1915. 27,500 ord. and 2,500 pref. shares taken up; £10 per share called up on 24,250 ord., £6 per share on 3,250 ord. and £10 per share on 2,500 pref.; £287,020 paid (including £20 paid on 5 shares forfeited); £13,000 considered as paid, being £4 per share on 3,250 shares. Mortgages and charges: £55,000.

General Accessories Co., Ltd. (104,464).—Capital, £3,000 in £1 shares (1,580 six per cent. pref., 920 five per cent. pref., and 500 ord.). Return dated August 10th (filed December 10th), 1915. All shares taken up; £1,580 paid; £1,420 considered as paid. Mortgages and charges: Nil.

Ruthin Electric Supply Co., Ltd. (138,021).—Capital, £5,000 in 400 pref. of £5 each and 1,000 pref. ord. and 2,000 ord. shares of £1 each. Return dated December 9th, 1915. 126 pref., 673 pref. ord., and 1,110 ord. shares taken up; £2,388 paid, leaving £25 in arrears. Mortgages and charges: Nil.

Railway Finance and Construction Co., Ltd. (72,015).—Capital, £100,000 in £1 shares. Return dated November 12th, 1915. 92,292 shares taken up; £1 per share called up on 657 and 4s. per share on 29,595 shares; £6,576 paid; £85,716 considered as paid, being £1 per share on 62,040 shares and 16s. per share on 29,595 shares. Mortgages and charges: Nil.

Electro Flex Steel Co., Ltd.—Issue on December 30th, 1915, of £4,000 debentures, part of a series of which particulars have already been filed.

Lamplough and Son, Ltd.—Memoranda of satisfaction in full on December 16th, 1915, of two debentures and a mortgage created by the receiver, and dated June 17th and January 4th, 1913, and May 14th, 1914, securing £500, £700, and £1,500 respectively, have been filed.

CITY NOTES.

French Electrical Companies.

The *Compagnie d'Electricité de l'Est Parisien* (*Est Lumière*), which has a share capital of £400,000, reports net profits and balance forward amounting to £55,000 for 1914-15, which has been transferred to the special reserve fund. No dividend was paid either in 1913-14, when the net profits of £39,000 were carried forward.

The *Compagnie Electrique de la Loire et du Centre*, which reports a large reduction in the gross profits in 1914-15, records net profits of £59,000, as contrasted with £95,000 in 1913-14, which sum was carried forward. These two amounts permit of the payment of a dividend of 6 per cent., and the appropriation of £90,000 for the general reserve fund for redemption.

The *Compagnie d'Electricité de l'Ouest Parisien* (*Ouest Lumière*) reports a great decline in the receipts in 1914-15, the profits being £65,000, as against £124,000 in 1913-14. Including the balance brought forward from the previous year, the net surplus available amounts to £107,000, which permits of the payment of a dividend of 6 per cent., as contrasted with no distribution in 1913-14.

The working results of the *Société d'Electricité de Paris* have been seriously affected through the war. According to the accounts for the year ended with June 30th, 1915, the gross profits amounted to £158,000, as compared with £275,000 in the previous year. By reducing the sum usually set aside for depreciation and renewals, the net profits have only declined from £105,000 in 1913-14 to £91,000 last year, the dividend being fixed at 16s. per share.

The report of the *Compagnie Générale d'Electricité, of Paris*, for the year ended with June 30th, 1915, states that the net profits amounted to £124,000, as compared with £148,000 in the previous year, when any distribution of profits was postponed. It is now proposed to pay a dividend at the rate of £1 per share for each year, to place £160,000 to a special reserve fund for current risks, and to carry forward the sum of £32,000. The allocation of this large sum to the reserve fund is explained by the statement that the company's liquid funds are scanty, whilst the great fluctuations in prices in the metal market may give rise to unexpected demands. The payment of the dividends is deferred for the present owing to the funds being provisionally tied up.

The *Société Industrielle des Téléphones, of Paris*, whose manufactures are in special request in connection with the work of national defence, reports that although the State is now the principal customer, private firms continued to place orders fairly regularly in 1914-15. Out of the six works, of which five are in the vicinity of Paris, only that at Calais suffered from the prevailing circumstances, as it had to be closed, and was occupied at present by the Belgian Army. The Calais works, which produces submarine cables, would have experienced the results of a lack of work even if events had not induced the directors to shut down. The net profits are returned at £69,000, as compared with £71,000 in 1913-14,

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the reduction being due to the allocation of £14,000 to the needs of the workmen who have been mobilised. It is intended to pay a dividend of 12s. per share, as against 9s. 7d. per share in 1913-14, the former rate reaching the level of that prevailing prior to the war.

The *Société d'Applications Industrielles, of Paris*, which is an investment company in which are interested the Swiss Bank Verein and the Swiss Motor Co. for Applied Electricity, proposes to carry forward the net profits of £4,000 realised in 1914-15, as in 1913-14, when the net profits reached £32,000. In explanation of this intention, the directors state that two subsidiary undertakings—the Energie Electrique du Nord and the Est Electrique—are situated in the districts occupied by the enemy, and no accounts were therefore available. Many other companies with which the Trust is also financially concerned had either reduced or omitted the payment of dividends under the existing conditions in order to keep their resources liquid for any eventuality. In addition, the cost of producing electrical energy, particularly in the case of steam power stations, had greatly increased in consequence of the dearness of coal, whilst the receipts of individual companies, which in normal years rose by 15 per cent., had fallen by that percentage in the past year.

Transport Companies in Berlin.

It appears that the traffic receipts of the electric tramways and the elevated and underground railway in Berlin have recently so much improved that it is claimed that these two undertakings have now recovered from the unfavourable influence of the war. Although information is not available concerning the working expenses, figures which have been published in that city show that the gross receipts of the Berlin Grand Tramways Co. amounted to £2,102,000 in 1915, or £57,000 more than in 1914, but £121,000 less than in 1913. The gross receipts of the Berlin Elevated and Underground Railway Co. were £452,000, or £52,000 less than in 1914 and £16,000 less than in 1913. On the other hand, the Berlin General Omnibus Co., whose horses and motor 'buses were requisitioned very largely by the Army authorities, reports receipts of £362,000 in 1915, this total being less by £221,000 than in 1914, and less by £301,000 than in the previous year. Since last August the returns issued monthly by the tramway company have shown that the large decreases which commenced on the outbreak of the war have been regularly reduced. In fact, the receipts in August, September, October, and November reached the level of those which obtained in the corresponding months in the peace year of 1913. At the same time, the diminution in the receipts during the war, which attained the maximum of £33,000 in September, 1914, must not be ascribed exclusively to the war, as the tramway company's receipts began to decline slightly in September, 1913, on the opening to traffic of the Schonhauser section of the overhead and underground railway. The diversion of traffic by the latter, however, seems to have now ascended to its maximum position, and any further appropriation of traffic seems out of the question in the near future. In a similar way the electric railway company appears to have surmounted the difficulties created by the war. Although the company's receipts in the last months of 1915 were on the average 16 per cent. less than in the equivalent months in 1913, the receipts since September have regularly advanced as compared with the corresponding months in 1914, and the total decrease of £52,000 in 1915 as against 1914 is attributed exclusively to the working results in the first seven months of the year. The recovery of both undertakings, as will be understood from the great reduction in the traffic of the omnibus company, has been effected at the expense of the latter, although this is immaterial financially, as the tramway company and the railway company each hold one-third of the ordinary shares in the omnibus undertaking. It is, however, questionable whether the latter, even if its full complement of horses and motor 'buses had been available, would have endeavoured to cultivate traffic under the existing conditions incidental to the higher cost of maintenance due to the great cost of fodder and benzine on the one hand, and the low fares on the other, which would probably have resulted in insignificant profits after provision had been made for depreciation.

German Electrical Companies.

The *A.G. für Gas und Elektrizitats, of Cologne*, whose expectations as to a progressive improvement in the situation of the undertaking have been unfulfilled through the war, will be unable to pay any dividend for 1915, as was also the case in the previous year.

The *Elektro-Osmose, A.G., of Berlin and Frankfort*, reports that the development of the undertaking in 1914-15 was greatly hampered through the war, and the carrying out of a number of installations had, therefore, to be postponed. On the other hand, considerable progress was made in the technical scientific work. As a result of the year's operations a loss of £14,000 was incurred, thus increasing the debit balance to £44,000 on a share capital of £150,000.

The financial statement of the *Kontinental Telegraphen Compagnie, of Berlin*, for 1914-15, indicates a loss of £3,400 on the telegraph business, as compared with profits of £2,500 in the previous year, but the income from investments was £3,500, as against £3,600. Including the balance brought forward, the accounts show net profits of £250, as contrasted with £6,200, and no dividend is in contemplation, whereas a rate of 11½ per cent. was paid for 1913-14.

The *A.G. für Stickstoffdunger, of Knapsack*, reports that operations were practically at a standstill in the first months of the war, and it was only towards the end of 1914 that it was possible gradually to bring the plant into full working with the exception of the ammonia factory. The large demand for nitrogen then rendered it possible fully to utilise the installations. As a result of the rupture of the contract on the part of the English, French, and Italian constituents, the Berlin Sales Bureau for Nitrogenous Fertilisers was dissolved, and the International Carbide Syndicate had also collapsed. The net profits realised by the Knapsack company in the year ended with June, 1915, amounted to £35,000, as contrasted with £25,000, and a dividend of 10 per cent. is recommended on the share capital of £150,000, which has now been increased to £400,000, as compared with 6 per cent. in 1913-14.

The directors of *Siemens Elektrische Betriebe, A.G., of Berlin*, reporting on the year ended September 30th, 1915, state that although the war exercised an unfavourable influence on the various supply works owned and leased by the company, the value of the total connections increased by over 10 per cent., and the receipts by about 7 per cent. In peace times, however, the augmentation would have been considerably greater than was represented by these percentages. On the other hand, the working expenses largely advanced owing to the dearness of coal and materials and higher wages. After appropriating £28,000 for depreciation, as compared with £24,000 in 1913-14, and placing £15,000 to the renewal fund, as against £13,000, the net profits are returned at £83,000, as contrasted with £75,000 in 1913-14. It is proposed to pay a dividend of 5 per cent., as compared with 6½ per cent. in the previous year, the participating ordinary share capital of £1,500,000 being greater than in 1913-14.

The *A.G. für Elektrizitats Anlagen, of Berlin*, which owns a number of electricity works and also controls the share capital of various supply companies, reports that the company's interests were not unaffected through the war. The heavy decline in the consumption of current in connection with the German works, which occurred in the initial months of the war, was subsequently followed by a great recovery, with the final result that at the close of the year 1914-15 the receipts in the case of some of the works exceeded those in the previous year. At the same time, the expenses increased everywhere owing to the advance in the cost of materials and of wages, and through the allowances granted to the families of the employés who were called to the Army. No definite information had been received for some time past in regard to the Russian interests—the Imatra Co. for the Production and Distribution of Electrical Energy, of Brussels, and the Moscow Electric Power Transmission Co. The accounts exhibit net profits of £45,000, as in 1913-14, and a dividend of 8 per cent. is proposed, as in the previous year.

Swiss Electrical Companies.

The working of the *Compagnie de l'Industrie Electrique et Mécanique, of Geneva*, was prejudicially affected in 1914-15 through the war and the general mobilisation. It is stated that the year's trading resulted in a loss, as was also the case in the preceding twelve months.

The *Watt, A.G. für Elektrische Unternehmungen, of Glarus*, which company is associated with the Zurich Bank for Electrical Undertakings, is interested in two Swiss electricity works and the Spanish Electricity Co., of Seville. Including the balance brought forward, the accounts for 1914-15 exhibit net profits amounting to £18,000, as compared with £26,000 in the previous year, and a dividend of 5 per cent. has been declared on the ordinary paid-up capital of £280,000, as contrasted with 6½ per cent. in 1913-14.

The report of the *Elektrizitats Werk Lonza, of Basle*, states that the situation in 1914-15 developed beyond expectation, and the works were again set in operation after a temporary interruption in the early months of the war and were now fully occupied. An increase took place in the turnover in calcium carbide and in ferro-silicon, and in other iron alloys, and the artificial silicon-carbide and abrasite were also in demand. The market for cyanamide was specially animated owing to the scarcity of Chilean nitrate. After overcoming the difficulties caused through the war, the company at Waldshart was able to start working. The other undertakings in which the Lonza Co. is also financially interested suffered from the effects of the war at first, but an improvement subsequently took place. The accounts of the Lonza Co. indicate gross profits of £91,000, as contrasted with £80,000 in 1913-14, and net profits of £48,000, as against £42,000. It is intended to pay a dividend of 6 per cent. on the ordinary share capital of £180,000, as compared with 5 per cent. in 1913-14.

The *Columbus, A.G. für Elektrische Unternehmungen, of Glarus*, which is a financial company belonging to the Brown-Boveri group, and which controls the majority of the shares in the Compania Ítalo-Argentina de Electricidad, of Buenos

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Aires, and the central stations at Dolores, Corrientes, and Pergamino, states that the war delayed the delivery of materials and caused difficulties in the sea transport, so that the extensions at the stations at Buenos Aires were retarded. The plant first completed there was of 18,000 KW., and the contracts concluded by the end of June, 1915, represented 15,000 KW., apart from the supply of energy to 2,000 public arc lamps. In addition, a contract had been entered into with the State for supply to the harbour works. The other three stations mentioned were also in course of satisfactory development. The accounts show gross profits of £59,000 for 1914-15, as compared with £8,000 in 1913-14, and net profits of £46,000, as against £5,700, and a dividend of 5 per cent. has been declared on the ordinary paid-up capital of £680,000, this rate contrasting with no distribution in 1913-14, which was the first complete business year.

Yorkshire (West Riding) Electric Tramways Co., Ltd.—The report for the year to December 31st, which is to be submitted at the annual meeting to-day, states that, after providing for all expenses, including repairs, maintenance, and debenture interest, the net balance is £29,310, plus £10,725 brought forward, making £40,035. A dividend of 6 per cent. per annum, less tax, on cumulative preference shares absorbs £12,028, and there is to be placed to depreciation, renewals, reserve fund in lieu of accident insurance, general reserve, etc., £12,962, carrying forward £15,045.

Western Union Telegraph Co.—The directors announce that the earnings report for the year ended December 31st last show revenue and income $52,356,286; expenses, including maintenance and reserve, $40,802,317; interest on bonds $1,335,588; net income, $10,218,381. The figures for the corresponding period in 1914 showed a net income of $5,371,395.—*Financial Times.*

East London Railway Co.—The number of passengers carried during 1915 was 8,497,284, against 6,172,121 in 1914.

Electrical Utilities Corporation, Ltd.—A quarterly dividend of 1¼ per cent. on the preferred stock has been declared for the quarter ended December 31st.

Brazilian Traction, Light and Power Co., Ltd.—The directors announce a dividend of 1 per cent. on the issued ordinary capital stock.

Sao Paulo Tramway, Light and Power Co., Ltd.—The directors have declared a dividend of 2½ per cent. on the issued common stock.

Montreal Light, Heat and Power Co., Ltd.—The directors have declared a dividend of 2½ per cent. for the quarter ending January 31st.

Rio de Janeiro Tramway, Light and Power Co., Ltd.—The directors announce a dividend of 1¼ per cent. on the capital stock.

STOCKS AND SHARES.

TUESDAY EVENING.

Cheerfulness is the prevailing note in the Stock Exchange markets. There is a fair amount of business doing in most of the "live" sections; while in that for rubber shares, although the activity received a sharp check towards the end of last week, in consequence of a break in the price of the raw material, a recovery in the latter has given a gentle stimulus to fresh orders, and the share market is recovering again. More trade is passing, too, in Home Railway stocks, the nearness of the dividend declarations importing fresh interest. The news from Central and South America is not conducive to better prices in the securities connected with the various countries concerned.

The Home Railway revival started with improvement in some of the preferred stocks of the leading companies. As soon as buyers came in, it was obvious that proprietors of stock were by no means anxious to part with their holdings; and it required very little demand to hoist prices materially. The Underground issues have shared slightly in this better feeling throughout the market; but so far as "Mets." and Districts are concerned, both stocks are, of course, more or less speculative, and therefore swayed by the tendency which prevails in the Stock Exchange as a whole, rather than by rises in such sober-sided stocks as North-Westerns and the like. Underground Electrics are keeping steady, the income bonds and the "A" shares receiving most attention at the present time. As regards the £10 shares, the demand has slanted off to a noticeable extent; and less is heard now of the hopes current a fortnight ago as to the possible payment of a dividend on the shares before long. However, the pooling arrangement between the various Tube companies will soon be coming into operation, and expectation runs high of the savings, and the increased revenue, that they should bring in their train.

The District Railway, by the way, has found it necessary to overhaul its generous concessions to season-ticket holders, whereby it accepted a season ticket on deposit and added the full time to the next renewal of the ticket—an excellent arrangement from the holder's point of view, when he went away for summer or other holidays. Difficulties in the working of the system and the many abuses that have arisen are adduced by the company as the reasons for modifying the concession to the extent of making it obligatory upon the holder to deposit his ticket for a minimum period of 28 days, in respect of which he will be allowed 14 days on the next renewal taken up. This regulation is also to apply to season tickets between the District and its associated companies—namely, the London Electric, City & South London, Central London, Metropolitan and East London Railways.

The East London Railway report shows that 8¼ million passengers were carried last year, an increase of 2,320,000 over 1914. The meeting will be held next Tuesday, January 25th. Bargains have been done in the ordinary stock this week at 3¾ and 3⅞.

News from Mexico is less indefinite, but less favourable, than had been hoped. Huerta, the strong man, is dead. He was looked upon as a useful second string if the Carranza *régime* were overthrown, either by diplomatic or military exigencies; indeed, many people in this country thought that Huerta would make a better President for the stormy State than Carranza. Various other generals are said to have relinquished this life in more or less summary fashion, and it seems as though conditions were once more drifting towards mere chaos. Therefore, Mexicans of all kinds are dull and depressed. Certain of the industrial bonds that were saleable are no longer so; and although the falls are comparatively small in the securities quoted overleaf, the present situation is that there are practically no buyers.

Brazil Tractions fell to 50, on a drop in the Brazilian exchange to 11⅛d.; but the price recovered 1⅛, leaving it ⅛ better on the week, thanks to the declaration of a dividend of 1 per cent. on the common shares. This was just 1 per cent. more than some of the pessimists had prophesied; but so long as the exchange question is so unsatisfactory, these apprehensions are bound to recur every quarter when the time for the dividend declaration draws near.

There is a little interest being taken in Canadian industrials, including those of the various power companies that are known to be engaged in munition work; and an unusually hopeful speech from the Chairman of the Bank of Montreal at last week's meeting has been of assistance to Dominion securities as a whole—more particularly those of the railroad and industrial concerns.

Anglo-Argentine Tramways are decidedly hard, and the First preference shares rose ⅛, possibly in sympathy with the strong efforts being made by American interests to acquire a controlling hand in Argentine railway companies. British Columbia preference is ex the dividend of 2½ points, but there is not much doing in the stocks of the company.

The intention of the Swiss Government to transform all its federal railways into an electrified system has been a matter of considerable comment. The estimated cost is put at twenty million pounds sterling—an amount which, before the European war educated us to think in millions, would have been regarded as an exceedingly large sum to raise. It is a matter for mild curiosity where the Swiss Government is going to get its money; because, unless it has a very substantial chest in reserve, it will have to go to the Western hemisphere, since the British Government is scarcely likely to permit investors in this country to use their money for such a project as that mentioned.

Falls of ¼ in Chelsea and in Metropolitan preference are the only changes in the list of home electricity shares. County of London keep steadily about 10, at which price, and a little over, there are buyers, whom holders are not anxious to supply, having regard to the proximity of the dividend announcement and the probability that it will be a satisfactory one. British Westinghouse preference keep very firm at their advanced price of 45s., and small improvements have taken place in both classes of Electric Construction shares.

The Telegraph market continues to attract investors, whose principal difficulty it is to secure the shares for which they have a fancy. Eastern Extensions, unchanged in price, are ex their dividend of 2s. 6d.; while Eastern Telegraph ordinary, also ex dividend, shows an actual rise of ¾. The latter is now on the same plane as Western Telegraph shares, which have risen to 12¾. Marconis are a better market, the parent shares improving in consequence of sharp rises in American Marconis and Canadians. The United States has been buying American Marconis freely, with the result that the price is up to 18s. 6d.; while Canadians have been bought with them, and, from 5s., went to 7s. 6d. in the course of a few days. Telegraph Constructions and India-Rubber shares both have rises of 10s. to their credit. Henleys for some time past have been difficult to pick up at all, but there has been rather more supply just lately; though when these shares are taken it will probably be as difficult as ever to get others.

Rubber slid from 4s. 3d. per lb. to 3s. 6d. per lb. in about a week, the drop unsettling the nerves of speculative investors who had been buying so freely while the raw material was on the rise. Business was brought to an abrupt halt, and there was a general turn round in prices. On rubber picking up a little, confidence followed suit; but there is nothing like the volume of trade being done that characterised the market a week or ten days ago. The iron and steel shares are mostly firm. Castner-Kellners at 3⅛ are the fraction to the good. The armament market is also harder. In fact, the industrial departments all round show noteworthy strength.

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SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Jan. 18, 1916.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.				
Brompton Ordinary	10	7½	—	£6 18 4
do. 7 per cent. Pref.	7	7	—	5 0 0
Charing Cross Ordinary	5	3½	—	7 2 10
do. do. do. 4½ Pref.	4½	8½	—	6 0 0
do. do. City Pref.	4½	3 xd	—	7 10 0
do. 4 Deb.	4	7⅓	—	5 2 7
Chelsea	5	4	— ¼	6 5 0
do. 4½ Deb.	4½	87	—	5 3 6
City of London	9	12½	—	7 7 8
do. do. 6 per cent. Pref.	6	11	—	5 9 1
do. do. 5 Deb.	5	98 xd	—	5 2 0
do. do. 4½ Deb.	4½	85 xd	—	5 6 0
County of London	7	10	—	7 0
do. do. 6 per cent. Pref.	6	10½	—	5 17 8
do. do. 1st Deb.	4½	85 xd	—	5 5 0
do. do. 2nd Deb.	4½	88	—	5 8 0
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	1⅜	—	8 8 4
do. do. 6 per cent. Pref.	6	4½	—	7 1 2
do. do. 4 Deb.	4	75	—	5 4 0
Metropolitan	8½	2½	—	7 15 7
do. 4½ per cent. Pref.	4½	8	— ¼	7 10 0
do. 4½ Deb.	4½	85	—	5 6 0
do. 5½ Deb.	5½	70	—	5 0 0
St. James' and Pall Mall	10	6	—	8 6 8
do. do. do. 7 per cent. Pref.	7	6	—	5 16 8
do. do. do. 5½ Deb.	5½	70 xd	—	5 0 0
South London	6	2⅜	—	7 5 6
South Metropolitan Pref.	7	1 7/16	—	6 14 0
Westminster Ordinary	9	6	—	7 10 0
do. 4½ Pref.	4½	4	—	5 12 6
TELEGRAPHS AND TELEPHONES.				
Anglo-Am. Tel. Pref.	6	99½ xd	—	6 1 0
do. Def.	88/6	21⅛	—	7 15 9
Chile Telephone	5	6⅛	—	6 3 0
Cuba Sub. Ord.	5	5	—	6 5 0
do. Pref.	10	15	—	6 18 4
Eastern Extension	7	12½ xd	+ ½	*6 8 0
do. 4 Deb.	4	80	—	5 0 0
Eastern Tel. Ord.	7	127½ xd	+ ¾	*6 5 0
do. 8½ Pref.	8½	66	—	5 6 0
do. 4 Deb.	4	81	—	4 19 0
Globe Tel. and T. Ord.	6	10⅜	—	*6 12 2
do. Pref.	6	10½	—	5 17 1
Gt. Northern Tel.	22	88⅛	+ ½	6 11 4
Indo-European	18	49	+1	6 15 4
Marconi	5	1 1/16	+ 1/16	5 3 1
New York Tel. 4½	4½	100	—	4 9 1
Oriental Telephone Ord.	10	17	—	5 6 8
do. Pref.	6	8	—	6 17 2
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	8	6	—	*7 12 5
do. Pref.	5	4⅜	—	5 8 1
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	12⅜	+ ½	*6 5 0
do. 4 Deb.	4	79 xd	—	5 1 0
HOME RAILS.				
Central London, Ord. Assented	4	70	—	5 14 4
Metropolitan	1¾	25½	—	4 18 0
do. District	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	1⅛	— 1/16	Nil
do. do. "A"	Nil	6/6	—	Nil
do. do. Income	6	82	+ ½	*8 7 3
FOREIGN TRAMS, &c.				
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
do. 5 Deb.	5	95	—	5 5 0
Anglo-Arg. Trams, First Pref.	5½	4⅛	+ ⅛	6 18 6
do. 2nd Pref.	5½	8⅜	—	8 3 0
do. 4 Deb.	4	71⅛	—	5 12 0
do. 4½ Deb.	4½	77	—	5 17 0
do. 5 Deb.	5	80⅛	—	6 4 0
Brazil Tractions	8½	51⅛	+ ½	6 16 0
Bombay Electric Pref.	6	10½	—	5 17 1
do. 4½ Deb.	4½	85	—	5 3 0
British Columbia Elec. Rly. Pfce.	5	59 xd	—	8 9 6
do. do. Preferred	—	40	—	Nil
do. do. Deferred	—	35	—	Nil
do. do. Deb.	4½	64	—	6 12 10
Mexico Trams	Nil	39	—1	Nil
do. 5 per cent. Bonds	—	47	—2	Nil
do. 6 per cent. Bonds	—	40	—3	Nil
Mexican Light Common	Nil	29	—	Nil
do. Pref.	Nil	18	—2	Nil
do. 1st Bonds	—	47	—	—
MANUFACTURING COMPANIES.				
Babcock & Wilcox	14	2 7/16	—	5 15 0
British Aluminium Ord.	5	22/6	—	4 9 0
do. Pref.	6	18/-	—	6 13 4
British Insulated Ord.	15	10½	—	7 2 10
do. Pref.	6	5½	—	5 11 7
British Westinghouse Pref.	7⅛	45/-	—	6 13 4
do. 4 Deb.	4	69	—	5 14 10
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	11½	—	6 13 4
do. 5 Pref.	5	4½	—	5 17 8
do. 4½ Deb.	4½	90	—	5 0 0
Castner-Kellner	20	2½	+ ⅛	6 8 0
Edison & Swan, £8 pd.	Nil	8/6	—6d.	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	60	—	6 13 4
do. do. 5% Deb.	5	60	—	8 6 8
Electric Construction	6	14/6	+6d.	8 5 6
do. do. Pref.	7	1	+3d.	7 0 0
Gen. Elec. Pref.	6	9½	—	6 8 1
Henley	20	18½	—	*8 12 6
do. 4½ Pref.	4½	4½	—	5 6 0
do. 4½ Deb.	4½	92	—	4 17 9
India-Rubber	10	9½	+ ½	*12 19 0
Telegraph Con.	20	35	+ ½	*7 16 6

*Allowance made for dividends being paid free of income-tax.

Copper.—The largest purchase of copper ever made has recently been negotiated by the British Government in America. According to New York papers, the contract is for 135,000,000 lb. of the metal.—*Times.*

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, January 19th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	..	..
a ,, Nitric	,,	..	..
a ,, Oxalic	per lb.	1/4	2d. inc.
a ,, Sulphuric	per cwt.	..	..
a Ammoniac Sal	,,	..	..
a Ammonia, Muriate (large crystal)	per ton	£50	..
a Bleaching powder	,,	..	..
a Bisulphide of Carbon	,,	£28	..
a Borax	,,	£25	..
a Copper Sulphate	,,	£15	..
a Lead, Nitrate	,,	..	..
a ,, White Sugar	,,	..	..
a ,, Peroxide	,,	..	..
a Methylated Spirit	per gal.	..	..
a Potassium, Bichromate, in casks	per lb.	..	..
a Potash, Caustic (88/90 %)	per ton	..	..
a ,, Chlorate	per lb.	1/8	3d. inc.
a ,, Perchlorate	,,	1/6	..
a Potassium, Cyanide (98/100 %) (for mining purposes only)	,,	Nom.	..
a Shellac	per cwt.	75/-	10/- inc.
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	,,	£11 10	..
a ,, Recovered	,,	..	..
a ,, Lump	,,	£8 10	..
a Soda, Caustic (white 76/77 %)	,,	..	..
a ,, Chlorate	per lb.	1/4½	..
a ,, Crystals	per ton	60/-	..
a Sodium Bichromate, casks	per lb.	8½d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	..	..
b ,, Wire, in ton lots (1 to 14 S.W.G.)	,,	..	..
b ,, Sheet, in ton lots	,,	..	..
c Babbitt's metal ingots	,,	..	..
c Brass (rolled metal 2" to 12" basis)	per lb.	1/2⅜ to 1/2⅝	½d. inc.
c ,, Tubes (solid drawn)	,,	1/3½ to 1/3⅝	½d. inc.
c ,, Wire, basis	,,	1/2⅜ to 1/2½	½d. inc.
c Copper Tubes (solid drawn)	,,	1/3⅜ to 1/4	½d. inc.
d ,, Bars (best selected)	per ton	£125	£6 inc.
d ,, Sheet	,,	£125	£6 inc.
d ,, Rod	,,	£125	£6 inc.
d ,, (Electrolytic) Bars	,,	£117	£8 10 inc.
d ,, ,, Sheets	,,	£185	£8 10 inc.
d ,, ,, Rods	,,	£124	£8 10 inc.
d ,, ,, H.C. Wire	per lb.	1/2½	½d. inc.
e Ebonite Rod	,,	3/-	..
f ,, Sheet	,,	2/6	..
g German Silver Wire	,,	1 10	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	3/6½	6½d. dec.
i Iron Pig (Cleveland warrants)	per ton	79/-	..
i ,, Wire, galv. No. 8, P.O. qual.	,,	£30	£2 inc.
g Lead, English Pig	,,	£31	15/- dec.
g Mercury	per bot.	£16 15	..
c Mica (in original cases) small	per lb.	6d. to 8/-	..
c ,, ,, medium	,,	8/6 to 6/-	..
c ,, ,, large	,,	7/6 to 14/- & up.	..
c Nickel, sheet, wire, &c.	,,	Nom.	..
j Phosphor Bronze, plain castings	,,	..	..
j ,, ,, rolled bars & rods	,,	..	..
j ,, ,, rolled strip & sheet	,,	..	..
c Platinum	per oz.	210/-	..
d Silicium Bronze Wire	per lb.	1/3	..
r Steel, Magnet, in bars	per ton	£85	..
g Tin, Block (English)	,,	£176 to £177	£2 inc.
a ,, Wire, Nos. 1 to 16	per lb.	2/8	..
j White Anti-friction Metals	per ton	..	..
k Zinc, Sh's (Vieille Montagne bnd.)	,,	Nom.	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m P. Ormiston & Sons.
n Johnson, Matthey & Co., Ltd.
o
r W. F. Dennis & Co.

Coal Prices and Charges to Electricity Consumers.

—In the House of Commons, Mr. Will Thorne asked the President of the Board of Trade whether he was aware that the metropolitan borough of Islington had sent a circular to its electricity consumers, stating that in consequence of an advance of nearly 70 per cent. in coal prices the Council was compelled to increase the price of electricity commencing with the March quarter, and whether, seeing that the expectancy that charges for coal would be materially increased had not been realised, he would take further action in the matter. Mr. Pretyman, in reply, said he understood that the Borough Council of Islington had sent out such a circular. The electric lighting order under which the Council supplied electricity fixed the maximum charges which might be made to consumers. Electric lighting undertakers were acting within their statutory powers in varying their prices so long as the prescribed maximum was not exceeded. He presumed that the pit-mouth price of the coal the Council was buying complied with the provisions of the Price of Coal (Limitation) Act.

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MUNICIPAL ELECTRICITY SUPPLY AT JOHANNESBURG.

By R. TURNBULL MAWDESLEY.

The vicissitudes of the municipal power plant at Johannesburg—from its inception in the pre-war days, down to the period of the gas engines whose absolute fiasco is still a green memory—need not be more than touched upon in this article.

In the early days, Johannesburg achieved an unenviable notoriety in the electrical world, for unreliability in its electric supply, which has taken some years to live down. This particular region of South Africa was then often very dark indeed. The lay Press used to wax mildly satirical on the subject of the trustworthiness of electric lighting and power; there were published rude caricatures of tramcars left forlorn upon the tracks, showing weeds growing up in abundance, between the track setts. In fact, ridicule was poured upon the scheme by all and sundry; and it is on record that ancient horse-drawn cabs used to follow cars bound for distant suburbs, secure in the knowledge that such cars would never reach their destinations.

In the days of the gas engines, it was no unknown thing for 20 or 30 natives to be "gassed" in one day; and old hands tell tales of the remarkable antics of white men, fresh from home, who, in some manner transcending the bounds of natural knowledge, became imbued with the indecorous spirit of the gas-engine room and behaved shamefully. One hears, too, of the seizure of "big-ends," and the indiscriminate scattering of white metal—what time the operating staff was outside in the fresh air, seeking recovery from the effects of the noxious fumes.

All that has been changed. Since the gas engines were scrapped, the municipal power station has gradually come into its own; and it is slowly but surely assuming its proper place in a town of the size and commercial importance of Johannesburg.

Johannesburg is situated on the southern slope of the Witwatersrand Range, and is about 6,000 ft. above sea level. Its population varies a great deal, but approximately there are now 130,000 whites and 150,000 coloured people. It is, historically, one of the most remarkable towns in the world—not excepting some of the mushroom towns which sprang up in America and Australia at the times of the gold rushes. In September, 1886, when the gold diggings were proclaimed by State President Kruger, the population of the township was only 50. To-day, notwithstanding the fact that it is, roughly, 1,000 miles by rail from Cape Town, and 600 miles from Durban, and connected to these coast towns for the most part by single-track railway, Johannesburg is a stately city. Its massive stone buildings, its wide roads, pavements, lighting and water, its tramways and means of communication, its police, with native police-"boys," to keep in order the hordes of semi-civilised Kaffirs; and, finally, its commercial and financial interests, are worthy of any European centre. Its association with the largest British power scheme will be known to all—though the Victoria Falls and Transvaal Power Co. have not, it is understood, any rights within the municipal area. The stability of the gold-mining industry is everywhere apparent, and not the least of Johannesburg's treasures is the South African School of Mines and Technology. Such is Johannesburg to-day.

It was perhaps unfortunate that some comprehensive scheme of power supply was not laid down by the Council of Johannesburg at first, as there could have been little doubt, even in the early days, that the future of the town was assured. It has been a gigantic and laborious task to undo the great amount of harm, caused—innocently enough, it may be—by the pioneers of the industry in South Africa.

Johannesburg was singularly unfortunate in having, first, an old-fashioned steam plant (belt-driven bipolar generators with horizontal engines); and secondly, in replacing these at great cost, by gas engines whose performance certainly did not come up to expectations, and whose failure left the city in a quandary.

The repeated failures of supply caused positive consternation in the city, and the subsequent law suits and recriminations are too well known to be recapitulated.

Gradually, however, a modern plant has been installed, whose reliability leaves little to be desired; its equipment has been brought up to date as quickly as circumstances have permitted, and to-day a "shut-down" is a distinct exception, rather that the previous rule.

The Gas, Electric Supply and Tramways Department of the Municipal Council of Johannesburg is at present managed by Prof. J. H. Dobson.

The principal power station is situated in President Street West, and is built upon a site adjacent to the original stations—the general offices, car-sheds and power station forming a compact group of buildings to the west of the city proper. There is a small gasworks to the north of the power station, which is managed by the same department; but little gas is used for illuminating purposes, the connections (numbering 470 at the end of November, 1914,) being mostly to hotels and restaurants, for cooking purposes. (During November, 1914, three million cubic ft. of gas were produced.)

The monopoly for lighting and power purposes is therefore held by the Electric Supply Department (within the municipal areas), and this is no mean consummation in the largest and most important city in Africa.

The original distributing system gave as much trouble as the generating plant, but this has been remedied as quickly as possible by the replacing of faulty feeders and distributors, as well as the laying of duplicate (in some cases quadruplicate) feeders. Considerable extensions in cable-laying have been, and are being, carried out, and the whole scheme is being brought up to modern ideas of maintenance and operation.

The present system, both as regards the generating plant and the distribution, is the outcome of a lengthy report, drawn up by Mr. Dobson in June, 1911, which contained an exhaustive survey of the original system—if system it could be called—and enumerated the alterations to be made both at the power station and on the lighting network, the object being to arrange for the installation of subterranean distribution, or link, chambers, at the busy centres, each with a duplicate feed, and the splitting up of sections by means of pillars above ground.

All this meant the removal of old and perished cable, disconnecting boxes, &c., and as a result the present system begins to stand out in strong contrast to that of 10 years ago.

Dealing first with the generating plant as at present installed at the principal power station, the capacity of steam-driven generators is 13,500 KW., made up as follows:—

No.	Capacity.	Make.	—	KW.
1	3,000 KW	Belliss - Lahmeyer turbo-alternator	2-phase	3,000
2	3,000 ,,	Belliss-Siemens turbo-alternators	2 phase	6,000
1	1,000 ,,	Belliss-E C C. reciprocating	2-phase	1,000
1	1,000 ,,	Belliss- Siemens ,,	D C.	1 000
1	1,000 ,,	Belliss-Dick, Kerr ,,	D.C.	1,000
1	500 ,,	Belliss-Dick, Kerr ,,	D.C.	500
1	500 ,,	Belliss-E C.C. ,,	D.C.	500
1	250 ,,	Allen-Mather & Platt	2-phase	250
1	250 ,,	Allen-Mather & Platt	D.C.	250
10	13,500 KW.	Total... ...	KW.	13 500

There is also installed in the main generating station some 4,000 KW. of motor-converting plant, the direct-current from which may be used either for D.C. lighting in the inner area of the town, or for traction purposes, as explained further on. The 250-KW. Allen reciprocators each have a two-phase alternator and two direct-current generators rigidly connected to the engine shafts in tandem, and it is possible by disconnecting the engine coupling-bolts, to use the A.C. and D C. machines as motor-generators—the alternators being used as synchronous motors, to drive the D.C. machines, or *vice versâ*, whichever may be desired. The starting up, in this case, is accomplished by means of ordinary starting resistances in the D C. armature circuits.

There are three distinct systems of supply from the generating station, the central parts of Johannesburg (or inner

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area) being supplied, both for lighting and power, by a three-wire direct-current system at 230 and 460 volts.

The outlying suburbs are fed by single and two-phase feeders (the latter for power) at 3,000 volts, to step-down transformers (placed in subterranean chambers for the most part) and in kiosks, from which the supply is taken at 200 volts for domestic and street lighting.

There is also a third supply at 600 volts, direct current, for traction purposes—which may be derived from the Belliss D.C. reciprocators or from the motor converters.

In connection with the tramway scheme, one rotary sub-station at Jeppestown is at present in commission, for supplying the outlying and congested traction areas. Eventually three such sub-stations will be put into operation, each of which will contain two British Westinghouse rotary converters of 500-KW. capacity. These will receive two-phase current at 3,000 volts, 50 cycles, for conversion to direct current at 600 volts.

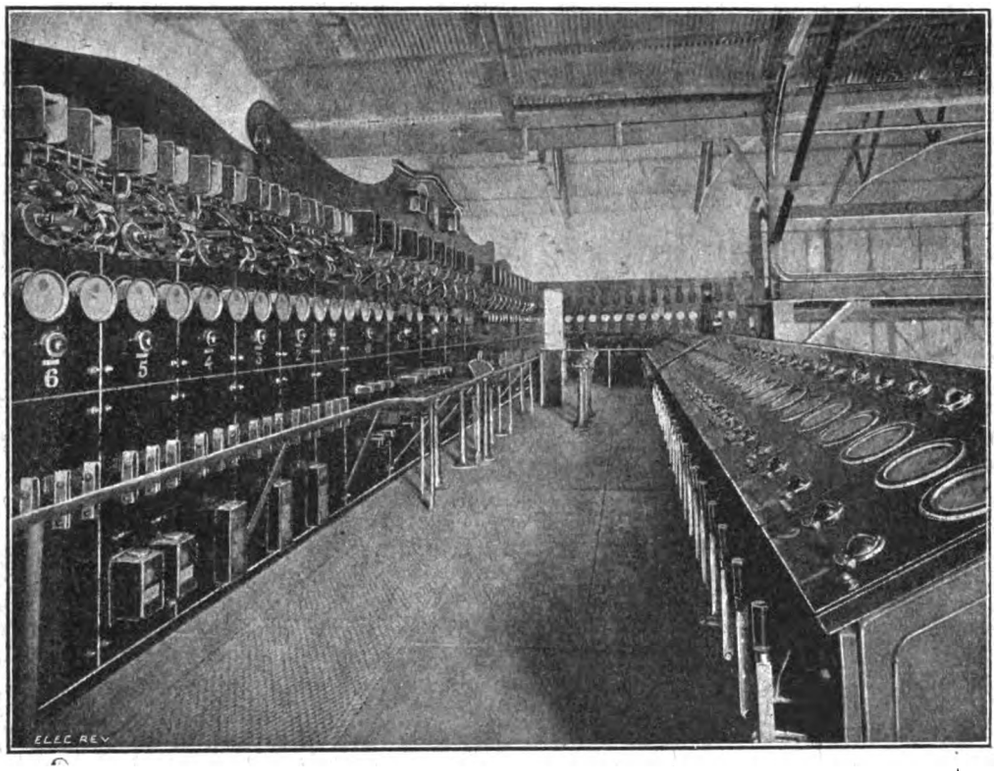

FIG. 1.—PART OF MAIN SWITCHBOARD WITH DESK-TYPE H.T. BOARD ON RIGHT.

The British Westinghouse Electric and Manufacturing Co., Ltd., have supplied the rotaries and transformers for these sub-stations, and the rotaries are of the so-called self-synchronising type.

Notwithstanding the three distinct systems of supply, the switchgear is not complicated, and a general view of the operating panels is given in fig. 1.

The desk type panels to the right control the A.C. supply at 3,000 volts, the alternator control switches and the synchronising gear being shown in the right background, while the single and two-phase feeder switch controls are shown in the right foreground. The 3,000-volt switches are of the oil-break remote-control type, mechanically operated by rods and handles, as shown—the oil switches themselves being contained in separate cubicles, built on a gallery below the operating platform. On this floor, shown in fig. 2, the regulating resistances are also placed, together with the auxiliary plant distributing board.

Referring to fig. 1, the main D.C. switchboard is shown on the left. In the middle portion of the board, four machine panels, for the Belliss direct-current sets, and four converter panels, controlling the direct current from the converters, are placed; the feeders branching to the left are three-wire lighting and power feeders (inner area) and those ranging off to the right are traction feeders. (There are, of course, two separate and distinct sets of bus-bars.)

Each D.C. machine has a main triple-pole change-over switch, the connections being such that, when it is placed in the upward position (*i.e.*, "on lighting") the machines run as shunt wound; and when it is in the downward position (*i.e.*, "on traction") the series field turns of the D.C. machines are cut in, and the machines run as compound wound. The whole of the D.C. steam-driven generators and the D.C. sides of the converters are slightly over-compounded, which has a dual effect on the converters, bringing the power factor to unity, and sometimes giving a leading current when the machines are doing their full rated load (on traction).

Fig. 3 shows a back view of the main direct-current switchboard, with positive traction bus-bar and feeder panels.

The Belliss-Siemens 1,000-KW. reciprocating set has a middle wire balancing connection. The converters each have a middle wire connection, to the star point of the rotor windings, which is, of course, earthed, and any out-of-balance current is distributed equally over the brush gear of the slip-rings.

The above-mentioned D.C. machine panels are each provided with two ammeters, a voltmeter, and a double-pole automatic circuit breaker—excepting the steam-driven non-balancing generator panels, which have only one ammeter. Plug sockets are provided on each machine panel for paralleling purposes.

The three-wire lighting feeders each have two ammeters, a triple-pole switch (the neutral connection of which is not used), and a double-pole automatic circuit breaker.

The traction feeders each have a single-pole switch or link, an ammeter, and a single-pole automatic circuit breaker. The double-pole lighting circuit breakers are interconnected mechanically, so that if one operates automatically, both circuit breakers open, leaving that particular feeder isolated. It should be mentioned that each lighting feeder feeds its own area, not being connected, normally, with other parts of the network.

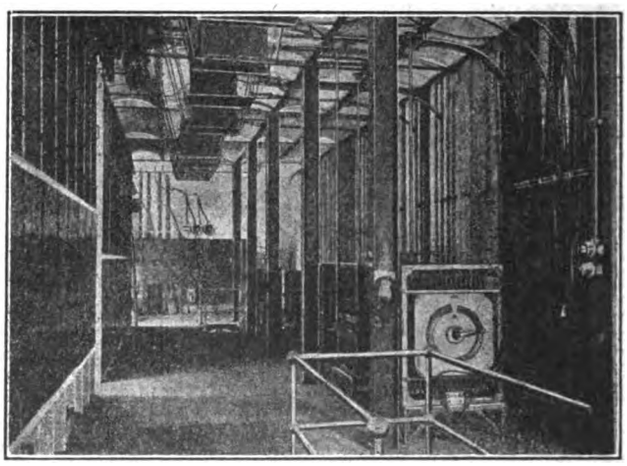

FIG. 2.—GALLERY UNDERNEATH MAIN SWITCHBOARD; OIL SWITCH CELLS ON LEFT.

Referring again to the A.C. control panels (fig. 1), the machine panels are each provided with two voltmeters and

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two ammeters (one per phase), two watt-hour meters, two power-factor indicators, and the necessary plug sockets for synchronising. The oil switches are operated for overload by the instrument current transformers, and the switch handles each have the customary loose link, so that the switch cannot be held closed on short circuit. The single-phase feeders are so arranged that by the aid of oil-immersed selection links any feeder may be connected either to "A" phase or "B" phase, coloured signal lamps giving a corresponding indication on the desk panels.

The single and two-phase feeder switches are operated for overload by series transformers, the secondaries of which

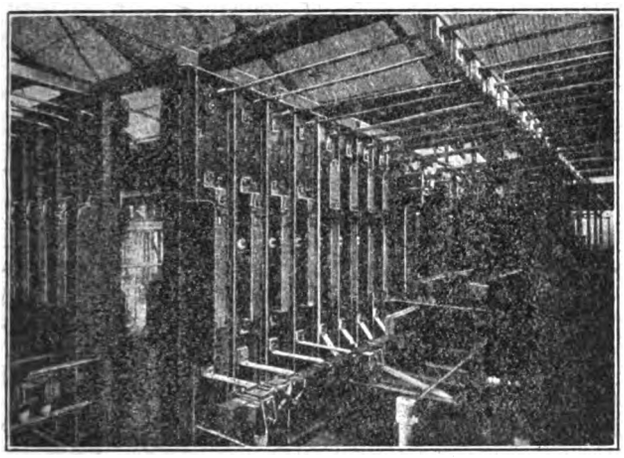

FIG. 3.—BACK VIEW OF PART OF MAIN SWITCHBOARD.

are connected in series with the ammeters and the switch trip-coils.

Duplicate synchronising gears are installed, one on each phase, and both the alternator oil switches and the feeder oil switches can be completely isolated by air-break links on either side of the switches.

The whole of the switchgear is by Messrs. Siemens Bros. Dynamo Works, Stafford. The original switchgear was placed on the engine-room floor level, but the existing Siemens switchgear is placed on a gallery at one end of the principal generating station.

(To be continued.)

NOTES ON ELECTRIC WELDING PRACTICE.

GREAT progress has been made in every system of electric welding during the twenty-five years or so which have elapsed since its practicability was first demonstrated, but the major portion of this progress has been accomplished during the last ten years, in which many manufacturers have concentrated their attention on the perfecting of special types of welding machines. Even to-day, and to a much greater extent in the past, trade reticence has had considerable effect in checking the extension of electric welding, for those firms who install electric welders find them such a "good thing" that they keep the fact to themselves—which is all right from their point of view, but none too pleasant for the electrical interests involved. However, that particular trouble lies chiefly in the past, and electric welders are now used in innumerable manufacturing processes, many of which would be commercially impracticable without electric welding.

The two broad classes into which electric welding applications may be divided are: (1) repair work and construction by building up—requiring skill; and (2) routine manufacture of parts in bulk—demanding, on commercial grounds, processes for which no special skill is necessary. There are innumerable manufactured parts now in daily use which could be made more cheaply from two or more pieces (instead of as a single casting, stamping or spun part), if only the component pieces could be joined cheaply and neatly. This is possible by electric welding, and the fact finds ever wider recognition and application.

Applicability.—It is undeniable that electric welding methods are by far the most widely applicable. Any "proposition" and any metal or pair of metals which can be welded by any other system of welding can be welded electrically but the converse is by no means true, for electric welding can do much that is impossible by other means. Primarily, electric welding alone can be reduced to a *machine process*, and this is of immense importance in manufacture; but naturally not all electric welding is mechanical. Judgment and skill are frequently required in its application, particularly where arc processes are concerned. One or other of the various possible methods of electric welding is applicable to practically every metal or combination of metals, whatever the mechanical form of the latter and, in particular, to many commonly employed metals which cannot be welded by any other means owing to their deterioration at high temperatures, rapid oxidisation, or some other unfavourable characteristic. Copper and aluminium, for instance, can be welded perfectly by electric butt or percussion welding. Wrought iron, mild steel, and even high carbon steel are regularly dealt with, whilst nickel steel is very easily welded electrically.

Composite welds, such as nickel to brass; brass to iron or steel or platinum; aluminium to brass or copper; platinum to iron or brass; German silver to wrought iron, copper or brass; and practically any grade of iron or steel to any other (*e.g.*, mild steel shanks to costly alloy steel tools or mild steel bars on to drop forgings)—all such welds and many others can be performed electrically and by no other means. As for the mechanical aspects of the work which can be performed, this ranges from plain "filling," butt, lap, scarf and angle welding to the most intricate combinations and multiplication of these operations. Bosses round holes may be formed by welding on rings after drilling or discs before drilling; all kinds of metal netting and lattice work can be performed in automatic electric welding machines; and tube seams can be closed, spokes attached to hubs, and all kinds of hardware and other sheet metal work built up by electric welding instead of soldering, brazing or riveting.

Strength of Weld.—Papers devoted specifically to consideration of the strength of electrically welded joints of all kinds have been read in considerable number, and it is neither practicable nor necessary to attempt to summarise the mass of data now available; but all data go to show that electric welds are invariably much stronger than hand welds (where the latter can be made), and generally stronger but never weaker than those made by gas flame methods. In the series of steels, the higher the percentage of carbon or other alloyed ingredient the greater the superiority of electrical over other welding methods.

It is an old precept that welded joints should be adopted very cautiously in working machinery and wherever failure would involve danger to life, the working stresses being made very low in such cases. This precept was and is a good one, but electric welding ensures such soundness in the weld itself and *so little affects metal on either side of the joint* that the union can be trusted in most responsible positions. For example, armature shafts, chain links, cables, and machine components are all regularly welded electrically. In short, electric welding has taken, and is quite competent to take, rank as a regular machine shop process in construction and repair. It is only necessary to recognise, as with any process, certain fundamental precautions in practice and design.

Methods.—All methods of electric welding depend fundamentally on the Joule effect, *i.e.*, on the conversion of electrical to thermal energy by resistance

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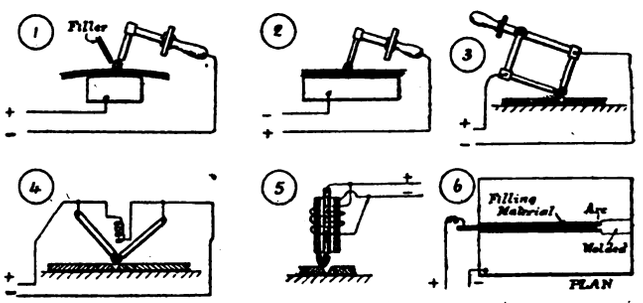
interposed in the electric circuit. Nevertheless, the term resistance welding, of which there are several varieties, is generally applied to systems utilising contact resistance between the pieces joined. Arc-welding systems utilise the contact resistance between arc crater and incandescent vapour column, and the heat thus generated may be applied quite externally as regards the work, or the latter may be made one electrode so that heat is again, in a sense, due to contact resistance on the work, but with this *very important difference* that an *arc* being struck, there is a definite and very high temperature at the crater and heating is intense, more local and less under control than in ordinary resistance welding. When the arc is between two independent electrodes, manipulated as a sort of blowpipe, heating of the work is more under control as regards rate, distribution, and degree, if the worker has the requisite manipulative skill. The Hohe electrolytic process is a modification of butt-resistance welding, the contact resistance being between the electrolyte and the work, and due chiefly to a polarisation layer of hydrogen.

Arc Systems.—There are quite a number of electric welding systems coming under this heading, but all are "autogenous" in their action, *i.e.*, metal is actually melted to form a joint of cast structure. By feeding the arc with suitable materials it is possible to produce joints of widely varying compositions, but all arc welding processes are essentially processes for craftsmen. They require considerable skill to ensure satisfactory results, the difficulty being that the arc temperature is really considerably higher than desirable and incapable of control. On the other hand, arc welding alone is applicable to miscellaneous repair work and, being essentially a "filling" process, it is very useful in running-in molten metal of approximately any required composition to fill casting blowholes, contraction cracks and other flaws; to build up worn or broken parts and so forth.

An arc welding tool is compact, can be supplied efficiently through a relatively long cable, and can be applied with equal facility to any piece of work, whereas other systems require a more or less specially constructed machine. Also arc welding can often be applied to work which, by its form or dimensions, could not be dealt with by resistance welding. The strength of the original or adjoining section can be equalled or exceeded by building up metal, and it is remarkable what thin ware can be arc-welded satisfactorily by a skilled worker. At the same time, the chief utility of arc welding lies in railway shops, shipyards, rolling mills, foundries, tank and boiler shops, and general engineering works (particularly repair shops), whilst resistance and percussive welding are the systems *par excellence* for repetition and very light manufacture. If the operator is not skilled there is considerable risk of carbonising or introducing other foreign material in arc-welded joints; it is not easy to see precisely what is going on at the working point, and there is always the risk that the work will be burnt on the one hand or remain too cool to unite intimately with added metal, on the other hand.

In the Benardos arc system, fig. 1 (largely used to build up lugs and gear teeth, fill blowholes, joint tanks, pipe flanges and boiler fittings, etc.), an arc is struck between the work to be welded and a carbon (negative) electrode about 1 in. in diameter. The weld is fed from a stick of suitable metal held in the arc, and the latter may consume several hundred amperes at 80 volts or so. By making the work positive, the risk of carbon entering the weld is reduced, and the temperature attained is reduced, for a metal arc crater is cooler than a carbon crater. The functions of negative electrode and "filler" are combined in the Slavianoff system (fig. 2), which resembles the Benardos except that a metal electrode is used, generally ⅛ to ¼ in. in diameter. The current consumption is seldom more than 100 amps., and often 20 amps., or less; and the voltage is much lower than for the carbon arc, say 25 to 35 volts. By making the metal electrode *positive*, molten metal is carried on to the work automatically, even when working on the underside of a surface. The metallic arc is very short (¼ in. or less) and very sensitive to pressure variations, so that it is not very easy to manipulate, and it is hardly possible to run two in



FIGS. 1 TO 6.

parallel from one generator. The rather slower working and the complete elimination of carbon are valuable features, particularly in light work. To prevent splashing of molten metal from the feede and protect it from possible oxidisation, the Kjellberg system uses a metal electrode surrounded by a casing which burns to form a crater and a flame arc; the voltage necessary is raised to 100 v., and from 100 to 200 amps. is consumed on boiler and marine repair work. The special electrode is connected to the positive main.

The Voltex, Zerener, and Coffin systems all use two electrodes producing a sort of electrical blowpipe, and permitting considerable control over the zone and degree of heating, which is specially valuable when working on thin sheet goods, welding straps and tube joints, etc. In the Voltex equipment (fig. 3), impregnated carbons set at right angles yield a long flame arc which consumes the carbon vapour and so protects the weld from carbon-hardening. The Zerener carbons (fig. 4) are in Vee-setting with an intermediate deflecting electromagnet; whilst the Coffin arrangement (fig. 5) is very ingenious in conception, and consists of concentric rod and tube electrodes and an electromagnet which causes the arc to run round the annular track provided for it, and so distributes the heating effect. The so-called Quazarc (Strohmenger-Slaughter) system (fig. 6) is semi-automatic in nature, and if carefully applied ensures a suitable quantity of "filling"-metal in the joint and correct speed of welding with no risk of overheating. A strip electrode of the filling-metal is lightly insulated (with a fluxing composition) and laid along the chamfer of the joint to be made; after once striking the arc at the end of this electrode, it runs along the latter as the metal melts, and ½ to 1 ft. of joint is welded per minute. So long as the right size of electrode and the correct current are employed, and the edges are true and symmetrical, good working is secured with freedom from any difficulty in maintaining arc adjustment. The method is usefully applicable to tank and metal barrel manufacture as well as to heavier work.

(To be continued.)

THE DESIGN OF HIGH-PRESSURE DISTRIBUTION SYSTEMS.

THE paper by Mr. J. R. BEARD, which was abstracted in our issues of December 24th and 31st, 1915, and January 7th and 14th, 1916, was read and discussed at a meeting of the MANCHESTER LOCAL SECTION of the INSTITUTION OF ELECTRICAL ENGINEERS on December 14th, 1915.

Mr. S. L. PEARCE considered the subject of the paper of enormous importance. Engineers were well aware of the advantages of taking extra-high-tension supplies straight into

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sub-stations on the consumers' premises, although to do this in the case of consumers having only 100 KW. demand (as suggested by the author) was perhaps open to question. He agreed that reactances were best used in connection with generators, not simply for the protection of any individual piece of switchgear, or even an individual generator, but chiefly for the purpose of preventing the derangement of the whole system in the event of a local fault developing, without dividing the system into a number of sections, or attempting to run the whole system in a most uneconomical way. Mr. Pearce exhibited a slide showing the lay-out of the main switchgear at the projected Barton station to illustrate his point. He agreed that it was impossible to estimate the severity of the fault which any particular switch might be called upon to deal with, and, whatever the capacity of the particular apparatus they might be controlling, the switches should be large enough to deal with any eventuality. Regarding the most economical section of mains, he exhibited a slide appertaining to 0.25 sq. in. 11,000-volt, 20,000-volt, and 30,000-volt cables, and giving figures showing the problem tackled from the point of view of dielectric losses. These were interesting as showing how the conclusions arrived at in favour of the 0.25 sq. in. 30,000-volt cable confirmed the conclusion of the author, who had dealt with the matter purely on the basis of $i^2 R$ losses. Figs. 5 and 6 showed that the higher the voltage the greater the maximum current per phase that could be carried, and the more nearly the cross sections of the cables (determined respectively by (*a*) consideration of economy on the one hand, and (*b*) safe carrying capacity on the other) approached one another. Fig. 6 would be of the greatest possible assistance to engineers laying out new systems or carrying out extensions to existing systems. The Manchester system was laid out about 14 years ago on the series-radial plan, and with the development of the area and industrial power load the number of sub-stations had increased to over 100. A rearrangement of the system became essential with a view to developing the useful employment of the copper laid, and also increasing the reliability of supply by the adoption of modern protective devices. Wherever possible existing mains were used to form ring mains with balanced-current protective devices, so that the copper would be more usefully employed, especially in outlying districts. The author was correct in stating that reverse power relays were unsatisfactory. His figures seemed to show an enormous difference in price between 20,000 and 30,000-volt switchgear; this did not agree with investigations made by the speaker some little time ago. In conclusion, Mr. Pearce said the trend of experience with modern high-pressure distribution stations, operating over wide areas and dealing with large and concentrated loads, seemed to point to the necessity first of all of choosing a distributing voltage even in excess of 20,000. It was well known that Manchester proposed to adopt 33,000 volts in connection with the Barton scheme. The second point was to employ the largest section of cable commercially possible. This would keep down the number of cables required for the system by the use of a balanced-current protective system, and, again, by adopting fewer cables the total number of switching points was reduced. Lastly, it was desirable to dispense with or limit as far as possible the number of step-down transformer points on the system, which, in other words, meant that the distinction between feeders and distributors was largely vanishing.

Mr. S. FERGUSON said that on a 6,000-volt system the capacity of the generating plant did not materially affect the initial short-circuit current flowing to a sub-station with an average-sized feeder exceeding one mile in length. The current was fixed by the impedance of the circuit, *i.e.*, the reactance of the generator windings and the resistance of the feeder, and in a typical case doubling the capacity of the plant only increased the short-circuit current by about 4 per cent. In both Manchester and Birmingham the sub-station oil switches had not been increased in size, although the capacity of the plant had increased enormously. Increased voltage (other things remaining constant) for the particular length of feeder mentioned made the short-circuit current more directly dependent upon the plant capacity, and it was advisable to bear in mind that the power delivered at a fault varied as the square of the voltage. Regarding interlocks, the most important on any cubicle was certainly the one dealing with incoming feeders. The attendant handling the switchgear could ensure the feeder being dead from the bus-bar side, but he could not answer for the man at the other side. Means should be provided for earthing the feeder or locking the feeder isolating switch chamber.

Dr. E. W. MARCHANT said that while a great deal of attention had been paid to the machinery of generating stations, far too little was given to distributing systems, which represented a large percentage of the capital outlay. Referring to the author's curves, and remarks concerning the most economical section of mains, he said that working out the relationship which existed by Kelvin's law of economy, it would be found that the economical current density in a cable was entirely dependent upon the cost of the cable, the resistance of the material of which the cable was made up, and the cost of energy per unit. Therefore, the economical current density was constant, and this result coincided with the author's tables; the curves between current and cross-section were straight lines, signifying that the current density was the same for all sizes of cable. An increase in voltage would cause the most economical current density for the cable also to increase. This was also shown by the author's tables, because the current density for a 20,000-volt cable was considerably greater than in the case of a 10,000-volt cable. It was clear from this result that if the working pressure was sufficiently increased and there was adequate insulation, a point would be reached where the economical current density would correspond with the heating limit. Kelvin's law, being founded on a basis of minimum total charge for energy distribution, was unsuitable for determining the most economical current for a cable already laid. The best basis for such a cable was minimum ratio of total cost of producing energy to revenue earned. As a rule, however, the difference was not very great.

Mr. G. HARLOW said the provision of an adequate size of primary winding on series transformers was very often overlooked, and within the past two years he had known at least seven cases of serious short circuits due to this trouble. An investigation of these had led to the adoption of primary windings at least equal in cross-section to the main to which they were connected. Regarding potential transformers on bus-bars, a protective oil switch, as suggested by the author, was absolutely necessary with 100,000-KW. main plant or 50,000-KW. in sub-stations. A breakdown at the transformer terminals was a fearful business, but if it occurred half way down the winding the impedance prevented much trouble. There were many stations where it was advantageous to use feeder reactances. Oil switches in sub-stations about one mile distant from the power station should be of the same capacity as the power-station switches. The speaker asked the author to state how much split conductor was laid on the North-East Coast system, and whether induction reactance was still used.

Mr. A. F. W. RICHARDS said that the curves showed that the cost of making ample provision for future requirements was almost negligible. Another outstanding point was that overhead mains at pressures up to 6,000 volts were not a paying proposition for transmitting power not exceeding 400 or 500 KW., assuming, of course, that there were not other considerations to be taken into account such as shortening route, etc.

Mr. S. J. WATSON spoke of the ease with which sub-stations could be set up when high-pressure distributing mains were adopted, whereas in the past in connection with D.C. systems low-pressure mains were frequently run out a considerable distance from the power station, with consequent difficulties in regulating and giving proper pressure to consumers. Whilst appreciating the author's efforts, he thought that in many cases the section of conductor for high-pressure systems was not worked out by the scientific methods set forth in the paper. Most systems, whether high or low-pressure, usually started in a small way, and when mains were laid there was very little indication where the load would come from. The practice had been to fix on a good-sized section of copper and lay cables in the directions where load seemed most promising. The generating station never by any chance became situated in the best position relative to the distributing system, and this fact appreciably affected not only the original lay-out but also new developments. In Bury the principal consumers were distributed in the form of a star. There was a fairly good demand adjacent to the main roads running out from the town, but between the tips of the star it was mostly waste land, and in an area of this kind a ring system could not be adopted on account of the cost and the large amount of idle cable. An important point was the small difference in cost (2½ to 5 per cent.), which enabled an engineer to increase the capacity of the cables by a very large percentage. A slight increase in copper was usually found to be a sound investment.

Mr. F. FERNIE asked whether the author excepted cables from the statement that no apparatus could be made immune from breakdown through external damage. It might be said that nobody could guard against damage to underground cables by workmen opening up the roads, but he knew of a case where the supply authorities received copies of all permits to open up roads, and by sending an inspector to point out the location of the cables damage of this nature was almost entirely eliminated. It had been reported that Newcastle proposed to use some 11,000-volt cables at 20,000 volts. Perhaps the author would state whether this had been done, or whether the 20,000-volt line of underground cable in fig. 6 would coincide with the 11,000-volt line. It was desired to know what minimum factor of safety the author considered permissible. Some of the 20,000-volt cables in the Newcastle district had a factor of safety of 7 to 8, whereas for 11,000 volts the figure was 10 to 15. By factor of safety was meant the ratio of the maximum stress at which the cable would break down to the maximum working stress. Referring again to fig. 6, some explanation was necessary to show why the inclination of the 20,000-volt line was different to that of the 11,000-volt line.

The AUTHOR, in reply, said that the reference to the use of high-pressure distribution for 100-KW. loads applied only to isolated loads, and in some cases it had been considered worth while to accept 50-KW. loads. Reactances on generating plant were very satisfactory on account of the perfection of modern automatic voltage regulation. The Ferranti-Waters and Callender-Waters systems were quite distinct, the former being a parallel feeder protection and the latter the split-conductor type, requiring a special cable. The Callender-Waters system was in actual use on the South-Western Railway at 3,000 volts. The cost of switchgear had not yet been dealt with in connection with the 30,000-volt gear, but the curve would probably continue upwards at about the same

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slope on account of the spacing and thickness of insulation increasing more than proportionate to the voltage. No reference was made to the Ferranti-Waters system because it was not in actual use when the paper was written. An actual case worked out on this system showed the cost to be about 18 per cent. greater than any other system. This seemed inevitable with all systems using parallel feeders. In reply to Mr. Ferguson, 15,000 amperes at high voltage was as much as the best switch would do, and probably very much less would wreck many of the switches at present on the market. Reactances should not be necessary at the sub-stations, and only as a last resource on feeders. The breakdown of potential transformers was not appreciably affected by the size of the station, breakdowns taking place almost as readily in small stations as large ones. It should be a general rule never to put potential transformers direct on bus-bars, even in sub-stations. Generally speaking, they were not necessary in sub-stations, as the main transformer would meet all requirements. Regarding the North-East Coast system, there were 140 miles of split conductor, 385 miles Merz-Price protected cable, and a balance of 185 miles of overload cable, which represented some systems not yet linked up. Approximately, half the original overload protected Tyneside system had been changed over, and the remainder would no doubt be included in due course. Induction reactance had not been used on the split-conductor system for the past two years, but there was still a lot in commission and working perfectly satisfactorily. There was no trouble owing to extensions upsetting existing protective gear.

Discussion at Newcastle.

At a meeting of the Newcastle-on-Tyne Local Section of the Institution of Electrical Engineers on the 10th inst., Mr. J. R. Beard read his paper, of which an abstract was given in our issues of December 24th and 31st, 1915, and January 7th and 14th, 1916.

Mr. C. Vernier, in opening the discussion, said it was surprising, considering how much money had been put into high-pressure systems, that the subject had not been more adequately considered before. Referring to the question of mains, he said Mr. Beard dealt well with the question without deciding whether overhead or underground cables should be preferred. Generally speaking, one ran overhead mains where possible in the open country, and where the necessary wayleaves could be obtained, and it must be remembered that the wayleave question was always a difficult one. He did not think there was much to say against overhead lines, although they had their faults, and it was only a question of time before they got the overhead as perfect as the underground system. With regard to the annual charges for overhead and underground mains, he thought Mr. Beard was a little cautious in taking as a basis for his estimates the life of an underground cable at 22½ years and of overhead lines at 17½ years. The author would agree with him that the life was likely to be more than the time he had mentioned. The diagram showing the annual cost per mile for interest and depreciation rather favoured the underground system, for it was usually possible to get shorter routes for overhead lines than for cables. Referring to the section on the lay-out of the distribution system, he thought the paper was an attempt to prove the case of the interconnected system. To most of them there it did not require proving, but it might elsewhere; but the thorough manner in which Mr. Beard had gone into the matter ought to settle the question of the interconnected system *versus* other systems which were often laid down even now.

Mr. H. W. Clothier referred to the importance of switchgear as the protective system of the general scheme. For years they had been looking into the details of switchgear and overlooking the larger influence it had on the whole scheme. The paper touched on a very important point in connection with the strength of switchgear, and without dealing with the heavy short-circuit conditions, he might say there seemed to be no end to the development of that. He spoke of the difficulty that faced them owing to the growth of systems and of plant beyond what was anticipated when the switchgear was put in. As to the importance of guarding live apparatus, and the statement that it was a simple matter to interlock the guarding arrangements, he submitted that it was a brain-racking thing to interlock and screen all parts.

Mr. G. L. Porter and Mr. R. W. Gregory also spoke upon the interconnected system.

Mr. Beard, in the course of his reply, said that in that district overhead lines had been brought to a very high state of perfection, and he thought, as Mr. Vernier had said, that in the course of time the overhead lines would be almost as immune from breakdowns as were underground mains. As to switchgear, he pointed out the small proportion of cost compared with the whole—about 20 per cent. or 30 per cent. or less.

The Russian Electricity Tax.—Respecting the contemplated taxation of electrical current in Russia, it is stated in the *Narnie Vremya* that according to preliminary calculations of the Ministry of Finance, this particular tax is expected to yield about 17,500,000 roubles per annum.

THE ELECTRIC LOCOMOTIVE.

By F. W. CARTER, M.A., Assoc.M.Inst.C.E.

(*Abstract of paper read before the* Institution of Civil Engineers, *January 11th*, 1916.)

Electric locomotives, particularly those driven by motors of uniform torque, are capable of making better use of their adhesive weight than steam locomotives; with suitable provision for sanding the rails, the tractive effort may amount to a third of the weight on the driving-wheels, and the parts should be designed mechanically and electrically on the assumption that this limit is attainable. Locomotives driven by impulsive torque, such as those which employ the single-phase commutator motor, are naturally incapable of exerting so high a mean tractive effort, although the maximum stresses in the parts are likely to be higher.

Most locomotives, particularly those designed for goods service, are required at times to exert as great a tractive effort as the conditions allow, and the control is therefore usually devised in many steps, in order that the tractive effort in starting may, if necessary, be maintained very close to the limit of adhesion without overstepping it by the greatness of the peaks. The necessity of adapting the accelerating effort to the immediate requirements, and of being able on occasion to work close to the limit of adhesion, renders automatic methods of governing the acceleration unsuitable for general locomotive work, and the best practice favours methods in which the accelerating effort is under the immediate control of the driver.

Railway motors being usually designed with sufficient reserve to slip the driving-wheels without detriment to themselves, the weight that it is desirable to allow on the driving-wheels is limited by the strength of the draw-gear of coaches and wagons, which also limits the weight of train and the acceleration permissible with locomotive haul. The couplings used on English goods wagons, consisting of 1¼-in. iron chains, probably have an ultimate strength of the order of 60 or 70 tons, and it is not advisable to haul with a locomotive capable of giving a steady pull much in excess of, say, 15 tons. A locomotive having a weight on the driving-wheels of the order of 70 tons, capable of exerting an adhesive tractive effort in service of 17½ tons or more, is accordingly about as heavy as it is advisable to employ at the head of a train in England. As the permissible weight per axle is generally at least 18 tons, the English locomotive needs no more than four driving axles.

The electric locomotive, on account of its large haulage capacity as compared with its weight, shows to great advantage where opposing gradients are long and steep; the economies resulting from this consideration have, in fact, in a number of cases, proved the determining factor influencing the decision to electrify a main-line division. Where such conditions prevail, the use of the locomotive motors, acting regeneratively to restrict the speed of trains descending gradients and return a portion of their gravitational energy to the line for use in operating other trains, becomes feasible and attractive.

Electric locomotives admit of a primary division into two groups, namely, those in which the driving axles are actuated each by a separate motor, and those in which these axles are grouped and driven collectively, through the medium of side rods, by one or more motors. With a few exceptions these two groups correspond with the continuous-current and the alternating-current systems of operation respectively, and have their origin primarily in limitations of motor design. The continuous-current series motor in the rugged form needed for satisfactory locomotive driving is capable of developing large power in a confined space, and there is no appreciable sacrifice of economy or increase of maintenance cost arising from the use of motors of such size as is required to supply the power of a single axle. The single-phase commutator motor, however, is of necessity close to the limits of satisfactory design in many respects, due primarily to the difficulty of obtaining sufficiently good commutation under the conditions of service; and the imposition of space restrictions is felt as a serious obstacle to the attainment of satisfactory operation; the motive power is therefore preferably collected in large units located where restrictions are least onerous and continuous supervision is possible. These considerations, rather than the intrinsic merits of the side-rod design, explain the assiduous efforts that have been made to develop a satisfactory side-rod locomotive. Space restrictions also hamper the polyphase motor, though to a smaller extent than the single-phase commutator motor.

The commonest method for driving locomotive axles independently is through single reduction gearing, the motor being suspended horizontally between axle and transom, and the gearing being entirely at one end of the motor. The unsymmetrical drive has a tendency to wear the pinion-end bearing linings, and thus to throw the armature shaft slightly out of parallelism with the axle, and to increase the stresses at the motor end of the teeth. The gear face is usually 5 in. to 5½ in. wide, and increase in width beyond this does not increase the strength of the teeth in like proportion. It has, accordingly, become the practice, where powerful motors are used, to transmit the power through twin gears, which make better use of the material of the teeth.

Geared motors mounted above the axles and driving them

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through quills are used on many American locomotives. Quill-driving fulfils a double purpose with regard to single-phase motors; it allows them to be supported elastically, and it helps to cushion the impulsive stresses of the driving forces which fall to zero or reverse twice in each period.

Another method extensively used for independent driving employs gearless motors having their armatures mounted concentrically with the axles. In the Grand Central Terminal locomotives of the New York Central and Hudson River Railroad the armature is built on the axle, and the field structure on the locomotive frame, the motor being bipolar, and so constructed that exact adjustment between armature and field in a vertical direction is unnecessary. The inelastically-supported weight on the driving axles in the case of the later types is less than 3 tons per axle, and is carried on 36-in. wheels. The gearless method of independent driving is particularly applicable to high-speed service, for which motors can readily be designed to make effective use of the material of construction.

In both geared and gearless types of independent drive, therefore, unless the expensive expedient of driving through a spring-supported quill is adopted, a certain amount of inelastically-carried weight is added to that of the wheels and axle. The determination of this in the case of gearless drives presents no difficulty, but the geared motor, in spite of its long standing, appears hitherto to have been wrongly treated.

Side-rod driving presents a much more difficult mechanical problem in the electrical locomotive than in the steam locomotive. In the electric side-rod locomotive the original drive is in the form of a uniform torque, and this cannot be converted to reciprocating drive without the introduction of large couples having transverse arms. The forces tending to produce distortion in the structure are accordingly considerable, but the permissible distortion, together with any inaccuracy of fitting, must nevertheless be no more than can be provided in the clearances between running surfaces. Careful design is therefore needed, and close adjustment of parts is necessary to avoid binding stresses; constant attention is, moreover,

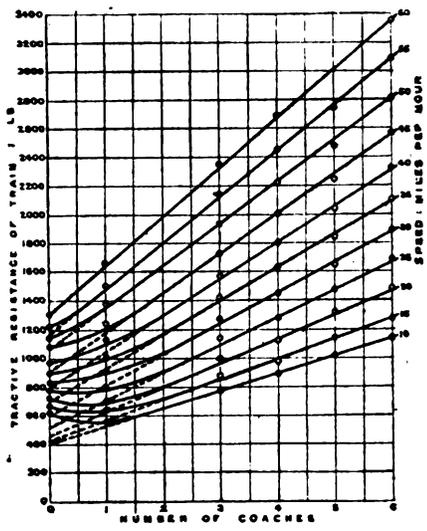

Fig. 1.

required to maintain the locomotive in satisfactory running order, to prevent knocking and the setting up of destructive vibrations.

Whilst locomotives driven by continuous torque are not likely to give trouble from fundamental causes, those driven by impulsive torque are apt at certain speeds to be set in resonant vibration by forces comparable in magnitude with the main driving forces, and it is doubtless to this that must be attributed the fracture of connecting-rods and shearing of crank-pins which has characterised this type of locomotive.

Even in locomotives driven by uniform torque there is possibility of resonant vibrations at certain speeds, due to higher harmonic components of driving force, and since these depend on the clearances and adjustments, the vibration may be more marked at some times than at others. In locomotives driven by impulsive torque, moreover, in addition to the possibility of resonant vibration arising from the fundamental forces, there is probability of such vibration being set up by some of the lower harmonic components of the driving force, and these are likely to be more violent than those set up in locomotives driven by continuous torque, which arise from higher harmonics. This is in accordance with experience; continuous-current and polyphase side-rod locomotives are apt to vibrate slightly at certain speeds, but single-phase side-rod locomotives vibrate much more violently and frequently. The Scotch yoke form of side-rod drive has long been in successful use on the three-phase lines of the Italian State Railways, 130 locomotives of the Giovi goods type alone having already been supplied. The use of the Scotch yoke form on the single-phase Lötschberg railway resulted in vibrations sufficient to fracture the yoke; in this case the trouble was mitigated, and the locomotives were rendered workable by transmitting the power of the motors through springs inserted between the gears and auxiliary shafts. Generally, however, destructive vibration has been characteristic of all single-phase side-rod locomotives employing commutator motors, and the combination of the periodic torque of constant frequency with the periodic change in the incidence of the driving forces of frequency depending on the speed appears to offer an adequate explanation of the phenomena observed; it is probable that single-phase rectifier locomotives driving through side-rods would exhibit similar characteristics, though to a smaller extent, since the application of power is somewhat impulsive in this case also.

Vibration under the control of the suspension springs may arise from want of balance in the rotating and reciprocating parts; since, however, all driving parts of an electric loco-

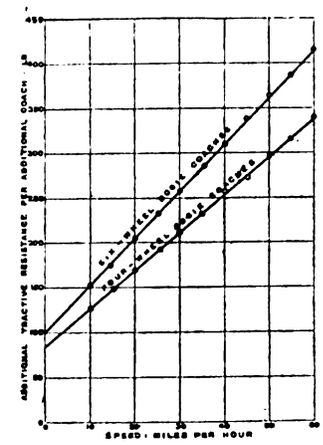
ADDITIONAL TRACTIVE RESISTANCE PER ADDITIONAL COACH
SIX-WHEEL BOGIE COACHES
FOUR-WHEEL BOGIE COACHES
SPEED: MILES PER HOUR

Fig. 2.

motive move in circles, dynamical balance is generally practicable.

The running of the locomotive on tilted rails and coned wheels causes it to progress with sinuous motion, and although the amplitude of this motion is restricted by the amount of flange clearance, its stability or instability has considerable influence on the performance of the locomotive, particularly with reference to the nosing tendency and the destructive track stresses resulting therefrom.

Factors making for stability are the haulage of a train, the elastic centring of guiding trucks, and to a smaller extent frictional resistances to the oscillation; the inertia of the structure, on the other hand, makes for instability.

In a locomotive fitted with guiding trucks centred by forces proportional to the transverse displacement, the motion is initially stable even when running without a train, and it is the task of the designer to render it stable within the whole range of operating speed and all conditions of operation.

The sinuous motion of the wheels also tends to set up a rolling oscillation of the locomotive, and when the speed is such that the period of this oscillation agrees with the natural period of rolling under the control of the suspension springs, violent swaying is likely to be experienced.

The subject of tractive resistance has received considerable attention in connection with steam trains, but few results derived from tests on electric trains are yet available. Of such tests, however, by far the most important and numerous were made by the General Electric Company in 1905 and 1906 on the Mohawk Division of the New York Central and Hudson River Railroad. Results of these tests have already been published in the usual form, in which the tractive

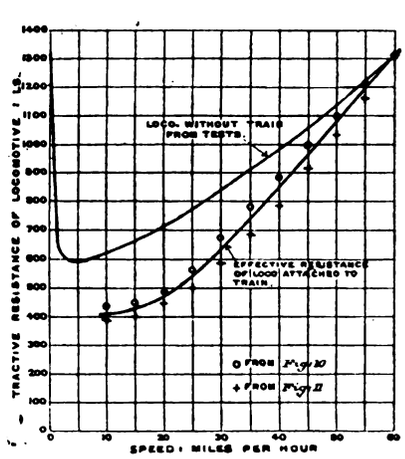
TRACTIVE RESISTANCE OF LOCOMOTIVE, LB
LOCO. WITHOUT TRAIN FROM TESTS.
EFFECTIVE RESISTANCE OF LOCO. ATTACHED TO TRAIN.
SPEED: MILES PER HOUR

Fig. 3.

resistance per ton of train is expressed in the form of a curve as a function of the speed, the curves for different lengths of train being adjusted to fit a certain type of formula. Re-examination of the original records, however, without bias towards a particular form of result, throws an interesting light on the mechanics of tractive resistance, which the authors of the tests in question appear to have overlooked.

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The tests were made on trains of passenger coaches of two different varieties, which were not mixed in the tests; all the coaches were loaded with sand to considerably more than their normal passenger capacity. The locomotive weighed 90.7 tons.

The curves of fig. 1 give results of the tests, the ordinate representing the total tractive resistance of the train, including the locomotive, plotted against the number of coaches as abscissa for different constant speeds. It will be seen from these figures that each curve becomes substantially a straight line at its upper end, or that, after the first two or three coaches, the additional tractive resistance per additional coach at any speed becomes constant.

In fig. 2 the additional tractive resistance per additional coach is expressed as a function of the speed, and discloses the notable result that for both types of coach the increment of tractive resistance in question is substantially a straight-line function of the speed within the range of speed covered by the tets. This result was hardly to be expected, and other types of coach may well be found to show sensible deviation from a straight-line curve. However this may be, the curve of increment of tractive resistance per additional coach affords valuable data which might with advantage be determined for the principal types of coach in use on a railway.

The tractive resistance of the locomotive apart from the train is not really of much importance, since the condition is not a service one. It is apparent, however, from fig. 1, that the train has a steadying effect on the running of the locomotive, particularly at low speed; in fact, in some cases the total tractive resistance of the locomotive and one coach is seen to be actually less than that of the locomotive alone. If the straight-line portion of a tractive-resistance curve of fig. 1 be extended backwards, as shown in broken lines, to the line of no coaches, the resistance thus indicated may be regarded as the effective resistance of the locomotive, and this is really more valuable than the results of direct test on the locomotive running alone, since it corresponds with service conditions.

Fig. 3 gives the effective locomotive resistance derived from fig. 1, and the resistance obtained by direct test of the locomotive running without a train.

The curves of effective tractive resistance of locomotive and additional tractive resistance per coach furnish the means of determining the tractive resistance of any train composed of the given locomotive and coaches, and the confidence that may legitimately be felt in such determination is of a higher order than can be derived from the data usually employed in this connection.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

339. "Radiotelegraphy apparatus." A. ARBIB & W. J. MELLERSH-JACKSON. January 7th.

16. "Electric switches and fuse switches." H. H. BERRY. January 3rd.

309. "Apparatus and process for separating argon." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., U.S.A.). January 7th.

198. "Starting mechanism for automobiles." BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO. January 5th.

133. "Temperature booster for hot-water heating systems." W. E. CLARK. January 4th.

43. "Electrolytic process for the manufacture of metallic wire and strip." S. O. COWPER-COLES. January 3rd.

44. "Process for the production of copper driving bands." S. O. COWPER-COLES. January 3rd.

385. "Electric indicators." EDISON & SWAN UNITED ELECTRIC LIGHT CO. and R. E. H. LOVELACE. January 8th

54. "Electrical range finders." FERRANTI, LTD., & C. REY & P. TESTARD. January 3rd.

224. "Driving and controlling dynamo-electric generators." J. FIRTH and W. F. W. RHODES. January 6th.

70. "Electric controller, particularly for use with electrically-propelled vehicles." J. E. HAMILTON. January 3rd.

149. "Suspenders for electric cables, etc." F. HUNTINGDON. January 5th.

245. "Receivers for wireless signals." MARCONI'S WIRELESS TELEGRAPH CO. and G. M. WRIGHT. January 6th.

246. "Receivers for wireless signals." MARCONI'S WIRELESS TELEGRAPH CO. and G. M. WRIGHT. January 6th.

247. "Receivers for wireless signals." MARCONI'S WIRELESS TELEGRAPH CO. and G. M. WRIGHT. January 6th.

346. "Electrolytic deposition of a cobalt-silver alloy." P. MARINO. January 7th.

235. "Guide for connecting trolley wheels to overhead wires." A. S. MIZEN. January 6th.

203. "Casings for electric wires." A. K. MODI. January 5th.

155. "Electrical signalling apparatus, specially applicable for military and training purposes." E. G. PULFORD. January 5th.

19. "Apparatus for undercutting the insulation between the commutator segments of electrical motors and dynamos." A. T. ROBINSON. January 3rd.

250. "Fuses for protecting electric circuits." A. SCHAANNING & S. A. STIGANT. January 6th.

334. "Order telegraphs, etc." L. SCHOR. January 7th.

139. "Transmitters, microphones, relays, etc., for telephonic and similar purposes." H. SMITH. January 4th.

269. "Extra-high-tension isolating-link phase indicator." V. H. TREGONING. January 7th.

184. "Electric incandescent lamps, filaments therefor, and manufacture thereof." E. WECHSLER. January 5th.

177. "Arc lamps." G. WESTERCAMP. January 5th.

179. "Means for propelling a load along a cable." G. WESTERCAMP. January 5th.

288. "Electric lighting means." R. S. WOODS. January 7th.

358. "Electric lighting system or circuits." H. WRIGLEY. January 8th.

PUBLISHED SPECIFICATIONS.

1914.

24,121. ELECTRIC ILLUMINATION SYSTEMS, MORE PARTICULARLY FOR AUTOMOBILE VEHICLES. L. Renault. December 15th. (April 3rd, 1914.)

24,231. RECEIVING SYSTEM FOR CONTINUOUS ELECTRIC WAVES. E. H. Armstrong. December 17th. (December 18th, 1913.)

24,235. MANUFACTURE OF RUBBER-COVERED ELECTRIC CONDUCTORS. W. Geipel. December 17th.

24,502. VAPOUR ELECTRIC LAMPS. F. Bousson. December 22nd. (Convention date not granted.)

24,746. TELEGRAPHIC TRANSMITTING APPARATUS. S. Wechsler. December 29th.

1915.

647. ELECTRIC SIGNALLING. F. G. Cole. January 15th.

1,090. ELECTRICAL TERMINALS. Sterling Telephone & Electric Co. and T. D. Ward-Miller. January 22nd.

2,014. ELECTRIC CONTROL APPARATUS. A. H. Curtis & Igranic Electric Co., Ltd. February 8th.

2,619. ELECTRIC STARTERS FOR INTERNAL-COMBUSTION ENGINES. A. H. Midgley and C. A. Vandervell. February 18th.

3,261. ELECTRIC LIGHT FITTINGS. L. A. Maurice (Executrix of G. Maurice, deceased) and F. T. Cash. March 1st.

4,045. ELECTRICAL SWITCHES. A. P. Lundberg, G. C. Lundberg, P. A. Lundberg, and G. Pegg. March 15th.

5,727. MEANS FOR ATTACHING ELECTRIC CABLES OR CONDUITS TO SWITCHES AND THE LIKE. G. Ellison and J. Anderson. April 16th.

5,879. COMBINED ELECTRIC SWITCH AND WALL PLUG. W. H. Sturge. April 20th.

5,889. ELECTRIC HEATING ELEMENT. Cable Accessories Co., Ltd., & F. H. Reeves. April 20th.

6,093. LEAD-JOINTING SLEEVE FOR ELECTRIC JOINTS. C. J. Beaver & E. A. Claremont. April 23rd.

13,051. REPLACEABLE ELECTRICAL SAFETY FUSES. W. J. John. September 13th.

An Exhibition in Spain.—The world-war notwithstanding, it is intended in Spain to hold an international exhibition of Spanish electrical and general industries. At a conference held on December 30th, the plans were discussed; the cost of the exhibition was stated to be estimated at 40 millions of pesetas and the receipts at 45 millions. A "Festival of the Spanish Race" will be a feature of the exhibition, and it is expected that the Presidents of the Spanish South American States will assist King Alfonso at the opening ceremony.

Factory Property in 1915.—MESSRS. LEOPOLD FARMER & SONS in their report on factory and commercial property sales in 1915, state that in their experience the sales and letting of factory property, wharves, land, &c., showed far better results than was the case in 1914. "This result is in a large measure due to the war, which has produced a great demand for factories and commercial property of all descriptions. As we anticipated in the early stages of the conflict a demand was created for factories, due primarily to the requirements of the Government for the manufacture of the necessary war equipment for our Fighting Forces, and, secondly, for the manufacture in this country of goods previously imported. . . . The nation's immediate wants have necessarily demanded extra pressure of manufacture which created a necessity for the opening up of factories, as well as the extension of present ones, to cope with the enormous requirements of the country. We have disposed of a large number of factories, with and without plant and machinery, at figures running into many thousands of pounds, and an unprecedented demand still exists for properties of all kinds. Premises that previously to the war had failed to find tenants for years have been rapidly taken up, owners in many cases having obtained, through competition, increased prices. It is interesting to record on analysing the demand for factories that many have been disposed of to the Government, Government contractors in all branches of manufacture, English firms starting to manufacture goods previously imported (now barred through the war), and Belgian manufacturers who largely exported goods to this country, but are prevented from doing so now owing to their works having been destroyed by the Germans."

Ball-Bearings on Railway Rolling Stock.—In 1910 experiments were made on the Montreux-Oberland electric railway with the use of ball-bearings on the rolling stock, and the results were so successful that now all new passenger motor-coaches and trailers and a proportion of the goods wagons are fitted with them. Their use has not been confined to the axles, as they have been found excellent for the bogie slides, easing the motion round curves. The latest step is to fit ball-bearings on the electric motors, which are of 114 H.P. each and run at 1,660 R.P.M. at 45 km. (28 miles) per hour, and the result has been entirely satisfactory. Experiments with dynamometers showed that with ordinary bearings the tractive resistance was 5·3 kg. per ton, and with ball-bearings 2·3 kg. per ton; the latter require lubrication only once in six months in place of every 10 or 15 days, and last for 10 to 15 years instead of about two years.

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THE

ELECTRICAL REVIEW.

VOL. LXXVIII. JANUARY 28, 1916. No. 1,992.

ELECTRICAL REVIEW.

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THE ELECTRICAL REVIEW.

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NOTICE.

IN view of the recent Increase in the Postal Charges, our Subscription Rates for Great Britain and Canada will until further notice be increased to £1 1s. 8d. and £1 3s. 10d. respectively.

TRADING WITH THE ENEMY.

THE introduction of the Trading with the Enemy (Amendment) (No. 2) Bill has once more brought into prominence certain vexed questions as to companies which consist in the main of enemy shareholders. The Government has been accused of delaying action in connection with the matter, and it has been stated that the early Acts ought to have more drastically dealt with the situation. The subject, however, is hedged about with difficulties of no ordinary kind, and in some respects those difficulties have been less understood by the legislative mind than by the mind of business men, who have been "up against" enemy-owned firms and companies ever since the outbreak of war. The legislative mind has viewed the matter perhaps too coldly and unsuspectingly, regarding it purely in its legal aspects; the business man, on the other hand, has been in some cases too ready to jump at conclusions, so obnoxious has it been to him to have relations with those who belonged to a race with so vile a record as Germany has written in blood and lust during these eighteen months. We can conceive, however, of circumstances under which the business of a company may well be advantageous to this country, although the majority of its shares are held in Germany and Austria, and it would not therefore be wise to say that a company must be wound up merely because some of its shareholders are Germans; but there is no reason for permitting concerns which are practically entirely German-owned to "carry on," making profits during the war, and keeping the way open for the enemy's "after-the-war trade."

It is most desirable that the matter be taken in hand, and the new Bill will be welcomed by everybody who has observed the extent to which German ownership and control have spread amongst us, notwithstanding the fact that our own Patents legislation has been responsible for much German capital being put into British factories. The principle of the Patents Act was not to enable the foreigner to get a firmer grip here, but to assist the development of British industries within these islands, and when the principle of "limited liability" was established some 60 years ago, it was never intended to enure for the benefit of countries which are at war with England.

The fact that a company is what lawyers call a "separate entity," as apart from the shareholders, should not be allowed to stand in the way if exigency demands that its operations be restricted. Under the law, as it now stands, the dividends on shares held in English companies by alien enemies may be paid to the custodian of enemy profits; but the company may still carry on in war time. The goodwill, which may belong almost entirely to alien enemies, is thus maintained, and war profits might even accrue. The profits thus accumulating might be of great use to the enemy at the end of the war. In particular, the existing law as to ownership of a ship is playing right into enemy hands. No alien can own a British ship, but two Germans can form a company, and that company can own a ship.

The Bill introduced by the Solicitor-General proposes to redress these evils. The Board of Trade is empowered to make inquiries. If satisfied that a business carried on in the United Kingdom is, by reason of enemy nationality or enemy association of those who carry it on, conducted wholly or mainly for the benefit of subjects of enemy states, then the Board may make an order either prohibiting the carrying on of the business during the war, or directing it to be wound up. If the business is for the national benefit, the Board of Trade may allow it to be carried on. If it

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is small and insignificant, or if its closure would involve unnecessary hardship, the Board will still be able to exercise its discretion. It will be observed that almost everything depends upon the pursuance of an energetic and thorough policy by the Board of Trade. When once this Bill becomes an Act the Board will have all the powers that it will need to deal with the matter, and we may be sure that if those powers are not put into force, not only the business world at home, but our Colonial statesmen who have worked so hard to eliminate German influence, will want to know why. In distributing the assets of a company which is to be wound up, preference will be given to British and friendly creditors over those who are enemy creditors. If the company has assets in the enemy country, regard will be had to the fact that those assets will probably be applied for the benefit of creditors in that country.

In accordance with the best traditions of English justice the powers given to the Board of Trade err on the side of leniency to the alien enemy. In a winding up the sum due to an enemy shareholder will not, of course, be paid over to him, but will be held until peace is declared, and until it is found how British property in enemy countries is being dealt with.

That it will be necessary to establish such a fund was made plain by Mr. Cave, when he told the House of an Englishman who, when war was declared, was carrying on business in the Fatherland. His business was placed under a controller, he himself was interned. In January, 1915, he was informed that he had nothing further to do with it, that it had become a German business; but that he, as manager, would still be responsible for its debts! But the most unkindest cut of all was that all the profits would be invested in the German War Loan! If this represents the way in which Germany is dealing with English property, it seems to us that the Government would be fully justified in confiscating all German property now in England. But that is not our way, though we may not find it impossible to have a progressive policy in this as in other connections, as the war takes on new phases. Under this new Bill the Government are going to hold on to German property until some time after the end of the war. It will be held in bond as security for fair dealing with property now owned by Englishmen on enemy soil.

The Bill was received with acclamation by the House of Commons, and that is not surprising, for enough has happened in the war to show that Germany is determined to show no mercy to England or to anything English; and the Government should do everything within their power, either through the medium of this Bill or in any other way, to enable us to carry on as far as possible without German companies, German shareholders, or German goods, when peace is once more restored. Acts such as this may go part way in assisting us to that end, but as we have repeatedly shown, there are many other respects in which we have got to set our house in order before Germany will be a permanently beaten commercial and industrial nation. We must not expect too much from Acts of Parliament—merit still counts and always will, and we must improve both the individual and the combined efficiency throughout the nation if we wish to hold our own, or to regain such part of it as we had lost.

Electric Railways.

Quite unexpectedly—for our thoughts for long have been directed elsewhere—a flood of information on the subject of heavy electric traction and electric locomotives has been let loose upon us, by Mr. H. M. Hobart and Mr. F. W. Carter respectively. Elsewhere in this issue we review the contents of Mr. Hobart's masterly lecture, which conclusively demonstrates that the steam locomotive, having reached its physical limits, has been beaten almost to a standstill by its younger rival. "Youth will be served," in the future as in the past; the steam locomotive for just over a century has done magnificent work, of incalculable benefit to mankind—it has deserved well at our hands, and will continue to do so for many years to come. But its best days are over, and, even in this country, where coal is abundant and water-power scarce, the inherent advantages of its electrical rival have compelled recognition, whilst in countries blessed with water-power and peace, the electrification of steam railways is rapidly advancing.

Mr. Hobart's lecture was devoted mainly to the marshalling of facts and the deductions that could be based upon them, leading up to the triumphant conclusion that electrification on an extended scale was imminent, preferably on the high-pressure direct-current system; Mr. Carter's paper, on the other hand, dealt with the design and performance of the numerous types of locomotives which have been evolved in the endeavour to find a satisfactory method of transmitting the power from the motors to the driving wheels. It is a curious fact, emphasised by Mr. Aspinall in the discussion, and later by Dr. Parshall, that the outstanding problem in the design of electric locomotives is a purely mechanical one, that of communicating the rotary motion of the motor armature to the revolving wheels—a simple enough matter on the surface, but in reality so complicated by considerations of space, weight, velocity ratio, spring suspension, flexibility of frame, smoothness of running, height of centre of gravity, and other important factors, that it remains up to the present without a satisfactory solution. Mr. Carter has applied the resources of mathematics to certain aspects of the question, particularly in connection with the "nosing" tendency of some types of locomotive, due to the interaction of the coned wheel treads, the flanges, and the rails, and by original methods has succeeded in dissecting the problem into its component parts and providing an apparently sound theory by means of which this objectionable proclivity can be restrained. Two very important facts which he has brought to light, on the basis of exhaustive tests of train resistance that were carried out 10 years ago, are that the tractive resistance of a train of coaches is a straight-line function of the number of coaches, at any given speed; also, the additional tractive resistance per additional coach is a straight-line function of the speed.

In view of the amount of work that has been expended on this subject, and the anomalous results previously obtained, it is extraordinary that these facts—which are now conclusively demonstrated—should have eluded discovery for so long a period, and the author is to be congratulated on the result of his examination of these data.

Both authors are well known to be strenuous upholders of the direct-current system as opposed to single-phase, and they have not failed to indicate the trend of their convictions in their latest writings; Mr. Hobart reminds us that many years ago he predicted the ultimate victory of the high-pressure D.C. system, and Mr. Carter ascribes the evolution of the side-rod "cranky" type of locomotive to the necessities of the single-phase system, which also is credited with resonance tendencies. Naturally, the supporters of S.P. likewise did not fail to repel the aspersions cast upon their *protégé*, which certainly is not yet by any means out of the running. But the controversy nowadays does not assume an acute form, and the amenities of debate were preserved. No new data regarding the commercial working of the single-phase system were forthcoming, as Col. Crompton regretfully remarked, with reference to Mr. Philip Dawson's contribution to the discussion; but it is interesting to record, as showing that Mr. Dawson preserves an open mind on the subject, that he recently approved of the high-pressure D.C. system as undoubtedly the right thing for a British railway in connection with which he was consulted.

Doubtless there is room for both systems, and both are being extended; but it seems obvious that the successful adoption of continually higher voltages on D.C. systems tends to rob the S.P. system of one of its most tangible advantages. Mr. Aspinall stated that the experimental 3,000-volt D.C. system on the L. & Y. Railway had worked successfully from the commencement.

Mr. Merz considered the United Kingdom particularly favourable to the development of electric traction on railways, and stated that the trial runs on the North-Eastern mineral line had proved highly satisfactory. It is generally agreed that for moderate speeds the existing designs of electric locomotive serve very well, but for express passenger service a satisfactory design is still awaited.

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These Consuls Again.

THE shortcomings of our Consular service, from the trade point of view, are becoming a popular theme—perhaps now we shall see something done. Speaking at a meeting of the Commercial Committee of the House of Commons, of which he is honorary secretary, Mr. Louis Sinclair, in an address to the Employers' Parliamentary Association, referred to those shortcomings, and said that more money should be spent upon the Consular trade service. Some of of us have been saying such things almost as long as we can remember. If the Commercial Committee of the House of Commons is worth its salt it will use its influence to secure that result. Particularly interesting are the remarks of the Earl of Rosebery on the same question and on another matter too. In an address to the Rotary Club, Edinburgh, last week, he said that it would be a mistake for business men to seek, or to reckon upon, any assistance from the Government for commercial enterprises after the war. There were, however, two points on which they should be prepared to disregard preconceived notions. They would have to reconsider the question of tariffs, and many of our previous formulas by which we could not be hampered in the prosecution of a successful foreign trade. This remark, be it noted, comes from one who, under other conditions, said that nationally we must stand or fall by Free Trade. The altered situation brought about by the war has put many people's views into the melting pot, but his lordship's attitude forms one of the most conspicuous examples of the willingness of eminent men to scrap their "preconceived notions." Lord Rosebery's second point was stated thus:—"The Foreign Office have always had the greatest antipathy to their Consular agents engaging in promoting commerce of particular firms in foreign countries. I think the *laissez aller* policy will have to be abandoned, and we shall have to sanction the interference of our Consular agents to promote our commerce in foreign countries." With all due deference to his lordship, we would say that it seems to us that in the reform of our Consular service for the good of commercial enterprises, business men have every reason to reckon upon receiving assistance from the Government.

In our opinion, the Foreign Office is far more to blame than any other department for our national shortcomings in this connection. As matters stand, with a few notable exceptions, we receive far greater assistance from our few Trade Commissioners than from all the Consuls, and we should like to see the Board of Trade's activities extended. The Board never really has had an opportunity of showing, on a proper scale, what it can do in legitimate ways through the medium of such representatives. "*Sanction interference*" indeed! Yet we are inclined to think that Lord Rosebery is one of those who really ought to know. Was he not Foreign Secretary once—and for a brief spell Prime Minister too?

"Promoting the commerce of *particular firms*" it might be right to object to under some circumstances, but a Teuton would have no scruples on that point, so long as the business went to Germany as the result of his Consular activity. But what about the commerce of our *nation* as a whole? Has the Foreign Office an "antipathy" to the fostering of that? We are very much afraid that that is how it has been too frequently in the past. Yet there is ground for hoping that even the Foreign Office is now willing to do something to assist British traders. We are grateful for its decision to appoint commercial attachés at Buenos Aires, Monte Video, and Rio de Janeiro, a consul and a vice-consul being called from other duties to fill these new offices. The appointments have been made, says the announcement, in consequence of the Secretary of State for Foreign Affairs "having decided to give further assistance towards the promotion of British trade in South America." If this is a sign of the times, we are profoundly thankful for it.

Those who are doubtful as to whether Government Departments are able to assist in the development of national trades might do worse than read the report which we give on another page concerning the first year's work of the U.S. Bureau of Foreign and Domestic Commerce. It tells, it is true, of some of the difficulties that America is "up against" in connection with export trade, but it quotes a number of definite practical results of the Bureau's recent efforts. The reference to the vote of $100,000 for new commercial attaché service, and the need for extending such vote and service, should be noted.

Copper.

COPPER prices continue to advance steadily, and it is generally believed in the trade that the recent official pronouncement regarding maximum prices is not to be taken seriously. At any rate, consumers report that they are unable to obtain supplies from the Government at the price fixed by them of £100 for refined material, and after waiting in vain in an attempt to secure relief from this direction have been forced into the market, where competitive buying has naturally forced rates still higher. At the present time it is exceedingly difficult to obtain copper at any price, for the leading producers are sold out for months ahead, and are only willing to make prices for very small lots for prompt or early shipment, while holding off altogether in respect of important distant business. On the top of this, stocks here are going down, and refiners are treating metal which they have discarded for years past, for the simple reason that they are unable to obtain anything else. The enormous margin, too, between the prices of standard copper and refined makes it possible for them to treat the former at a profit, whereas for a long period they have been unable to handle this class of material, and to make a living out of it. The American position shows not the least sign of abating in its strength, and reports to hand from America speak of a copper "famine." Certainly the leading selling agents in America are unanimous in declaring that this condition of affairs has now come to pass, there being hardly any January, February, March or April copper now to be obtained except as a favour. There seems some truth, too, in the statement which emanates from leading producers that there is not sufficient copper to go round, and certainly consumers in need of supplies have been paying enormous prices. Refinery capacity, although going to the fullest extent, is unable to turn out the quantities of material required by the trade, while there seems to be a glut of raw copper, for the mines and furnaces are turning out more material than the refineries can handle. How long this state of affairs can continue is a matter of conjecture, but there can certainly be no relief until war conditions are modified, and we seem likely, therefore, to drift on for months before any definite lead is given. According to statistics just available, the United States output of refined copper from native and imported raw material broke all records—at 735,000 tons, against 684,000 tons in 1914.

British Electrical Exports and Imports during 1915.

ELSEWHERE in this issue we publish a graphic summary of British electrical export and import business during the year 1915, which will be of considerable interest to our readers in view of the exceedingly difficult period through which this country, in common with others, has been passing.

Black as has been the outlook, from the point of view of British trade during the year, it cannot be said that the clouds show any real signs of rolling away, and our consolation, such as it is, must be gathered from the excellent fight which the home electrical manufacturer has been able to put up with a view to retaining overseas trade, despite our concentration on munition making and war supplies.

Although the total value of our electrical exports was naturally much less than during the last few years, it must be remembered that 1915 was devoid of bulk submarine telegraphic exports.

America has usurped the place of Germany as an importer into this country, as was expected, under the conditions prevailing, and the only blot in the import returns for the year, appears to be the fact that it should have been necessary for us to purchase £125,000 worth of lamps and parts from Holland, material which is produced by female labour, and could, therefore, have been produced here, had the manufacturing facilities existed.

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MUNICIPAL ELECTRICITY SUPPLY AT JOHANNESBURG.

BY R. TURNBULL MAWDESLEY.

(*Continued from page* 91.)

THERE are four Peebles-La Cour motor-converters installed in the principal generating station, two of 750-KW. capacity and two of 1,250 KW. made by Messrs. Bruce Peebles and Co., Edinburgh, all of which are in constant service. As previously explained, any of these converters may be run either on the D.C. lighting load, or "on traction," by means

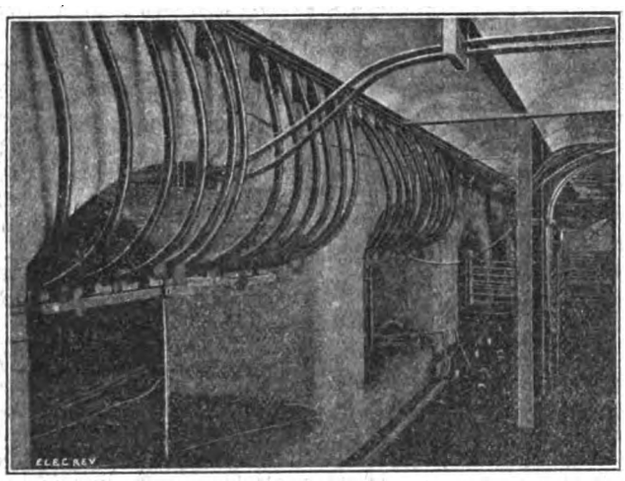

FIG. 5.—STATION CABLES ENTERING CABLE TUNNEL.

of the triple-pole main change-over switch on the generator panels.

An interesting point is the wide pressure regulation possible on the D.C. ends of these converters which varies from 460 volts for lighting (shunt wound) to 600 volts for traction. This variation is handled solely by a regulating resistance in the shunt field circuit. As previously observed, the power-factor may be leading when on traction load, and is never below ·96 on lighting.

It will appear that these converters may (or may not) be operating in parallel on both the A.C. sides and the D.C. sides—but in either case no trouble whatever arises in operating these machines in parallel, whether the D.C. ends are in parallel or not.

The starting-up of these converters is accomplished by switching the high-tension (3,000-volt) current, direct to the stator winding. On the 750-KW. converters three of the 12-phase windings of the rotor are brought out through slip-rings to a non-inductive metallic resistance, the neutral point of which is earthed, and connected to the middle wire of the D.C. lighting system (and also to the negative (rail) of the traction system). On the 1,250-KW. converters, six tappings are brought out from the rotor windings, through slip-rings, also to an external non-inductive resistance, the neutral point of which is earthed, as above. The other ends of these windings are permanently connected to the D.C. armature windings, through the shaft, which is hollow, and supported by a central bearing between the A.C. and D.C. sides of the machine.

The stator currents induce currents in the phase windings of the rotor, and the machine starts up as an ordinary induction motor. When the speed rises to synchronism—which can be observed by the oscillations of the pointer of a voltmeter connected across the starting resistance—this resistance (which is not variable as in three-phase converters) is short-circuited by a switch on the starter.

The converter is now in parallel on the A.C. side, the slip-rings and the open ends of the remaining windings being short-circuited by a lever on the end of the shaft.

During the starting-up period, the D.C. end of the converter is not connected to the D.C. bus-bars at all, the only D.C. circuit closed being that of the shunt field.

Slight variations in speed before synchronising can be made by altering the shunt field resistance—but practice has shown a more or less permanent position for the field regulator—on starting.

Mr. J. W. Saaler, A.M.I.E.E., of Messrs. Sykes & Co., Johannesburg, who obtained part of the converter contract, gives the following test figures for one of the 750-KW. converters, in a paper "On Converters," read before the South African Institute of Engineers.

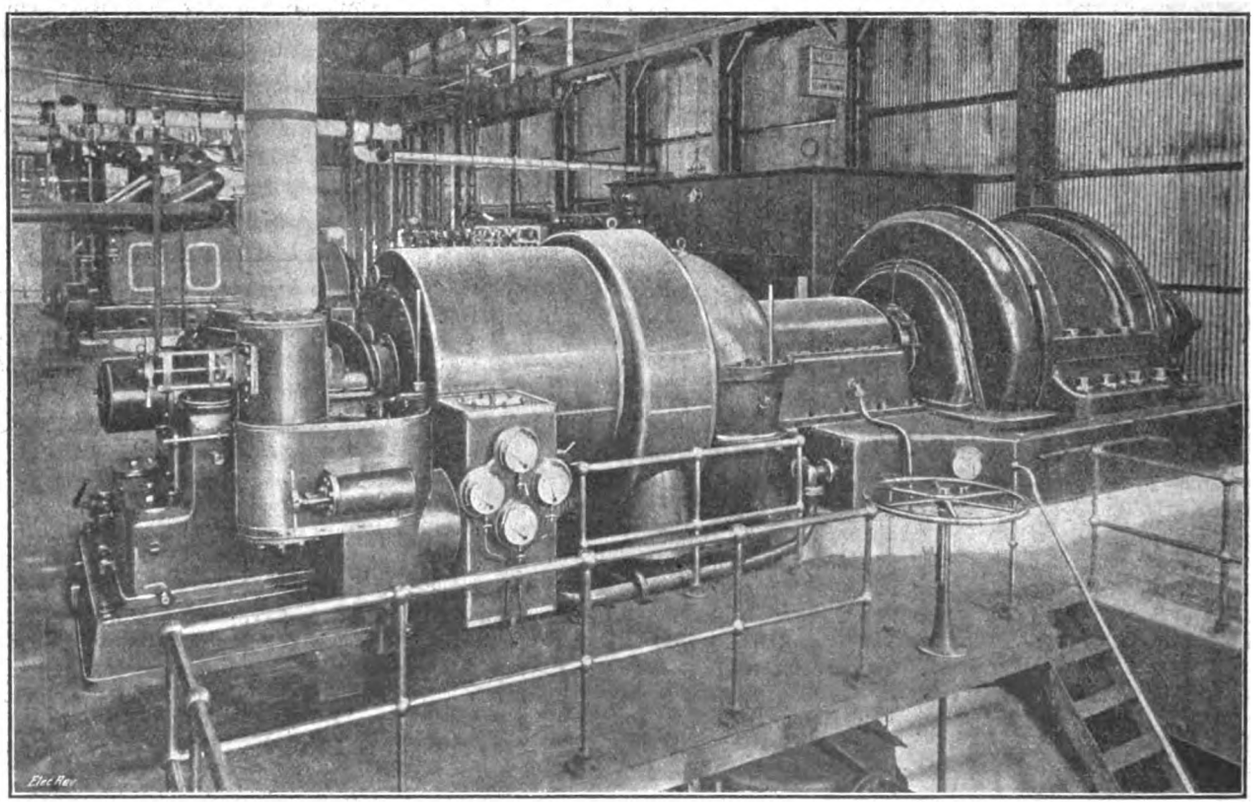

FIG. 6.—VIEW IN THE ENGINE ROOM, JOHANNESBURG MUNICIPAL POWER STATION.

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MOTOR-CONVERTERS OF 750-KW. CAPACITY.

Specification.

A.C. end, 3,300 volts—2-phase, 50 periods.
D.C. end, 460/520 volts as shunt—1,630 amps.
500/600 volts as compound—1,250 amps.
Number of poles on A.C. side—8
Number of poles on D.C. side—8 } speed, 375 revs.
Number of commutating poles—8

Efficiency measured as shunt generator for lighting at 520 volts —1,445 amps., 750 KW., D.C. output.

It is assumed that the efficiency is in the neighbourhood of 91 per cent, the input, therefore, on the A.C. end is 825 KW. With this input at 3,300 volts, the current per phase is 125 amps.

	Full load.	*Half load.*
No-load losses, comprising friction in bearings and commutator, windage losses, all A.C. and D.C. iron losses, measured	29·0	29·0
Resistance of shunt winding 76·5 ohms, hot shunt current about 6·5 amps....	3·2	3·2
No-load losses	32·2	32·2
Resistance of stator winding 0·18 ohm hot per phase—		
Full-load current, 125 amps. ...	5·65	—
Half-load current, 63 amps. ...	—	1·43
Resistance of rotor winding 0·019 ohm per phase hot—		
Full-load current, 193 amps. ...	8·5	—
Half-load current, 96·5 amps. ...	—	2·12
Resistance of D.C. armature winding, 0·0067 ohm hot—		
Full load 1445/1·5 = 963 amps. ...	6·25	—
Half load 723/1·5 = 482·5 amps....	—	1·56
Resistance of interpole winding hot, 0·00037 ohm—		
Full load, 1,445 amps.	0·77	—
Half load, 723 amps.	—	0·19
Commutator current losses at 1·445 amps., drop two volts, resistance 0·00138	2·88	—
Half load, 723 amps.	—	0·72
Total losses ...	56·25	38·22

Total losses in per cent.—

Full load $\frac{56{\cdot}25 \times 100}{806{\cdot}25} = 6{\cdot}97\%$ Half load $\frac{38{\cdot}22 \times 100}{413{\cdot}22} = 9{\cdot}25\ \%$

Efficiencies—

At full load = 93·03 % At half load = 90·75 %

The cable work at the back of the D.C. main board, the roomy cable chamber (fig. 4) beneath the oil switch cubicles, and the system of supporting the machine and feeder cables, are worthy of note.

Fig. 5 shows cables from the station entering the main cable tunnel, about a quarter of a mile long.

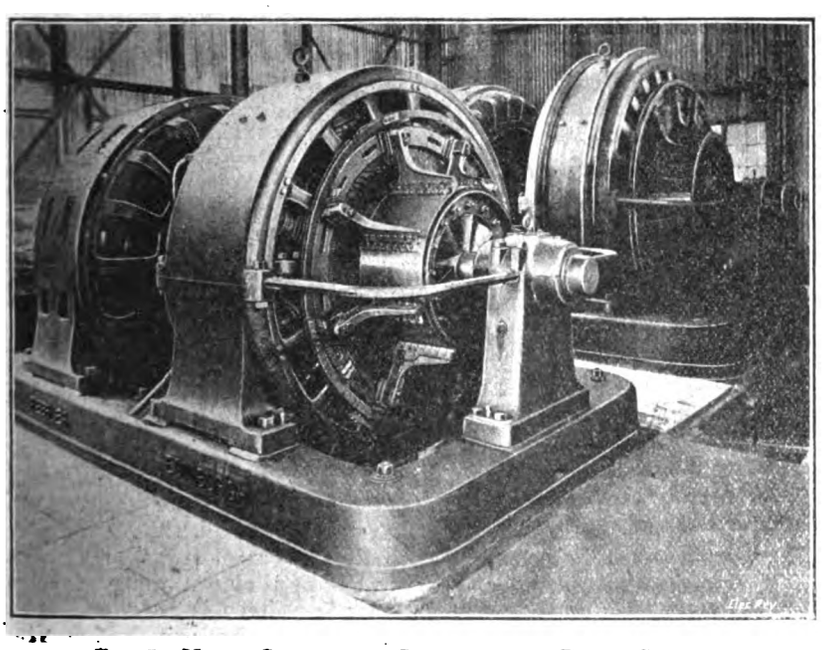

FIG. 7.—MOTOR CONVERTERS, JOHANNESBURG POWER STATION.

A comprehensive view of part of the converter plant is shown in fig. 7, the view showing one 750-KW. and one 1,250-KW. Peebles converters.

The three steam turbines at present installed were made by Messrs. Belliss & Morcom, and were supplied through Messrs. Reunert & Lenz, their Johannesburg agents. They are each of the high-pressure re-action type, but two of them are furnished with exhaust steam belts, as shown in fig. 6. The turbines are not supplied at present with mixed pressure steam, that is to say, the exhaust from the reciprocating Belliss sets is not utilised in the turbines, but passes direct into separate condensers.

The reason for this is not obvious, as, on the peak loads, the Belliss reciprocators carry anything up to 2,000-KW. load, and sometimes more.

Each turbine has its own condenser, of the surface type, having a cooling surface of 7,200 sq. ft. with 3,670 tubes 10·2 in. long. Their intended duty is to condense 46,200 lb. of steam per hour, and to maintain a vacuum within 1·6 in. of the barometer, with circulating water at an initial temperature of 70° F.

The circulating and kinetic air pumps are motor-driven at the following speeds:—Air pump, 1,500 R.P.M., and circulating pump,* 600 R.P.M. Each turbine has a cooling tower to deal with its condenser circulating water, the towers being erected directly over their individual cold wells. As these wells are at different levels, the necessary by-pass pipes and valves are fitted to maintain the water levels in the wells, or dams. The circulating pumps are situated outside the station proper, and have both A.C. and D.C. drives. It will be understood that the problem of circulating water in Johannesburg has presented some difficulties, as the town is situated in an extremely dry area, and all cooling ponds are artificial. Make-up water, for circulating purposes, comes from bore-holes sunk in the immediate vicinity, or, as stand-by, from the Rand Water Board, but in the rainy season there is no need for make up.

The turbo-generators call for little comment. Each supplies current at 3,000 volts, 50 ~ two-phase; and each has a direct connected exciter on the generator shaft.

There is at present no arrangement for operating the exciters in parallel, each machine and exciter comprising a unit.

The Belliss reciprocators shown in the background of fig. 6 are of the standard triple-expansion type, each direct connected to a continuous-current generator. These four engines exhaust directly into two condensers situated between the sets, the condensers operating individually, or in multiple as may be required.

As the switchboard gallery is placed at one end of the station, two operator's signalling devices have been installed, one for the turbines and one for the reciprocators.

Each is operated from the switchboard gallery, the various signals being shown on illuminated boards, attention to which is drawn by trembling bells.

A point not without interest is the fact that no shift engineers are employed in the Johannesburg Municipal Power Station. The responsibility of operating the station is vested in a shift electrician, who is virtually, though not nominally, in charge. All switching operations are carried out by the shift electrician, who by signal advises the drivers concerned if more machines are required. The drivers and boilermen are each made responsible for their own part of the work—and although at first sight such an arrangement would seem to point to trouble arising, such has not occurred. It is well to add that the station engineer resides on the property, and is always within call.

The 1,000-KW. alternator, coupled to a Belliss reciprocator, together with the two 250-KW. Allen engines, are erected in a separate engine room, adjoining the present boiler house—which building originally housed the first belt-driven bi-polar generators, before the gas engine period. This 1,000-KW. Belliss set and the two small Allen sets are run non-condensing—but this is not a serious item, as their hours of service are strictly curtailed—unless in case of trouble or emergency.

(To be continued.)

* Circulating pump designed for 60 ft. head, including suction and discharge and allowance for pipe friction.

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COST ACCOUNTING BY MACHINERY.

A REMARKABLE machine was described in a recent issue of the *American Machinist*, which is intended to replace mental labour in analysing and combining works cost accounts. The installation, which is electrically operated throughout, has been at work since October 1st, 1915. At any moment of a working week it shows how much each man has earned up to that time, the total wages accrued in each department, and the grand total of wages in all departments. It also shows during the life of each shop order how much labour has been expended on it, how much labour each department has accumulated since the commencement of the week, and the total labour expended in all departments during the same period.

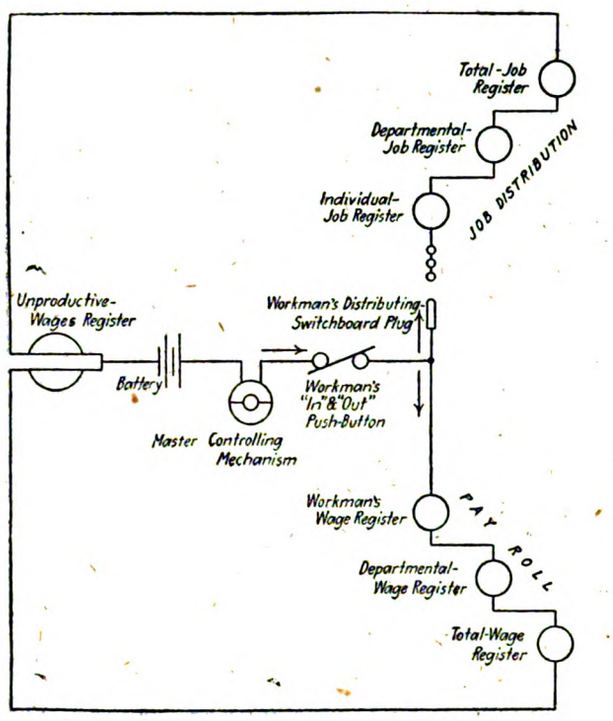

FIG. 1.—DIAGRAM OF OPERATION OF REGISTERS.

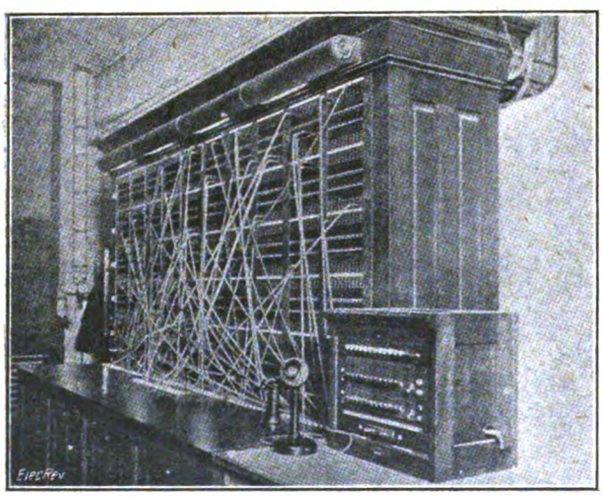

FIG. 2.—JOB-DISTRIBUTING SWITCHBOARD.

The machine deals with about 60 workmen; about 300 to 350 job changes are made every day, and 500 jobs can be registered at once.

The system is known as the "Chrono Cost-Accounting System," and the equipment was designed by the Synthelytic Co., of Chicago, and installed in the plant of the Liquid Carbonic Co., also of Chicago. The product of this plant is soda-water fountains, bottling machinery and soda-fountain supplies. Thus far only four departments are being served.

The equipment comprises a cabinet in which the pay-roll accounts are registered, two cabinets for job accounts, and the job-distributing switchboard. A standard type of programme clock is also provided. Only a single operator is necessary.

In a diagrammatic form the operation of the recording mechanism is shown in fig. 1. The source of electric current is a storage battery which is connected to the circuits through the master controlling machine. The recording circuit through the pay-roll registers is closed by the workman when he pushes in his button on entering the shop in the morning and at noon. On leaving at noon and night he releases his button. When the hour for beginning work arrives, the controlling mechanism begins to send electric impulses through the pay-roll registers, depending in frequency upon the man's rate. These impulses actuate the counters and accumulate his wages, a cent at a time, on one counter, his part of a departmental wage on another, and his part of the total wage of all the departments of the shop on a third.

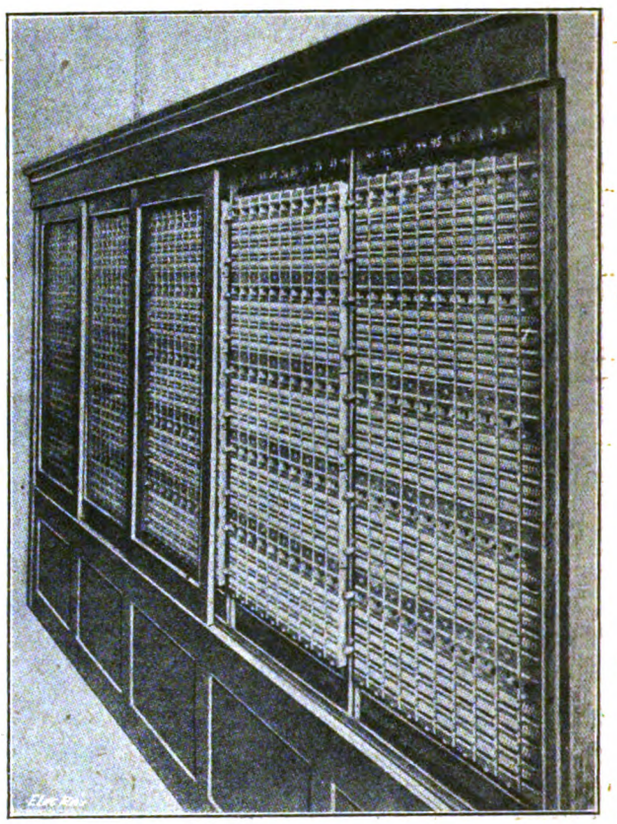

FIG. 3.—JOB LABOUR-DISTRIBUTING REGISTERS.

These registers accumulate for each pay-roll week, which runs from Thursday morning to Wednesday evening. The totals are then transferred to written records and the counters are re-set to zero and replaced, or others already set to zero substituted for them. By these changes the equipment is made ready for the next week's pay-roll accounting.

Turning back to the diagram, it will be noticed that only the lower circuit through the pay-roll registers has been traced. There is another, and as drawn, upper, circuit passing through the job-distributing registers.

When a workman's circuit is plugged into the proper job register through the distributing switchboard, the same impulses that register his wages also register the amount of his labour, first on the individual job counter, second on his departmental job counter, and third on the job-labour counter for all the departments. The record of the individual job register is copied off as soon as the job is finished, the counter is removed, set back to zero, and

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replaced ready to record another job. The department distribution totals and the grand total are used to check the pay-roll totals, and are erased at the end of each pay-roll week.

This explanation covers all the features of the diagram, fig. 1, except the "unproductive-wage register." Its purpose is to accumulate all the wages by departments that are being recorded on the pay-roll registers, but not on job-distribution registers. It is evident that for any week the sum of the readings of the "total-job register" and "unproductive-wage register" must equal the reading of the "total-wage register."

The workman's push-buttons are in the form of simple push-button switches built up into panels placed near the shop entrance. White buttons register in, and black ones, out. These panels replace the usual time clocks.

The payroll register cabinet has been developed from a measured-service meter that has been used for years in telephone exchanges. The job-distributing switchboard, which also has been adapted from telephone practice, is shown in fig. 2. The plugs when inserted into the jacks connect the source of electric impulses for individual jobs with the job-distributing counters for the jobs on which they are

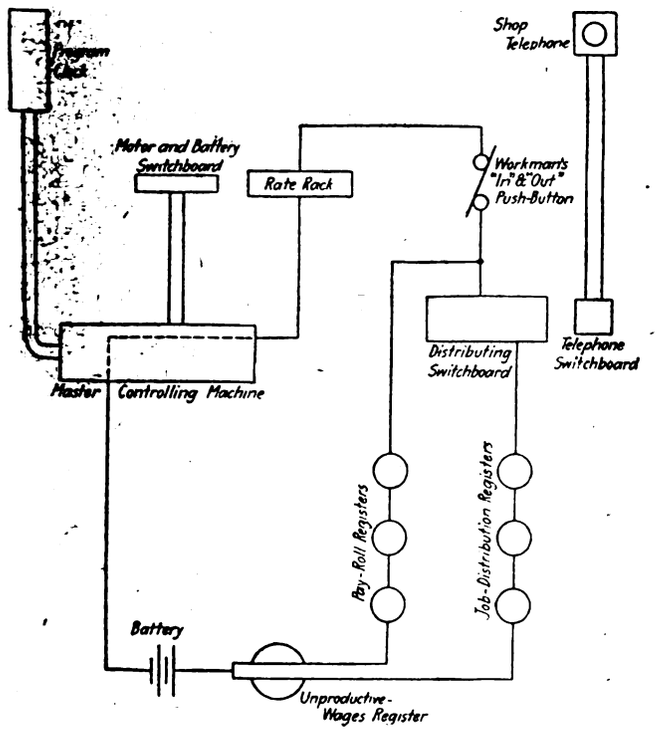

Fig. 4.—Arrangement of Complete Equipment.

working. The counters are shown in fig. 3; five counters are fitted in a frame and form a unit. Each counter records from 1 cent up to $9999.99 by one-cent increments, and each electric impulse accumulates one cent. On the back of each registering unit is a locking device which prevents any movement of the counter wheels when a strip is removed from the cabinet.

The devices that control and send the electric impulses which actuate the registers consist of a master controlling machine, a programme clock that controls its operation with reference to elapsed time, a switchboard and rheostats that control the driving motors of the machine, a storage battery supplying current for the registering circuits, a rate rack for the workmen's rates of pay, and a private telephone system to convey information with regard to jobs. The machine can be run at normal speed, 1½ times or twice normal. The whole arrangement is diagrammatically shown in fig. 4.

The principle on which the system operates is that of figuratively allotting to each workman a small fraction of his wages at short intervals, the amount being always one cent, and the interval being varied according to the workman's rate of pay. An impulse is "offered" to every circuit once every minute; whether it is sent on or not depends on the circuit being open or closed, and this is determined by the relationship of the man's rate and any particular minute in question.

The rates are set as regards the mechanism by the rate rack, which provides groups of connections for all even-cent rates from 6 to 60 per hour. The circuit from each man's push-button is through the rack and the particular group of connections corresponding with his rate. An impulse from the machine for a 30c. man finds a closed electric circuit only every other minute.

The information for the completion of the circuit between an individual man's rate-rack connection and the proper job register is received at the distributing switchboard over the private telephone system. When a workman begins or finishes a job he telephones his own number and the job number to the switchboard. From this information the switchboard operator makes or breaks the proper connection. It is evident that this distributing board is constantly undergoing changes in settings as some jobs are completed and others begun.

The master controlling machine is most ingenious in design and interesting in construction. It is driven by a three-phase motor, together with an emergency D.C. motor that will automatically pick up the load of the machine if the alternating current fails.

When the shop goes on time-and-a-half (5 p.m. to 11 p.m.), the controlling machine runs at 1½ times normal speed, and for double time (11 p.m. till morning) at double speed. Provision is made to meet the case of labourers who are paid at lower overtime rates, and for odd fractional rates of payment.

Supervision is arranged for at two places—on the distributing switchboard and in a special lamp panel in the superintendent's office. Under normal working conditions a lamp glows on the superintendent's panel for every man whose wages are being added to the unproductive-wage account. By pressing a button a lamp glows for every man who is registered as in attendance and is drawing wages. Similar signals show on the plug shelf of the switchboard.

Beyond this, each man's circuit is provided with a lamp located near the switchboard plugs. These light at the instant that an impulse is being sent along their associated circuits to the registering mechanism. The purpose behind this feature is to forestall the possibility of plugging a man from one job to another at the precise instant an impulse is being sent over his circuit.

ELECTRIC RAILWAYS.

The "James Forrest" lecture, which was prepared for the Institution of Civil Engineers by Mr. H. M. Hobart, M.Inst.C.E., and delivered on his behalf by Mr. J. A. F. Aspinall, is a compendium of information on the subject of electric railways in general, and especially upon recent progress in the United States. So rapid has been the development in this branch of engineering since electric locomotives commenced running on the City and South London Railway in 1890, that there are now 3,460 miles of steam railway track converted to electrical operation in the United States and Canada alone; on the other hand, there remains 380,000 miles of track still operated by steam, so that there is abundant scope for future conversion. The author gives the total mileage of electric railways in the United States and Canada as 45,000 miles, but this clearly includes tramways.

During the last five years the mileage of steam railway converted has more than doubled. The reason given for this rapid growth is the continual

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decrease in the cost of electrical energy, which in turn has been accelerated by the railway demand: even ten years ago a price of 1d. per KW.-hour would have been the minimum permitting of any profit, whereas now electrical energy can be purchased at little more than ½d. per KW.-hour, and on the Butte, Anaconda and Pacific Railway the cost is 0.265d., whilst the Chicago, Milwaukee and St. Paul Railway will pay only 0.26d.; in both these cases the electricity is derived from water-power. The cost of plant has also come down with a run; a 3,000-KW. set 15 years ago cost £30,000, whereas now a 30,000-KW. steam-turbine-driven set can be obtained for less than £60,000, and consumes only ⅔ as much steam per KW.-hour.

While the fixed charges are lower than the operating costs in the case of a steam-driven station, the reverse holds good for the hydro-electric station, and for load factors above 20 per cent. the total costs of the latter are much the lower, so that, as an electrically-operated railway has a fairly good load factor, the greatest progress has been made with railway electrification in countries possessing abundant water-power. The author sets out the working costs of a 150,000-KW. steam-driven generating station equipped with generating sets of 30,000-KW. each, with a load factor of 50 per cent., and shows that with fuel at 8s. per ton, the total costs amount to 0.265d. per unit, of which fuel accounts for 0.075d. Transmission for a distance of 100 miles adds only 0.08d. per unit to the cost. Whilst an electric locomotive may have a load factor of only 15 per cent., the combined load factor of 30 locomotives may be as high as 60 per cent., thanks to the diversity factor of the system, which in this example is 4.0. But by combining the loads of other consumers with the railway load, a still better load factor can be obtained, and hence a railway rarely generates its own electricity at so low a cost as that at which it can be manufactured by a company giving a general supply.

These principles have been put into practice recently on a scale so large as conclusively to demonstrate their correctness; as an example, the author describes the B.A.P. Railway above-mentioned, a mountain-grade system employing a considerable number of freight locomotives; this system was described in our issues of March 27th and April 3rd, 1914. It comprises 114 miles of single track, and was formerly operated with 27 steam locomotives, consuming 197 lb. coal per locomotive-mile, which coal cost 19s. per ton. The electrification of the system has been nearly completed, and at present the traffic is handled with 17 electric locomotives and four steam locomotives; the former consume 26.3 KW.-hours per locomotive-mile, at 0.265d. per unit, costing 7d. per mile, as compared with 19.9d. per steam locomotive-mile for fuel. The line voltage is 2,400 volts D.C., the motors being wound for 1,200 volts and permanently connected two in series. The electric locomotives have a maximum tractive effort of 48,000 lb., and a continuous tractive effort of 25,000 lb. at 16.2 M.P.H. corresponding to 1,080 H.P. The net ton-mileage at present carried by the railway is some 170 million ton-miles, the gross ton-mileage, including the locomotives, being 400 million ton-miles per annum. With electric traction the average weight of the ore trains has been increased from 1,600 to about 2,100 tons; two locomotives can haul a train weighing in all 4,300 tons up a grade of 0.3 per cent. at a speed of 16 miles per hour, which is more than twice as fast as the lighter trains (3,600 tons) hauled by the steam locomotives.

The author analyses the performance of the electric locomotives at some length, and shows that the efficiency of the locomotives from pantograph to drawbar is of the order of 80 per cent.; he also compares their performance with that of the steam trains, and finds that the outlay for fuel and power has decreased by 39 per cent., with electrical operation. Owing to the greater speed and the heavier trains hauled by the electric locomotives, the number of trains per day has been reduced by 25 per cent., resulting in a saving of 33 per cent. in the total hours of work of engine crews as well as a reduction of 21 per cent. in trainmen's wages. In the passenger service on the same railway, the delays to trains amounted to only one-fourth as much as with steam haulage. The total net annual saving due to the adoption of electric haulage amounts to £74,000, whilst the capital outlay on the electrification is estimated at £300,000, and the author considers it safe to say that by the year 1920, seven years from the commencement of the conversion, the savings effected by electrical operation will have wiped out the entire cost of the work.

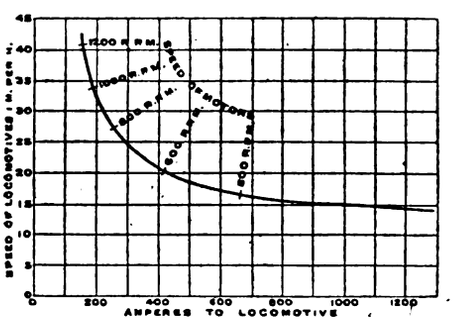

FIG. 1.

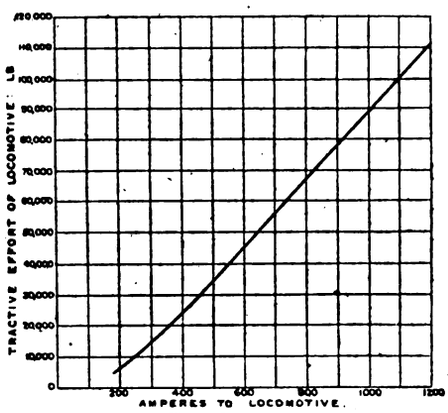

FIG. 2.

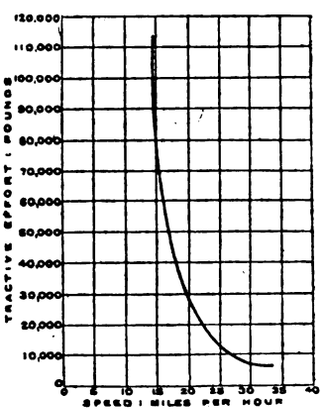

FIG. 3.

CHARACTERISTICS OF 3,000-H.P. ELECTRIC LOCOMOTIVES.

Mr. Hobart states that the chief item of expense in electrifying a railway of this character is that for electric locomotives; these are comparatively new types of machine, and cost (gear-driven) from £80 to £90 per ton, whereas steam locomotives are thoroughly standardised, and cost only £30 per ton. Against this must be set the greater weight of the steam locomotives (2:1), and the greater traffic-handling capacity of the electric locomotive, and the author find that 21 electric locomotives costing £134,000 would be equivalent to 32 steam locomotives, which also would cost £134,000. As the design becomes standardised, the cost of the electric locomotive is certain to decrease.

Electric locomotives cost far less than steam for repairs, this item on the B.A.P. Railway amounting to 2.2d. per locomotive-mile for the former compared with 6.5d. for the latter.

The employment of the 2,400-volt system enabled the two sub-stations on this line to be spaced 26 miles apart; had the pressure been 600 volts, at least six sub-stations would have been necessary, costing more than twice as much and having a lower load factor and lower efficiency, whilst the wages of at-

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tendants would have been correspondingly greater. Motor-generators are employed, running at 720 R.P.M., and rated at 1,000 KW. (1,500 KW. for 2 hours). Each synchronous motor drives two 1,200-volt generators connected in series; the latter are compound wound, provided with interpoles, and fitted with distributed compensating windings in the pole shoes. The average sub-station load factor is about 34 per cent., and the average load 2,050 KW. The motors are run with over-excited fields so as to have a leading power-factor, which offsets the lagging power-factor of other customers of the Great Falls Power Co., which supplies the energy to the railway company.

The trolley conductor has a cross-section of 0.166 sq. in., and the cost of the distribution system has amounted to £1,110 per mile of single track, of which one-half represents the cost of erection. The current collected by two locomotives attains a maximum of about 800 amperes, and as it may not divide equally between the two pantograph collectors, a single contact may carry as much as 500 amperes; the trolley wire can carry 1,000 amperes continuously with a rise of temperature of 180° C. in the open air, and as the current comes from both directions along it, the system can deal with four 72-ton locomotives between two adjacent feeding points, requiring an aggregate of some 2,000 amperes. Under normal conditions of running the average current collected per pantograph is only 400 to 500 amperes when starting and ascending grades.

Mr. Hobart next deals with the still more important Chicago, Milwaukee and St. Paul Railway, which is being electrified at 3,000 volts D.C. for a length of 440 miles, comprising 650 miles of single track; eventually it is expected that the electrification will be continued to the Pacific coast, making a total route length of 850 miles. The system was described in our issue of November 5th, 1915. Forty-two electric locomotives, each weighing 250 tons, with equipment for 14 sub-stations, are being supplied, and a length of about 113 miles has just recently been put in electrical operation; energy is purchased from the Montana Power Co., which has 10 hydro-electric plants in this region, having an ultimate aggregate capacity of over 200,000 KW. The electricity will be supplied at a pressure of 100,000 volts, 60 cycles, at 0.26d. per unit. With 3,000 volts on the line, the sub-stations are spaced at an average distance of 32.5 miles apart, but the actual distance varies from 18 to 43 miles. Gradients of 2 per cent., 21 miles long, and 1.66 per cent., 10 miles long, have to be overcome.

The sub-station machinery is similar to that of the B.A.P. Railway, but the sets are of 1,500 and 2,000 KW. continuous rating; the total capacity installed is 59,500 KW.

Each locomotive has a continuous rating of 3,020 H.P., and is thus 40 per cent. more powerful than two B.A.P. locomotives; a noteworthy feature of the former is the equipment for regenerative braking for long periods on down grades. The collector has a double contact device, and can collect 2,000 amperes from a double trolley wire at 60 M.P.H. The line is equipped with the double-wire catenary construction, having two No. 0000 wires both suspended from the same catenary wire, but by independent hangers, the suspenders of one wire being midway between those of the other. The two wires hang close together, and the alternate suspension provides exceedingly smooth operation, with complete elimination of any tendency to flash at the points of suspension. The tractive effort of the locomotive at 15.9 M.P.H. is 71,000 lb. (continuous rating), and is provided by eight motors, each driving one axle; the locomotive can haul a load of 2,250 tons, in addition to its own weight, up a gradient of 1.0 per cent. at 15.9 M.P.H., developing 3,020 H.P., with a pantograph-drawbar efficiency of 80 per cent. As in the case of the B.A.P. Railway, the motors are cooled by the forced circulation of air from an external blower. The accompanying figures, 1-3, show the characteristics of these locomotives.

The heaviest duty imposed upon the locomotives is drawing a load of 2,230 tons 49 miles up an average gradient of 0.7 per cent., the ruling gradient being 1 per cent.; the speed is 16.5 M.P.H., and the average output of the motors 2,380 H.P. The cost of electrical energy is 43d. per train-mile, compared with 58d. for steam.

Allowing for fuel and power, wages, repairs, and capital charges, the annual outlay per electric locomotive-mile is given as 43.3d., as against 47.5d. for steam traction; but this figure takes no account of the indirect economies recorded due to the heavier trains and higher speeds, which increase the capacity of the railway and reduce wages. Moreover, the C.M. & S.P. Railway locomotives are equipped with regenerative braking, which is estimated to effect an economy of about 25 per cent.; wear on wheels and brake shoes will be decreased, and the speed on down grades may be higher in the absence of heating of

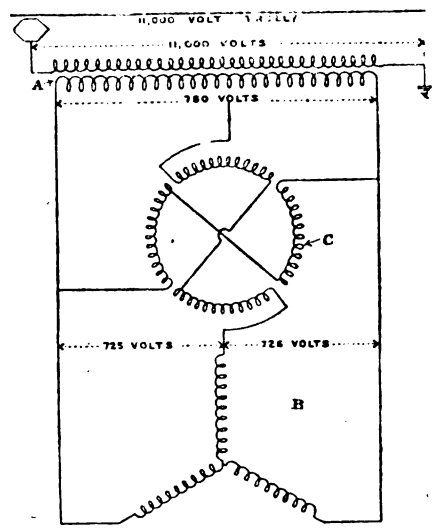

FIG. 4.—CONNECTIONS OF TRANSFORMER, PHASE-SPLITTER, AND MOTOR.

tires. Another advantage of regenerative braking is the fact that the energy thus generated by descending trains is supplied to neighbouring ascending trains, with a greatly reduced loss in transmission, and the capacity of the generating and sub-station plant is virtually increased. The author points out that, though regenerative operation was considered 10 or 15 years ago, it would not then have had the advantages which now accrue, owing to the greater weight of the electrical equipment in those days and the increase in the total weight of the train due to the regenerative feature. In the case of an electric railway handling dense traffic, requiring, say, 100 million KW.-hours per annum, by the adoption of regenerative control the plant necessary might be reduced from 25,000 KW. to 22,500 KW., and this would run through the whole of the system.

Mr. Hobart next deals with the Norfolk and Western 11,000-volt single-phase railway, comprising 29 miles of double track (97 miles of single track). Electrical operation was commenced in May last year with 12 240-ton locomotives, each consisting of two 120-ton units. Trains weighing 2,900 tons, in addition to two 240-ton locomotives, are hauled up gradients averaging 1.13 per cent. and 15 miles long at 14 M.P.H., twice the speed at which three 240-ton steam locomotives took up similar trains. The advantages claimed for this electrification are similar to those already set forth; in this case also regenerative control is employed, and by relieving the congestion at a single-track tunnel 4,000 ft. long, the carrying capacity of the line has been greatly increased. Fig. 4 shows the connections on the locomotive; electricity at 11,000 volts, 25 cycles, is received by a step-down transformer carried on the locomotive, and indicated at A, fig. 4. The pressure

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at the secondary terminals of this transformer is 750 volts. Part of the electricity goes direct from the secondary of the transformer to the polyphase motors (indicated diagrammatically as B in fig. 4) which drive the locomotive; the remainder of the electricity passes through the phase-splitter C on its way to the polyphase motors B. By this means the single-phase electricity supplied to the locomotive is converted into polyphase electricity, and is thus made suitable for driving the polyphase motors. Each 240-ton locomotive is equipped with eight of these motors.

With a view to economical working, the tendency on American railways for many years has been to keep down the train-mileage and to increase the ton-mileage, involving a continual increase in the power of the locomotives; in 12 years the average tractive power was increased 50 per cent., and the capacity of freight cars 40 per cent. Not only can this policy be most effectively carried on with electric locomotives, but the latter also enable the speed to be doubled.

The author proceeds to describe the "1913" type of electric locomotive in use on the New York Central Railway, which weighs 115 tons and has a continuous rating of 2,000 H.P., with a tractive effort of 13,840 lb. at 54.5 M.P.H., on a 600-volt D.C. third-rail system. The armatures of the motors, which are bipolar and of 250 H.P., are mounted directly on the axles. These locomotives haul at 60 M.P.H. trains having a total weight of 1,100 tons, and have an efficiency from collecting shoe to drawbar of nearly 80 per cent.

In 1915 the total single-track mileage of electric railways in the United States operated on the single-phase system was 1,490 miles, while that using high-pressure direct current was 3,720 miles; while the adoption of the single-phase system has by no means come to a standstill, the author holds that the superiority of the high-pressure D.C. system ensures its general use on main-line railways in preference to the single-phase system, and points out that nearly nine years ago he foretold this outcome. He draws attention to the defects of the rectified single-phase current which has been adopted on some lines, and to the necessity of installing frequency-changers to obtain 25-cycle single-phase current from 60-cycle supply, thus doing away with the advantages of static sub-stations, while the efficiency of the system is inherently lower than that of the D.C. system.

The cost of supply, analysed at considerable length, is found to be about the same at the locomotive, no matter whether the high-pressure D.C. system or the single-phase 25-cycle system be employed, while a 60-cycle supply converted to 25-cycle single-phase costs rather more; but the cost of the single-phase locomotives is inherently greater than that of the D.C. machine.

Mr. Hobart concludes that the extensive conversion of steam railways is in prospect in the near future; that the D.C. system is the most appropriate; and that high-pressure D.C. locomotives are an established success.

COMMERCIAL MOBILISATION.

On Thursday last week, at the Connaught Rooms, the British Electrical and Allied Manufacturers' Association held the fourth of its series of trade conferences, this one being devoted to the consideration of the steps that ought to be taken towards organising industry in readiness for the commercial campaign that will follow the war. The audience numbered about 120, and included many prominent representatives of industry, shipping, and finance. Mr. F. R. Davenport, chairman of the Council, presided.

The discussion was opened by Mr. Henry Thornton, general manager of the Great Eastern Railway, with a short address which was accorded a very hearty reception. Mr. Thornton regarded it as a sign of very healthy optimism that England was discussing what was to be done with Germany when Germany was "down and out"; he shared the conviction that we would shortly make rapid progress on land and sea, and commended British manufacturers for looking ahead.

The new conditions would be strange and uncertain, and there would be tremendous changes, but England's trade would continue to progress; no doubt there would be some difficulty in finding capital, but the British Empire, which had never yet defaulted, possessed unassailable credit, an immense mercantile marine, vast Colonies with unlimited natural resources, and a population skilled in manufacturing and of indomitable pluck—with such assets at command, the Empire could never be insolvent.

The time for talking was over—the time was now ripe for *action*. The problem was how to set about the capture of foreign markets. In the United States it was recognised that very large resources were necessary for such a purpose, and that the capital could only be obtained by arousing the interest and co-operation of the entire nation; thorough organisation, machinery for the investigation of foreign markets, competent men at the head, were indispensable requirements. Accordingly, a Corporation had been formed, with a capital of ten millions sterling, for the purpose of engaging in any kind of business, and was controlled by representatives of big companies in every branch of commercial activity. But the conditions in this country were different, and he did not recommend the adoption of the American plan. At present the British had no one scheme backed by powerful influence and sufficiently comprehensive to contemplate a successful attack on foreign markets; there was, in fact, a danger that the movement might dissipate itself in a number of small and separate efforts. Amongst the essential factors of success were the assistance of the banks, the aid of linguists, the combined support of the various transport agencies, the help of the Government in every possible way, and the assistance of the Press. The Government backing in particular must be effective. As the first tangible, constructive step towards the goal, he advocated the formation of a committee of experienced business men, on which all interests should be represented, with a specially competent man at the head—a Lord Derby for commercial affairs. Let them enlist the banking interests, and send agents into the foreign markets with the weight of the whole country behind them.

Mr. C. H. Merz emphasised the importance of making a beginning on the right lines. An organisation such as Mr. Thornton had outlined might be taken to be partly in existence already. After the war, electrical manufacturers would have to go still further on the lines this association was formed to promote. Hitherto the efforts of British manufacturers had suffered from want of cohesion and organisation; when one required plant, etc., it was embarrassing to find that so many people all wanted to quote for the same thing. This country did not take kindly to anything in the nature of a "trust," but the Association would strengthen its position if it could agree that a certain number of manufacturers should manufacture certain articles—why should so many want to make everything? Economical production with small output was not possible, and competition had gone beyond the point up to which it was of advantage to the purchaser.

The first essential to success in establishing a given export trade was prosperity in that industry at home, which would secure to it financial support, as in the case of the textile industry. The electrical industry had suffered from the socialistic experiments of Parliament, with the result that financial aid was not attracted, experience was not gained, men were not trained. The Association should insist on being given the opportunity of acquiring experience at home; there was plenty of scope for it, in connection with our big industries. Unless they could train the men at home, they could not successfully carry on trade abroad; the men sent overseas must know their work, and the goods must be of the right quality.

Mr. H. Gordon Selfridge said that after this war the business men of this country would have to take up the struggle, and should prepare for the task with the help of the best intelligence available to them. England had grown so rich that the commercial fight was hardly so attractive as in olden times, but there was plenty of sport in commercial warfare; there was also a duty laid upon the shoulders of the business men, who were the wage earners of the nation, and on their efforts would depend the rejuvenation of the national finances. This country was well able to stand the strain; it should now again seize and hold the position of the world's chief manufacturing, money-making, and producing country. The Government was made up of lawyers, who occupied too big a place in most governments, and it was useless to expect support from it—they must rely upon themselves; the business men should form their own committee and carry on without reference to the lawyers. Inertia must be over-ruled—those who were aggressive must ignore those who were sluggish, and press on as in the days following the Napoleonic wars, when Britain covered the world's requirements. All depended upon the spirit, enthusiasm, and imagination of the business men; never was there such a wonderful opportunity for a nation to make itself supreme, and to make the commerce of this country a most interesting career. Londoners could hardly realise what the name of London meant to the rest of the world; the prestige and respect attached to it made it a world asset. This was the first body he had heard of which had sought to form a great combination that would set the pace for the rest of the nation; he approved of the idea of forming a vigorous committee, and declared that with the united efforts

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of enthusiastic business men this country could do anything it chose.

Mr. COLTON declared that they must fight the Germans to a standstill; the enemy had developed a great commercial machine, with the aid of money obtained from British banks —what would they do for capital in the future? Already they were considering means for strengthening their strong organisation and overcoming the prejudice which had been created against their wares.

Mr. S. Z. DE FERRANTI expressed the pleasure he felt at seeing the B.E.A.M.A. acting on the right lines to bring about success. The first thing to be done to promote trade after the war was to make sure of our own home market. It would be better for the country if British manufacturers consisted of a moderate number of very rich and prosperous concerns instead of many small and poor ones. The electrical industry had suffered under conditions of the most severe competition and legislative restrictions in the past; adversity brought out one's good qualities, but might be carried too far. In order to go ahead and secure command of the world's trade we must have plenty of money for development work. From a technical point of view, to arrive at the most perfect product required a steady flow of money and continuous progress; the development of the world's markets also required that plenty of money should be available. For these two reasons prosperity in the home markets was essential. After the war they must not work under excessive handicaps, they must be strong and have ample funds at command. America and Germany protected their home markets, and upon success at home Germany built up her foreign successes. Municipal enthusiasts here used electricity as their plaything for socialistic experiments, and the politicians killed what otherwise might have been another textile industry in point of national importance. The textile industry grew to huge proportions unhindered, whereas Parliament cramped the electrical industry, as it had also strangled the automobile industry. The greater the prosperity in any industry, the better for all the people. He fully endorsed what other speakers had said about the after-war campaign; they must use every precaution to conserve their energies. He himself held extreme views; they were dealing with an enemy that was as unscrupulous and dirty in commerce as on the field of battle, and as vermin was exterminated without compunction, so we should use every available method of crushing the enemy. He would like to see the allied nations utterly exclude everything Teutonic—forbid German ownership of property, refuse to hold intercourse with them, shut out their goods entirely. They must give no heed to objectors; the devil was always there, and would break out again if the chance were given. No half-measures—let them bar out the Germans from any chance of commercial recovery, by completely closing the Allies' markets to them; the enemy would never overcome this handicap and again become a great commercial power. But if such proposals were too extreme, at any rate let them do all that they could to protect home markets, and combine to fight for the world's markets.

Mr. F. W. WILE, referring to Mr. Runciman's recent speech, said that that gentleman planted a most insidious idea in the minds of the British public when he said that Germany was already commercially a defeated nation, lulling the people into a false sense of security. He could hardly pick up a German paper that did not show that Mr. Runciman was utterly mistaken. In Germany the co-operation of the Government with big businesses was a great success; the German Government promoted trade by means of its diplomatic and consular services. The German State-owned railways and canals and the great shipping lines co-operated, and three departments of the Government, with business men at their heads, were devoted to the same purpose. Germany was now throbbing with movements and efforts directed towards the resumption of trade after the war, and was by no means commercially beaten. With 1¼ million square miles of territory and a population of 200 millions at her command, Germany was nowhere near famine, and could never be beaten by starvation—she would have to be knocked out on the field of battle.

Winding up the discussion, Mr. DAVENPORT said that most of them agreed with Mr. Wile that there was too much optimism. A concrete organisation should be created, with representatives of all the principal engineering associations, for the single purpose of improving British industry; it was the duty of the leaders to keep the British engineering industry in as powerful a position as possible. With regard to trusts, they had no desire to become a trust concern; they wished to adopt a reasonable and moderate policy, and the general desire to play the game would prevent the nauseous trust atmosphere from arising. The Association was ready to join with the central organisation in helping all British industries, and would do its share to bring about co-ordination and cohesion of the interests involved.

Mr. JAMES KEITH was unable to speak at the meeting, but communicated his views to the secretary. He wished to point out that Mr. Runciman had been rather unfairly criticised, whereas, for one thing, he had promised a new Patent Act, a matter of the first importance. Mr. Keith advocated the establishment of a real search for novelty and validity before an application for a patent was even entertained, the abolition of renewal fees, extension of the period of the patent to 17 years, Government protection for the *bona-fide* inventor, a special Court solely for trying patent cases, etc., and urged that in the formulation of a new Act, inventors, engineers, and business men of the first rank should be taken into consultation. The revolutionary Act of 1883 was framed and carried by a business man—the late Mr. Joseph Chamberlain—whereas the 1907 Act was drawn up by a lawyer, and, hence, had practically failed to give anything like satisfaction or justice to British inventors. He called for the exclusion of German and Austrian trade from our business relations for ever. The appointment of a Minister of Industry and the improvement of the patent law would bring this country into line with the United States, which would undoubtedly be our future principal competitor for the world's trade, and Britain would then have every chance of holding its own in the coming struggle.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Electric Iron Connections.

May I draw the attention of the manufacturers of electric flat-irons to the numerous inquiries I have received for an electric flat-iron that will not require its socket connection rewired, after a few months' use? Almost everyone in the electrical profession must know of this trouble, which, I should say, is caused by the electric flat-iron, when connected to the supply, and not placed with its face on a heat-conducting substance, reaching a very high temperature. The heat is conducted to the terminals and socket connection, passing along to the flexible cord. The conductor itself becomes hot, the insulation is slightly charred, and very quickly the conductor breaks. I have carefully examined the broken ends of the conductor and noted the dryness of the insulation, especially between the break and the socket connector. Could not this trouble be obviated by introducing a perforated socket connector that would allow a cool draught of air to pass through it? Surely this improvement would bring the electric flat-iron to a higher state of perfection.

E. A. Deacon, *Student I.E.E.*

Twickenham, *January 19th*, 1916.

The Institution of Electrical Engineers and Alien Enemy Members.

The correspondence upon the above question and your references thereto have attracted considerable attention, and we have been much interested in the subject.

With your kind consent we now propose to state our views upon the alien enemy question in general, and its application to alien enemy members of the Institution. We wish to state at the outset that we think the alien enemy (whether naturalised or not) should, for the reasons set forth below, be excluded from any kind of association with true Britishers. The alien enemy has conclusively placed himself quite outside all claims to civilisation and consideration:—

1. By the ghastly atrocities committed in Belgium, France, Serbia, and other countries upon helpless and innocent non-combatant inhabitants (Lord Bryce's report deals pretty fully with these matters, but the cases dealt with in the report are the least horrible, many others, of which full records are kept, being quite unfit for publication, and representing horrors unspeakable).

2. By the deliberate and wanton murder of civilian passengers on board the *Lusitania* and many other liners and ships.

3. By air raids upon civilians in London and numerous other cities and towns, to say nothing of the destruction of valuable property.

4. By the use of dastardly methods of warfare, such as gas, liquid fire, explosive bullets and the like, before unheard-of in the annals of civilised warfare, and in direct contravention of its rules.

5. By the murder of Nurse Cavell.

6. By the diabolical treatment of Allied soldiers who have been taken prisoners by the enemy, but more especially those who are British.

These crimes against humanity have been committed, not only by common soldiers, but in innumerable instances by officers and professional men, who, in many cases, have been taken red-handed at their foul and devilish work, or whose acts have been described on oath by reliable witnesses. In other cases they have been committed by the direct command of high officers or by their knowledge and consent. So much for the very brief résumé of the acts and nature of these high priests of "Kultur."

The above proves that the alien enemy is either a degenerate of the vilest type, and his once much-lauded and advertised civilisation only the thinnest veneer, which was both put on and stripped off at will to serve his own unworthy ends, or he has always been at heart of the most brutal and degraded nature, and has succeeded in concealing the fact as long as it suited his plans.

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In any case, he has effected his purpose in worming his way by treachery and deceit into the confidence of the world at large, and now laughs at the fools who accepted him at his own valuation and made a friend of him. In August, 1914, he began to reveal his true nature, and has continued to do so more and more plainly every day up to the present time.

It has been urged that to class the naturalised alien with all the others of his race generally would be an injustice. Suppose such may be the case with a few individuals; is it not better that a few may suffer some sort of injustice than that the many should escape punishment? How many thousands of innocent men, women and children have suffered the vilest torture and death at the hands of the bestial and brutal enemy? yet an outcry is raised because it is proposed to give a few naturalised alien enemies the cold shoulder. Cases have been cited of alien enemies who have been naturalised in England for a number of years and who have relatives fighting for us. We have frequently heard that the love of the alien enemy for his country amounts almost to a religion, and that patriotism is far stronger amongst them than amongst Englishmen. If that be so, and we have no reason to doubt it, the reasons for distrusting the naturalised alien are increased.'

When the hypothetical alien (now naturalised for many years) first came to this country, he came not for his country's good, but obviously in his own interests. His attachment (if he has any) is, therefore, a purely selfish one, and if he is in accord with his sons or other relatives fighting against his Fatherland, he is obviously a traitor to his own country, and cannot, therefore, be trusted to be loyal to any.

Suppose the enemy succeeded in landing in England, and even reached London: which side do you suppose the naturalised alien would take, bearing in mind the record of his race? After all, his naturalisation is represented but by a scrap of paper, and as a leopard cannot change his spots, so the alien is an alien still, and can become de-naturalised as easily as he was naturalised, and, indeed, very much more easily, for all he has to do is to put the papers in the fire and he becomes a true and faithful member of the Fatherland again. No, sir, if a tiger lives in a stable, or is even born in a stable, he does not become a horse, but remains a tiger for the rest of his life, and, although he may be apparently tamed, his true nature will be revealed under provocation.

War with our present enemies (at one time our dear and *trusted* friends) has been forecast for years, and those who ought to know have said that it was not intended to embroil England at present, but when France and Russia had been laid low, and the enemy had had time to recuperate (say, in ten years or so), then England's turn would come.

In this connection it is instructive to note that Dr. Klingenberg delivered a few years ago at the Institution an address on how to supply light and power to London, and advocated one or two huge generating stations for the purpose, the present generating stations to be turned into sub-stations and distributing centres; in other words, putting all our eggs into one basket (or two at the outside). A scheme was ultimately proposed, more or less upon these lines, and was urged by the promoters as the ideal thing, whereby everybody was to get a supply for next to nothing.

Now, suppose this scheme had gone through, it would probably have been completed just in time to suit the enemy. An air raid or two, and what condition would London be in? Two well-aimed bombs upon two splendid targets, and London would be in a state of chaos. One more upon the gas works and the work would be complete: all lights out and munition works shut down. "Far-fetched," some may say; but is it? We know only too well, by bitter experience, the craft and foresight of the enemy. Ask America and practically every other civilised State in the world who are hag-ridden by the enemy, and can scarcely call their souls their own, what they think of it.

The danger to England is a very real one, for she has never before had to fight an enemy who does not possess a scrap of honour, or even common honesty, and as she cannot use similar weapons and means used by the enemy, she and her allies are at a great disadvantage, and have been from the beginning. If we had had an honourable foe to deal with the war would doubtless have been over long ago.

One fact is plain to all but those who wilfully, and perhaps intentionally, close their eyes, and that is that Germany must go under, or England will do so sooner or later. How anyone can have the slightest confidence in any member of a race possessing a philosophy and morality (or, rather, lack of morality) such as they possess, to say nothing of their blasphemous hypocrisy, is a mystery to all who are not biased in their favour, rather than in favour of their own flesh and blood and the land of their birth.

We have been told that many naturalised alien enemies have expressed their regret and horror at the foul acts of their countrymen. Quite so; and the Kaiser, according to his own statement, "wept tears of blood" for poor Servia!

It is surprising that any action should be necessary to remove the names of alien enemies (naturalised or not) from the Roll of the Institution, as, knowing the public feeling in the matter and the diabolical acts of their own countrymen, they should have resigned long ago. We can only assume that, like their fellow-countrymen still in the Fatherland, their hides are too thick to be affected by any amount of castigation. Until the alien enemy is known for what he is worth with all his scheming and plotting, and driven out of the society of decent men, we will set our faces against him, whether he is naturalised or not. We have not the slightest feeling against any individual personally, but we are supporting a general principle, and shall continue to do so even if a few, apparently harmless, are "sent to Coventry."

It is suggestive that the Government of Australia has just given notice that within three months all alien enemies, *whether naturalised or not*, must resign their holdings in any company incorporated within the Commonwealth. All honour to our splendid Colony for setting such an admirable example of patriotism to the mother country, who, we fear, badly needs it.

In conclusion, we re-assert that we are wholehearted for the exclusion of all alien enemies, whether naturalised or not, from the Institution of Electrical Engineers and every other society of true Britishers.

Six Borough Electrical Engineers,
Members of the I.E.E.

P.S.—Since the above was written a notice has appeared in your issue of January 21st that the Council of the Institution has passed a resolution that they are of opinion that Clause 41 of the Articles of Association provides sufficient means for the expulsion of undesirable persons (whether alien enemies or not) from the Institution. We would point out, however, that it would appear that under Article 41 *each case has to be taken separately*, and as this amounts to an attack upon individuals, we strongly object to this being done, as we have stated that we have not the slightest feeling against any individual personally, but are supporting a general principle.

Electrolytic Copper.

May I trespass on your space with just a few lines, even at the risk of repeating myself, in reply to Mr. Welbourn's courteous letter in your issue of January 14th?

His Manchester address was such an able expression of all-round knowledge of the subject that I should not venture to critcise anything except the scientist's tendency to succumb to the attractiveness of a formula.

Hard-drawn copper wire in various sizes is produced by various methods, partly from necessity and partly to suit the convenience of manufacturers, or the purpose for which it is used; consequently, the resulting properties have no fixed relation to the area or to the diameter, and it is impossible to define them by a single expression in terms of either of these throughout the whole range of sizes in use, without considerable inaccuracy at some point or other.

For this reason I have always deprecated the introduction of any formula such as Mr. Pye's as a standard definition, and I am strengthened in my objection by learning that this formula is actually being used by engineers. I think in such case they may, in many sizes, either be contenting themselves with an unnecessarily low grade of wire, or may be adopting a larger factor of safety than is needful, to the detriment of both economy and appearance in their work.

Although I write, as Mr. Welbourn truly remarks, from the point of view of the manufacturer, yet I believe the interests of manufacturers and users are practically identical in this matter, in so far as both want a specification for any given size of wire which will ensure its being the most suitable for its purpose that can be obtained without entailing undue cost or difficulty, either in manufacture or in testing. I do not think that either are particularly interested in a definition which is not capable of being used as such a specification, but may have the appearance of having been so intended. It was for this reason that the Standards Committee agreed to follow my suggestion and to make their *definition* simply a broad statement, marking approximately the dividing line between hard and soft copper, and I fear I must disclaim having any better definition to suggest. If, however, through the collaboration of scientists, users, and manufacturers, a standard *specification* for every size could be drawn up which the E.S.C. could adopt, we should have something of great practical value.

My idea of the procedure would be something on the following lines:—

First collect together a considerable number of samples of wire of each of two sizes, one being comparatively thick, such as 3/0 or 4/0, and the other a thin size, say, 10 or 12 S.W.G., and on each of these sets carry out very complete tests, including breaking stress, elastic limit, limit of proportionality, extension, total elongation on fracture, as well as wrapping and bending tests—(torsion, I think, might be omitted as being somewhat liable to variation through differences of manipulation). An examination of the figures obtained would show how far a definite relation exists between the properties most valuable to users and the simpler tests which can be easily applied without liability to dispute. If the result were satisfactory, a much smaller number of tests on other sizes would be sufficient to establish the standard that might reasonably be asked for in the simple tests selected, and the properties which engineers could rely upon being proved by them.

Thos. Bolton.

London, *January 18th*, 1916.

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WAR ITEMS.

After the War Trade.—Speaking at a luncheon given in his honour at Cannon Street Hotel on Friday last, Sir George Reid, M.P., said, as reported in the Press:—"Might he suggest to those whom he was addressing that all the patriotism which they might devote to revising our tariff arrangements and our national trade would not come to much if they did not develop their own intelligence and reform their methods of trade. There was a wonderful slowness about this country. Practical business men were wanted to do spade work for the statesmen, each to go boldly into his own branch of industry, always bearing in mind the needs of the future. And when the spade work was done, then let the Royal Commission come. A multitude of interests had got to be established; and we must first rely on practical experts of British trade to prepare cases for the consideration of the statesmen. There were many men in the City who could render enormous services to the whole Empire by reviewing intelligently and earnestly all the facts of the present and the past in order to enable statesmen to make a really good piece of work of the restoration of the vitality of the Empire." Sir George Reid may take it for granted that if the statesmen of this country are really in earnest in regard to adopting a safe line for the development of the Empire in the future, they will not find the practical trade experts wanting in willingness to place their knowledge at the Empire's disposal. What the Empire will become in the years that follow the war must inevitably be influenced by the new trade and industrial policy that is evolved from all our present discussion and as the result of conferences with the Colonial and Allied representatives.

Registration of Firms Rejected.—In the House of Lords, on January 19th, Lord Southwark moved the second reading of the Registration of Firms Bill. According to the "Times" report, he explained that its object was to secure that every firm carrying on business in the kingdom under a trade name which did not consist of the full names of all the partners without any addition, and every person carrying on business under a trade name containing any name or addition other than the person's full name, should register the name under which the business was intended to be carried on, together with the nature and place of the business, the full name, address, occupation of the person or persons carrying on the business, and the names of any foreign partners. Germans and Austrians trading here were forewarned of the war and took English or French names or some trading name to conceal their origin. It was certainly desirable that trading under assumed names should cease. The practice had developed considerably during the last few months. The Duke of Devonshire said it would be a serious undertaking to compile a register of the kind suggested in the measure, and it would greatly increase the work of the Board of Trade in a time of great pressure. He suggested that the measure should be re-introduced in another Session with a view to its consideration by a Select Committee. The second reading was negatived.

Women Electricians.—Following upon a consultation with various officers of the Labour Exchange on the proposal submitted by him to the Liverpool branch of the Electrical Contractors' Association on the training of a certain number of women in branches of electrical work, Mr. Arthur Angers has submitted his scheme to the Minister of Munitions. In effect, his plan is that women from the age of 20 to 27 or 28 should be employed in the allied electrical trades, for the double purpose, he states, of releasing men to take an active part either in direct military service or else in war work, and of saving an important industry, which in normal times employs thousands of men, from bankruptcy. The positions found for these women must be vacated for the electrician-soldier after the war. The women shall be instructed in electrical work by qualified instructors, and shall, after passing an examination, be paid the same wages as men thus employed. After suggesting other details, Mr. Angers asks for a conference of representatives of the employers and of the Electrical Trades Union to consider the scheme.—"Liverpool Post."

German Capital in Swiss Undertakings.—A step recently taken by the Swiss Government shows that certain aspects of the present war have not failed to impart their natural instruction even in neutral countries. The A.E.G., of Berlin, were holders of shares in the Oberargau-Seeland Railway to the nominal value of 110,000 fr., on which 22,000 fr. were paid up. The Swiss Government have now called upon the railway company to repay this sum, with interest, to the Berlin company, and thus abolish the foreign investment. Similar action has been ordered in the case of a Strassburg company. These steps, it is stated, are taken in the interests of Swiss industry. Commenting on the matter, the Swiss journal "Electro Industrie," which, by the way, declares itself in sympathy with the Central Powers, observes: "Our authorities are beginning to show a true comprehension of the industry of the country and of a national method of thinking and acting."

Engineers Wanted for the Naval Air Service.—The Royal Naval Air Service calls for "skilled engineers, especially those with experience of internal combustion engines, for deferred entry or immediate service."

"Key" Industries.—Speaking at Huddersfield, Sir Algernon Firth, president of the Associated Chambers of Commerce, said, according to the "Times," that the Advisory Committee which had been formed to consider what was necessary to continue the enterprise against German competition, had made its report, and this would shortly be published. Among the industries which had been considered were those in which Germans had specialised and had gained an absolute monopoly before the war. These were the "key" industries which manufactured basic materials so essential to the important industries of this country. The advisory committee had represented in their report to the Government that immediate steps should be taken, by a subsidy or a guarantee of protection to these new enterprises, to develop them by assuring, in the national interest, remuneration to those engaged in them. The committee hoped to extend investigations to other industries which the Germans had specially studied.

Serbian Relief Funds.—To avoid any possibility of confusion in the administration of contributions intended for the benefit of the distressed Serbian population, the Serbian Legation requests that subscriptions intended for the Serbian Relief Fund, of which H.M. the Queen is Patroness, should be sent to the Earl of Desart, K.C.B., at the offices of the fund, 5, Cromwell Road, South Kensington, S.W. The Serbian Legation will continue to receive subscriptions for the following Serbian funds:—The Archbishop of Belgrade's Fund, for the families of the killed and wounded soldiers. The Society of the Serbian Red Cross. The Parliamentary Commission for the Refugees. The Society of St. Helena, for the orphans whose parents have been killed in the war. All contributions addressed to the Serbian Legation (195, Queen's Gate S.W., London) for these funds will be gratefully received and acknowledged.

Australian Metals: The Enemy Control Question.—In the House of Commons, on Monday, Sir Philip Magnus asked the Secretary of State for the Colonies what had been the result of his communications with the Government of Australia respecting measures to carry out the desire of that Government to free the metals of the Commonwealth from enemy control and to encourage their development for the benefit of the industries of Australia and the British Empire. Mr. Bonar Law, in reply, stated that this important subject was one which the Prime Minister of the Commonwealth had telegraphed his desire to discuss personally with him during his forthcoming visit to this country.

Tyneside Engineers and the Dilution of Labour.—At a conference representing Tyneside members of the Amalgamated Society of Engineers, united machine workers, steam-engine makers, and electrical engineers at Jarrow, on Saturday, the Government proposals on the dilution of labour were discussed for three hours on the receipt of a report from the London conference. No resolution was come to on the report, but the meeting criticised the methods adopted by their leaders when they met members of the Government, and passed a resolution thereon.—"Birmingham Daily Post."

Russia After the War.—The "Times" states that the Russian Cabinet has decided to create a Higher Council of Ministers to consider questions relating to the country's economic, commercial, and industrial position in respect of the war.

War Bonus Refused.—The Portsmouth Corporation having decided to adhere to its decision to refuse to grant a war bonus to its employés, the men, who number some hundreds, and, it is stated, include those engaged in connection with the electric light and power system, gave notice that they would cease work on February 2nd unless such bonus were granted.

Germany's Pig-Iron Production.—The German output of pig-iron in December amounted to 1,029,144 tons, as compared with 855,186 in December, 1914, or 33,189 tons per working day, against 27,564.—"Times."

Enemy Trading in South Africa.—A Reuter dispatch from Durban says that an anti-German movement, the object of which is to induce the Government to prevent enemy subjects from trading within the Union, is being vigorously prosecuted.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Lamp-Locking Devices.

THE EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD., of Ponder's End, Middlesex, have forwarded us copies of their Leaflets Nos. A 3,128 and A 3,130, dealing with "Lamlok Specialities."

Fig. 1 shows a lamp-locking lampholder which can only be unlocked with a key held by the person responsible for the lighting arrangements. By this means thieving, changing small C.P. for higher C.P. lamps, &c., is eliminated, and a great saving assured to many large public buildings.

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It will be seen that a pin passes through a channel in the lamp-holder, and, when locked by turning the key, the rounded end of the pin engages with the lamp cap, thus preventing the upward movement of the lamp necessary to release it from the bayonet catch.

Figs. 2 and 3 show a lamp-locking ring which can be used with any existing bayonet holder, plain or screwed, or batten holder.

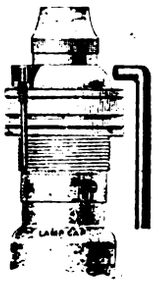
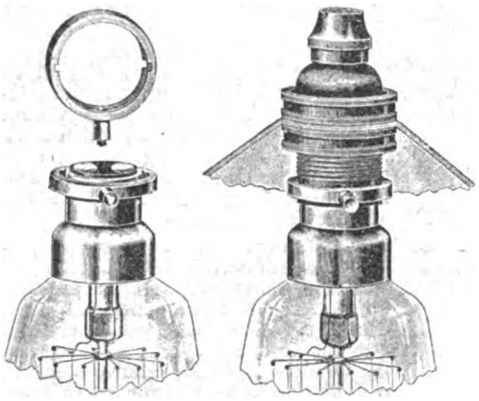


FIG. 1. LAMP-LOCKING LAMPHOLDER.



FIGS. 2 AND 3. LAMP-LOCKING RING, SHOWING METHOD OF ATTACHMENT.

Once the lamp is locked it cannot be removed until it is unlocked by the special key provided, which is sufficient to control any number of lamps.

The bayonet pins are engaged with the internal groove on the ring, through the slots in the ring; the lamp is put into the holder, and the ring turned round until the locking-pin is opposite the bayonet-slot, on the holder; the pin is then screwed down into the bayonet-slot with the key provided. When the lamp is securely locked, a small cap is slipped over the boss on the ring.

Mazda Revolving Lamp Shade.

We understand from the BRITISH THOMSON-HOUSTON CO., LTD., of Mazda House, 77, Upper Thames Street, E.C., that they have still available a few of the Mazda revolving lamp shades, such as we illustrate in fig. 4. This effective little advertising device comes to dealers packed in a neat flat packet containing all the necessary parts and simple instructions to enable it to be erected.

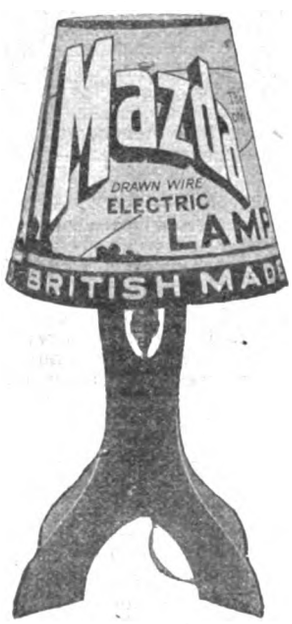


FIG. 4.—REVOLVING LAMP SHADE.

The shade proper rests on the tip of the Mazda lamp, the warm air from which, rising through the shade, operates an ingenious fan disk which causes the shade to revolve.

The advertising efficacy of devices in motion is doubtless familiar to readers, and this particular device can be employed, even where lighting restrictions are severe.

American Carbons for Italy.—An American Commerce report says:—"The Catania Street Railway and Lighting Co. has placed an order for 19,400 American light carbons as the result of a Trade Opportunity published in 'Commerce Reports.' This initial purchase of American lighting supplies for Catania is important in that subsequent orders will follow, in all probability, for other cities and towns in the district. As a rule, the difficulty lies in securing the initial order."

LEGAL.

Re ESSEX BATTERY AND MANUFACTURING CO.

ON Friday, before his Honour Sir W. Lucius Selfe, in the Marylebone County Court, Messrs. Napier, Kimber & Co., electrical engineers, Bayswater Road, W., sought to recover £28 17s. 6d., which had been paid to the Essex Battery Manufacturing Co., of Ilford.

MR. ARTHUR KIMBER, one of the plaintiff firm, stated that in November last they had 976 faulty batteries, 411 of which were returned to the company and the balance were waiting to be returned. £30 had been paid. The defective batteries were returned to the defendants, and as they were not redelivered he had made inquiries and found that they firm had gone away.

His HONOUR: What was wrong with them?

WITNESS: We could get no voltage from them. These refills are guaranteed for six months, and in three weeks they were useless. I sent to Ilford to see about the defective batteries, and found the works closed and the firm gone.

His HONOUR: And I expect your money has gone with them. You can have judgment for what it is worth, with costs.

BELFAST SLANDER ACTION.

IN the King's Bench Division, Dublin, before Mr. Justice Madden, Mr. T. W. Brown, on behalf of Mr. Alex. Bryce Farrell, of Ravenhill Park, Belfast, resident superintendent in the central electrical station at East Bridge Street, plaintiff in an action against Mr. Thos. W. Bloxam, chief electrical engineer for Belfast, applied for an order for the discovery of documents. He stated that the action was for slander of; and concerning the plaintiff, in the way of his business. Plaintiff's complaint was that on October 29th, 1915, defendant stated to Alderman Tyrrell and Councillor Duff, at the electrical station: "Main feeder cables in the tunnel in subway were supported and clamped in a manner likely to destroy the cable, and to be a danger of fire in the station, and that Farrell was responsible for this; that cheap cotton 'flex' was used where cables should have been used as a lead for current to a lamp at a small auxiliary engine, and that Farrell was responsible for that; and that Farrell was irreconcilable, and was causing disorganisation in the station, so much so that he (defendant) would prefer to carry on the next two months' work without anyone, rather than with Farrell." The plaintiff said that the works referred to were done under the direct superintendence of the defendant; that defendant signed the order for the materials; and that if anyone was responsible, it was the defendant. The defence, Counsel added, was a traverse of the cause of action, and, in addition, a plea was entered that the communications were privileged.

MR. JUSTICE MADDEN made the order applied for.

PORT OF LONDON AUTHORITY'S APPEAL.

ON Friday the Court of Appeal, composed of Lords Justices Swinfen-Eady, Pickford and Bankes, disposed of an appeal by the Port of London Authority against the refusal of the Lord Chief Justice to enter judgment in their favour in an action brought against them by the widow of an electrician named Blatch, who fell into a graving dock belonging to the appellants, and was drowned. The accident occurred on a dark and foggy night when the deceased was returning from the Millwall Dock, where he had been employed on a ship, in connection with certain electrical fittings. At the trial the jury disagreed, and the defendants applied for judgment. The learned Judge, however, would not accede to this, and the plaintiff set the case down for retrial. The present appeal was advanced so that it might be disposed of before the case was reheard.

Their Lordships allowed the appeal, and entered judgment for the defendants, holding that there was no evidence called by the plaintiff of any breach of duty by the defendants towards the deceased, nor any evidence that the defendants omitted any precautions usually or ordinarily taken by the owners of graving docks.

MUNITIONS CASES.

AT a sitting of the Oldham Munitions Tribunal last week, a local electrical firm complained that a volunteer munitions worker had committed a breach of Sub-Sec. 1 of Sec. 6 of the Act—a Sub-Section which makes it an offence for a munition volunteer who enters into an undertaking with the Ministry of Munitions to act in contravention or not fully to comply with the undertaking. It appeared that the man had been working for the firm for some years, and on January 11th he ceased work and refused to go back, stating that he was tired of the job and felt unsettled. The Trade Union Secretary stated that although the man was a munitions volunteer he had never been "transferred" to the works by the Ministry of Munitions.—Mr. W. Sellers (President): But he was working there when he became a volunteer.—The Secretary stated that there were hundreds in the country similarly situated, but they did not come under Sec. 6 until they were transferred and their war badges were changed. The badge was not changed until the man was transferred.—The employer said he would take the workman back at once, and the Trade Union official said he would advise the man to return.—The President of the Tribunal agreed to a suggestion that he should cause a letter to be sent to the Ministry of Munitions asking for a ruling as to when a man was to be considered transferred. Such a ruling, it was stated, would be of great value in the country.

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AN IRISH ARBITRATION.

MR. A. E. PORTE, M.I.C.E., has concluded arbitration proceedings in Dublin concerning a dispute between the Marquis of Sligo and Mr. T. E. Brunker, electrical engineer, Dublin, in respect of an installation of electric lighting in Westport House, Co. Sligo. Mr. Brunker claimed £100 as extras, which were disallowed by the architect, Mr. R. E. Mellon, Dublin, and a sum of £156 was deducted for work alleged not to be in conformity with contract. Lord Sligo counterclaimed for penalties for delay.

The ARBITRATOR said he would inspect the premises before giving his decision.

BUSINESS NOTES.

Wholesale Traders' Association.—The 13th annual meeting of the Wholesale Traders' Association for the Protection of the Hardware, Furnishing and Metal Industries, Ltd., was held at the registered offices, 26, Corporation Street, Birmingham, on January 17th, Major J. H. Cartland, J.P., presiding.

The chairman, in presenting the report and balance sheet, referred to the death of Mr. Thos. Cumberland, who, as late chairman, had presided over the deliberations of the Board since 1902. The operations of the Association had again been fully maintained, and the members had made extensive use of its various departments, which had afforded them exceptional facilities and assistance in many directions in the present crisis. 189 new members had joined the Association during the past year bringing the total membership up to 3,082. The speaker said that notwithstanding the war and the fact that a large number of firms were doing Government work, and, therefore, were not seeking to open new accounts, the number of status inquiries sent in during the year had reached the total of 92,173, thereby showing that there was still a good general trade being done by the various manufacturers and merchants throughout the country, and that a large number of orders had been received from Foreign and Colonial markets, which they were unable to execute at the present time. With regard to the debt recovery department, the number of cases sent in for collection was 19,233 against 18,126 during the previous year, showing an increase of 6½ per cent., and representing a total credit of upwards of £171,000. Out of this sum he was able to report that only about 10 per cent. proved irrecoverable or bad. With regard to the insolvency department, companies' liquidations, &c., a large number of cases were reported to the Association during the year, meetings attended, and action taken in the interests of members. In several instances the result has been an increased dividend for the creditors, and it was essential that members should make the fullest use possible of this department as occasion arose. There was still an impression in the minds of some of the small traders that a sort of moratorium still existed, and that there was no reason to pay their debts. This, of course, was absurd as the only exception now prevailing was that no person should have judgment enforced against him by execution, if there was reason to believe that the debt was owing to adverse circumstances brought about by the war. It was reported that a Bill was shortly to be introduced in the House of Lords for the registration of persons and firms carrying on business in Great Britain and Ireland, and this was a measure which the Association had long advocated through different channels for some time past.

Liquidations. — J. WHITEHOUSE, LTD., 15, The Parade, Golder's Green, Middlesex.—The winding up order in this matter was made on the petition of two creditors, and according to the figures prepared, the liabilities amounted to £993, to meet which there are assets of £917. After deducting the claims of preferential creditors and claims of debenture-holders, the assets were reduced to £167, the estate disclosing a deficiency of £827 as regards the unsecured creditors, whilst as regards the contributories the deficiency amounts to £1,984. It appears that the company was registered on June 23rd, 1914, and was formed to take over as a going concern the business of an electrical engineer, &c., carried on by J. Whitehouse, at 15, The Parade, Golder's Green. The contract for sale to the company was dated August 22nd, 1914, and it provided that J. Whitehouse should sell to the company the goodwill and connection of the business of electrical engineers formerly carried on by J. R. Whitehouse, and the stock, fixtures, plant and book debts, and also the leasehold hereditaments belonging to him, and he agreed to grant a sub-tenancy of his shop at an annual rent of £100. The nominal capital of the company was £3,000 divided into 3,000 shares of £1 each. The company was promoted by Mr. Whitehouse. The property acquired by the company totalled £2,297 odd, while the liabilities were stated to be £1,152 unsecured, the proprietor's capital being £1,145. The trading account for the six months to June 30th, 1914, shows a net profit of £426 odd on a turnover of £1,858, the productive wages being shown at £300, and other drawings and salaries £171. The consideration to be given by the company was, as to part, the allotment to him of 1,155 fully-paid shares in the company, and as to the remainder an undertaking by the company to pay all debts and liabilities of the vendor in relation to the business. The shares were duly allotted to J. Whitehouse, who still holds them. The first director of the company was J. Whitehouse, and he was appointed permanent managing director under the articles. Mrs. Whitehouse is also said to have been a director, but there is no record of how she became one, as she was not nominated under the articles, nor was she elected at any meeting so far as the minute book shows. Mrs. Whitehouse appears to have resigned as a director on August 11th, 1915. By a service agreement with the company J. Whitehouse was to receive a salary of £312 a year and £208 a year for expenses, and on December 20th, 1914, Mrs. Whitehouse was voted a sum of £55 to cover the director's fees and expenses incurred. This sum appears to have been taken to the credit of J. Whitehouse's salary account. The company being a private one, no capital was offered for public subscription nor was any prospectus issued. Mr. Whitehouse holds 1,155 shares in the company, and Mrs. Whitehouse is the holder of one share. From the minute-book, however, it would appear that applications were made for two shares by another person, and it was resolved that these should be duly allotted to him. No share certificate book has been produced. Apparently the company ever since its formation has traded at a loss, there being, in fact, a net loss of £247 on the trading for the first 12 months. The failure is ascribed to stoppage of work owing to the war, although in November, 1914, the company extended it business by taking additional business premises at Child's Hill. Further investigation is to be made into the affairs of the company.

CANADIAN-BRITISH ENGINEERING CO., LTD.—This company is winding up voluntarily with Mr. R. G. Sidford, 20, John Street, Adelphi, W.C., as liquidator. A meeting of creditors is called for February 1st.

SCIENTIFIC MANUFACTURERS, LTD.—This company is winding up voluntarily, with Mr. A. H. Partridge, 3, Warwick Court, Holborn, London, as liquidator.

HELE-SHAW PATENT CLUTCH CO., LTD.—This company is winding up voluntarily, with Mr. W. G. Needham, Holly Bank, Oldham, as liquidator. A meeting of creditors will be held on January 31st, at Hartford Works, Oldham.

AUTOMATIC ELECTRIC BLOCK SIGNALLING CO., LTD.—This company is winding up voluntarily, with Mr. A. Colls as liquidator.

ELECTRIC RAILWAY SIGNALLING SYNDICATE, LTD.—A meeting is called for March 1st, at 32, Great St. Helens, E.C., to hear an account of the winding up from the liquidator, Mr. C. F. Palmer.

Bankruptcy Proceedings.—G. E. BONNER, electrical agent, 105, Fox Lane, Palmer's Green, Middlesex.—Receiving order made January 19th, on debtor's petition.

Book Notices.—"Key to the London Telephone Directory and Business and Trades Directory." Vol. II, No. 2. September, 1915, to April, 1916. London: W. H. Smith & Son. Price 5s. net.

"Annuaire pour l'An, 1916." Paris: Gauthier-Villars et Cie. Price 1 fr. 50.

"The Two-stroke Engine." By Dr. A. M. Low. London: Temple Press, Ltd. Price 1s. 6d. net.

Calendars, Catalogues, &c.—MESSRS. ALFRED GRAHAM & CO., of St. Andrew's Works, Crofton Park, London, S.E., have sent us one of their desk blotting pads, with diary pages interleaved with blotting at the left-hand side. They have also issued their usual useful book of time and speed tables for 1916.

MESSRS. THOMAS WHITTLE & SONS, LTD, Warrington.—40-page catalogue, giving full particulars and sizes of their patent belting, which is a combination of leather and steel links. A large number of excellent half-tone pictures show the application of the belting in the driving of electrical and other machinery.

MESSRS. SIEMENS BROS. & CO., LTD., Woolwich, S.E.—Reprint of pages 903-908 of their Catalogue No. 510, giving revised prices of their jointing materials consequent upon the alterations in cost of materials, &c.

MESSRS. A. G. THORNTON, LTD., Paragon Works, King Street West, Manchester.—Two new catalogues—drawing office and pocket edition respectively—of drawing, surveying and scientific instruments and drawing office materials. The former is a publication of nearly 450 pages, and it contains illustrated descriptions, price particulars, and a telegraphic code, relating to a very complete collection of instruments and equipment. The pocket edition consists of some 160 pp. of material concerning a selection of instruments and materials suitable for draughtsmen and students. The first of these catalogues was in preparation prior to the outbreak of war, and the prices therein are based on pre-war factory costs.

"Z" ELECTRIC LAMP MANUFACTURING CO., LTD., Standen Road, Southfields, London, S.W.—Catalogue No. E 502 giving some particulars of the "Z" drawn-wire lamps and half-watt lamps, also prices of same. The pictures include some views of the stores, the filament winding department, and the test-room at Southfields.

MESSRS. ISENTHAL & CO., Denzil Works, Willesden, N.W.—32-page illustrated catalogue and price list of slate rheostats of many different types, also tubular rheostats. Diagrams of connections are given. The rheostats are of all-British type and manufacture, and they are finding an increasing market in the Allied countries. Two other sections of the catalogue dealing with field, arc lamp resistance, dimmers and special types, are in preparation, and will be issued shortly.

MESSRS. J. H. TUCKER & CO., King's Road, Hay Mills, Birmingham.—Detailed lists of fuse and distributing boards, main switches, and miscellaneous items that are in stock.

THE NOTTINGHAM SOCIETY OF ENGINEERS has sent us one of its pocket diaries for 1916. A full list of officers and members of the Association is given, also a list of kindred Associations, together with a number of engineering advertisements, these preceding a Letts's note-book and diary.

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Private Arrangement.—JOSEPH PERCY ANDREW, trading as the Ray Electric Co., 82, Woodgrange Road, Forest Gate, and 350, High Street North, Manor Park, electrical engineer. A meeting of the creditors of the above was held on Monday, at the offices of Messrs. Henry Sydney & Son, solicitors, 185, Aldersgate Street, E.C. A statement of affairs was presented which had been prepared by Messrs. Poppleton, Appleby & Hawkins, and which showed total liabilities of £1,706, exclusive of a claim by the debtor's wife for £55 for money lent. The liabilities included a claim by the debtor's father for £300, money lent, and there were two other cash creditors whose claims aggregated £78, while the claims of the German trade creditors amounted to £309. Mr. E. H. Hawkins stated that the debtor started trading, in partnership, at 339, High Street, Manor Park, in November, 1906. No deed of partnership was entered into, but the debtor and his partner each agreed to put in £100, and the profits and losses were to be equally shared. The debtor's £100 was lent him by his father. The debtor was to draw £1 a week, while the partner was to have £2 weekly. In June, 1908, the partnership was dissolved, and the partner retired. The assets were then valued at £200, and the liabilities at £40, and it was agreed that the outgoing partner should receive £100. The debtor paid £50 of that amount down, and the balance of £50 he borrowed from his father. Since that date the debtor had traded alone. In 1909 the debtor removed to 350, High Street North, the premises being held on a lease at £55, rising to £60 per annum. In 1913 the debtor found he was trading at a profit, and he decided to open another shop at Green Street, Upton Park, where he acquired premises at a rental of £50 per annum. Last December he removed the stock from that shop, and sold the goodwill and his interest in the premises for £40. In March, 1914, still thinking he was making a profit, the debtor opened the Woodgrange Road shop, which he acquired at a rental of £65, rising to £70 per annum. The debtor agreed to spend £300 on improvements to the premises, and had paid £242 for alterations. Mr. Hawkins added that the assets were estimated to realise £568, but from that amount had to be deducted £90 for preference claims, leaving net assets of £478.

In answer to questions, Mr. Hawkins stated that some creditors had obtained judgment against the debtor. During the year ended March, 1913, the sales were £4,098, while in the following year they increased to £6,132. In the next 12 months they were £6,069. Since last March the sales had fallen off somewhat. The drawings had been at the rate of £3 a week.

Mr. Sydney, on behalf of the debtor, made an offer of a composition of 5s. in the £, payable by four equal quarterly instalments, the cash creditors postponing their claims.

Mr. Hawkins said that the money necessary for the payment of the amount of the composition to the German creditors would have to be found by the debtor, and it would then be handed over to the Public Trustee.

Several creditors intimated that they were not prepared to accept 5s. in the £, and Mr. Sydney increased the offer to one of 6s. 8d. in the £, payable by five quarterly instalments. After a short discussion, it was decided to accept the amended offer, and it was also resolved that a deed of assignment should be executed, with Mr. E. H. Hawkins as trustee. A committee of inspection of the principal creditors was appointed. The following are creditors :—

G. G. Bussey	£15	Robin Hood Cycle Co.	£14
East London Rubber Co.	47	Pitco Electric Co.	24
Foster Engineering Co.	21	Walmsley & Sons, Ltd.	16
Elswick Hopper Co.	30	Johnson & Phillips	21
Butcher & Sons	35	Clemens Bros.	36
Summers Bros. & Co.	31	Turner & Burger	12
Dunlop Rubber Co.	15	Jaeger Bros.	102
Times Electric Co.	50	Lohman & Co.	125
New Polyphon Supply Co.	17	H. Feldchenfeld & Co.	65
New Hudson Cycle Co.	12	Stern & Co.	15
Bryans, Ltd.	20		

Trade Announcements.—MESSRS. ELECTRA, LTD., of 1, The Triangle, New Barnet, N., state that they are inaugurating a new scheme of insurance and maintenance of motor-car lighting sets and electrical accessories.

MESSRS. BOVING & CO., LTD., who have now removed to their new premises at Imperial Buildings, 56, Kingsway, London, W.C., have in circulation a booklet containing some excellent views of these premises.

MESSRS. THOMAS & BISHOP have removed to 37, Tabernacle Street, in order to have their general offices, stores and works under one roof. All general correspondence and goods should be addressed there. The accounts departments will continue at 119-125, Finsbury Pavement, E.C.

German Catalogues.—In order that British manufacturers may have an opportunity of familiarising themselves with German methods of publicity, the Board of Trade have collected over 3,000 specimen catalogues of German origin, illustrating a great variety of industries, and these may be inspected at the Foreign Samples Section of the Commercial Intelligence Branch, 32, Cheapside, London, E.C. A complete index of the catalogues has been prepared, rendering identification of any particular catalogue a simple matter. Arrangements have been made whereby catalogues may be lent for a few days to United Kingdom firms established in the Provinces.—*B. of T. Journal.*

For Sale.—The Salford Electricity Committee invites tenders for one Browett-Lindley three-crank, three-cylinder Uniflow engine, direct-coupled to Mather & Platt D.C. generator, and one Browett-Lindley six-cylinder compound engine, direct-coupled to Mather & Platt D.C. generator, both sets complete with jet-condensing plant. Particulars are given in our advertisement pages to-day.

Trade in China : Catalogues Wanted.—H.M. Commercial Attaché at Peking (Mr. W. P. Ker, C.M.G.) reports that the Chinese Ministry of Agriculture and Commerce have recently established a Commercial and Industrial Commission, whose object is the collection of statistics and the development of Trade in China, and that this Commission desires to receive copies of catalogues issued by United Kingdom manufacturers. United Kingdom manufacturers, and exporters of U.K. goods, who may be interested, should address catalogues and price lists of their goods to the Commercial and Industrial Commission, Ministry of Agriculture and Commerce, Peking.—*B. of T. Journal.*

An Inquiry from British Columbia.—MESSRS. P. F. LETTS & CO., electrical engineers and contractors, of 3,044, Granville Street, Vancouver, B.C., wish to receive catalogues, prices &c., from manufacturers of silk shades for electrical table, floor, and candle lamps.

LIGHTING AND POWER NOTES.

Aldershot.—REVISED TARIFF.—The U.D.C. has adopted a revised scale of charges for electricity for power and heating, varying from 2d. per unit for under 250 units per quarter, to 1½d. per unit for over 2,000 and under 5,000 units; beyond this amount a special arrangement will be made. The lighting accounts, as from March 31st, will be increased by 10 per cent.

Argentina.—The municipality of the city of Santiago del Estero has voted $300,000 for the cost of installing a power house for the public supply of electric light and energy.

The latest electrical news of importance from the Argentine Republic is as follows :—The electric light and power installation now in course of construction in the progressive town of Villa Canas, in the province of Santa Fé, will shortly be completed and ready for the inauguration ceremony. The inauguration has just taken place of the electricity station, recently constructed at Monteros, by Messrs. Otonello & Brothers. Proposals have been made to the authorities of Lules, in the province of Tacumany, to light that town from the electric station situated in the neighbouring townships of Concepcion and Tafi-Viejo. The municipality of Colon has received the plans of the projected electric light installation, and so soon as they are approved, the contractors, Messrs. Klug & Hubscher, will begin operations. At Nogoya the large flour-milling company, the Sociedad Anonima Molinos Harineros y Elevadores, have arranged for the equipment of their new mill with electric driving.

Australia.—A majority of the ratepayers of Balaklava, South Australia, has decided in favour of borrowing £3,750 for the purpose of installing electric light. The question was first discussed four years ago.—*Tenders.*

The annual report of the Port Melbourne municipal electric light and power scheme inaugurated two years ago, shows receipts amounting to £4,514, and expenditure to £3,782; the year's revenue included the following :—Private consumers for power, £2,020; for lighting, £1,408; street lighting, £981; the expenditure included £2,403 paid to the Melbourne City Council for electricity. From the year's profit of £752, £239, the debit balance of the previous year, has to be deducted, leaving a profit of £513 for the two years.

The city electrical engineer of Melbourne, in his report on the proposal to install electric lighting in city premises on extended terms of payment running to 30 months, states that the greatest objection to the scheme would be the very large number of bad debts the City Council would be liable to incur. It would also be necessary to obtain legislation allowing the Council to make the payments a first charge on the land. The engineer does not consider the scheme would be availed of to an extent to justify its adoption; landlords would not be willing to bear the expense of the installation even if it were spread over a period without increasing the rents; the only class of property for which he could recommend the scheme would be where the owner was also sole tenant.—*Australian Mining Standard.*

The Wollongong Municipal Council has adopted the plans and specifications of Mr. J. R. Rumford for an electric light installation, the maximum demand being put at 105 KW. Electricity will be supplied from the Department of Public Works power house at Mount Kembla; 28 miles of reticulation are specified. The contractor is providing the installation on terms of payment extending over 10 years.

The Mudgee Electric Lighting Co. has installed a small steam generator set for the day load, and a new battery is to be obtained by the company, which is also in negotiation for a new generator set from South Australia, to take the place of a set ordered in England, and unobtainable owing to the war.—*Sydney Telegraph.*

N.S.W.—ELECTRIC WINDERS.—Two electric winders are in use in the coal mines of New South Wales, one being at the Aberaman Colliery and the other at the Richmond Main Colliery. The first-mentioned is connected through gearing to a 105-H.P., D.C., 250-volt motor, and is used to draw coal from the bottom to the top seam. It is operated by means of a reversible controller and powerful foot-brakes. The winder at Richmond Main is direct-coupled to an 800-volt D.C. motor of 800 to 1,850 B.H.P., and is fitted with over-speed and over-winding gear, also compressed-air brakes. It operates on the Siemens-Ilgner system, a fly-wheel converter set being installed. A clutch is provided so that the

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fly-wheel can be put out of gear, and the winder worked on the Ward-Leonard system when the loads are light. As this mine is only in the development stage, no figures as regards the capacity of the winder are available.—*Australian Mining and Engineering Review.*

Aylesham.—E.L. SCHEME.—The P.C., after discussing with Mr. Chas. H. Best, of Bradford, and Mr. Pullan, details of an electricity scheme for the parish, using overhead cables, has passed a resolution welcoming an efficient scheme of electric supply, but without taking any action in the promotion of a company for the purpose. Mr. Best proposes to float a company with a nominal capital of about £3,000, and to supply current for lighting at 6d. per unit, with a substantially lower rate for power and heating.

Bradford.—WAR BONUSES.—The Special Committee appointed to consider the question of war bonuses to the employés of the various departments of the Corporation, has decided to recommend that it is desirable to maintain the principle of dealing with any adjustment of wages during the war by means of war bonuses rather than the revision of the wage standard. The Committee also recommends a revision of war bonuses as follows: 3s. a week for men over 19, where the wages do not exeed £3 a week; 2s. a week for male employés under 19, and female employées 2s. a week all round.

Ballater.—E.L. SCHEME.—Application has been made to the B. of T. by Duncan's Electricity Supply Co., Ltd., for consent to the erection of 220-volt overhead transmission lines throughout the burgh of Ballater, for the purposes of supply under the Ballater Electric Lighting Order, 1914.

Bedford.—Messrs. W. H. Allen, Son & Co., Ltd., have informed the T.C. that they are installing a further 250-KW. motor-generator, so as to enable them to take the whole of their supply from the electricity undertaking, instead of it being necessary to run their own plant as well. The existing mains, it was stated, would be large enough to take the increased demand provided a synchronous motor-generator was installed, and this the firm had agreed to put in. The Council has decided to provide the necessary additional meters and switchgear, at an estimated cost of £130.

Brighton.—PROPOSED TARIFF INCREASE.—At the last meeting of the T.C., the electrical engineer submitted a further report on the situation that has arisen in connection with the electricity undertaking owing to the war. He considers that there will be a possible increase for the year of £8,000 in the cost of coal and a decrease in consumption, together estimated to cause a deficit of over £5,000. The Electricity Committee, on the advice of Mr. Christie, recommended a flat rate of 5½d. per unit for all classes of consumers, excepting for power and tramway supply, subject to reductions of ½d. per unit for each additional 1,000 units after the first 1,000, with a minimum of 3½d. per unit for everything over 4,000. The change is estimated to produce an additional revenue of £12,000, the proposals to take effect from the March quarter. After a long discussion the whole matter was referred back to the Committee.

Chislehurst.—The Foots Cray Electricity Co. has decided to make a quarterly charge of 1s. per meter from January 1st last. The Finance Committee of the U.D.C. reported that although no charge for meters had hitherto been made, the company had adopted this course rather than increase the price of current.

Coniston.—E.L. SCHEME.—The Ulverston R.D.C. has again deferred the question of signing a draft agreement with the Coniston E.L. Co. for a scheme for electric supply in the parish, and decided to submit the agreement to counsel for advice regarding certain clauses.

Continental.—ITALY.—In consequence of the enormous rise in the price of coal in Italy, the municipality of Vercelli has decided to draw upon the hydroelectric works of the Società Officine di Energia Elettrica, of Novara, for current for lighting and power for the period from dusk to dawn, reserving its own steam plant for the remainder of the 24 hours. The position of Vercelli is typical of very many cities in Italy at the present time.

Darlington.—The output of the municipal electricity works for December was 665,127 units, an increase of 29·65 per cent. upon the figures for December, 1914. During the nine months ended December 4,347,064 units were generated, being an increase of 715,482 units, or 19·97 per cent., for the year to date.

Dublin.—A number of motors have been installed in a new factory at Parkgate Street, and will be supplied from the Corporation electricity mains, it being estimated that at least 600 H.P. will be required to keep the factory running. The factory will be in full work by March 1st.

Dungannon.—E.L. SCHEME.—The Provisional Committee for the introduction of public electric lighting proposes to erect the generating plant at a waterfall, at Altmore, about six miles from the town, where riparian owners are giving every facility. The new company will be worked on co-operative lines. Already a considerable sum of money has been subscribed.

Edinburgh.—NEW POWER STATION.—The T.C. has adopted the Electric Lighting Committee's report recommending approval of the plans for the Portobello power station, and that estimates be obtained. The report stated that the cost of the work for which tenders have been accepted was £93,369, and the estimated cost of the remainder of the work was £106,215, a total of £199,584. The purchase price of the site of the station was £15,800, including a certain amount of property which would continue to yield revenue for some years.—*Edinburgh Evening News.*

Eton.—HOSPITAL LIGHTING.—The R.D.C. has accepted the offer of the Electricity Co. to supply current to the isolation hospital at 6d. per unit on a five years' contract. The company recently advanced the price to other consumers to 6½d. per unit.

Fleetwood.—NEW PLANT.—The electrical engineer to the U.D.C. has been authorised to proceed with his scheme for providing apparatus for softening and filtering water from the Clough for the electricity works.

Greenock.—Figures for the output of the Dellingburn electricity works, for the month of December, show 2,568,032 units generated, an increase of 1,104,188 on the corresponding period of last year.

Hull.—The acting city electrical engineer (Mr. McGoris), in the absence of the engineer (Mr. Bell), who is now with the Forces, has prepared revenue estimates of the Corporation electricity undertaking for the financial year ending March 31st, 1917. He estimated that the receipts would be £93,970, and that there would be a balance, after interest on loans and contributions to sinking funds amounting to £35,235 had been met. The estimates were approved. A number of applications for increases of salary were referred to a Sub-Committee for consideration.

India.—The electrical scheme of the Allahabad Municipal Board is making progress, and the company hopes to complete the work by the middle of April next.—*Indian Engineering.*

Keighley.—MOTOR HIRING.—The T.C. has decided to purchase no further motors for letting out on hire, but existing arrangements with consumers already supplied will be continued, and motors returned from hire will be relet to fresh customers.

Letchworth.—The output of the First Garden City Co.'s electricity works for the year 1915 was 907,000 units, as against 582,510 for 1914. During the year considerable extensions have been made, which, when completed, will give a total of 2,140 H.P. of plant installed at the electricity works.

Limerick.—YEAR'S WORKING.—At a meeting of the Corporation it was stated that the electric light works were now paying, a deficit of £1,700 having been wiped out during 1915, and a profit of £500 recorded.

London.—ST. PANCRAS.—On November 24th the borough treasurer submitted a statement of electricity capital expenditure for the year ending March 31st, 1916, showing that sufficient balances are in hand to meet the estimated requirements for the remainder of the year, and that it would be unnecessary to borrow further.

The Finance Committee has received a communication from the L.C.C. stating that the loan of £8,970 last granted was based upon the estimated expenditure in 1914-15 under the head of mains £8,000, and that it now appears that the actual expenditure on mains in that period was £1,057 only; the Council therefore asks the B.C. to repay the sum of £2,587 advanced in respect of estimated expenditure in 1914-15 upon electricity mains (which with £5,413 in hand under this head at March 31st, 1914, made up the £8 000 referred to).

The Finance Committee, in reply to a communication to the L.C.C. as to the urgency of sanction being received for a loan of £13,000 in respect of the King's Road electricity station extension, has been informed by the Controller of the C.C. that his Finance Sub-Committee has agreed that the application should be proceeded with.

The Electricity Committee recommends that the L.C.C. be informed that it is intended to extend the feeder mains in the Northern and Prince of Wales Road district, at an estimated cost of £4,526; and that the £2,587 will be absorbed by this extension. The Finance Committee approves the recommendation.

The Electricity Committee has received a petition from the station mains staff for 15 per cent. increase in their wages in lieu of the present war bonus. The Committee is of opinion that the Council should reconsider the whole question of the war bonus now in operation.

The engineer recommends that the remaining 250 arc lamps be converted for incandescent lighting; he also reports that his amended estimated expenditure for 1915-16 will reduce the amount by £2,395, and the expenditure next year will be further lessened by £750 in respect of the hire of the Ljüngstrom turbine, and £551 for watching the stations, which will not be necessary.

L.C.C.—ELECTRIC COOKING.—The Education Committee has decided to continue for a further period of one year the electric cooking stove installed as an experiment at the Maxey Road (Woolwich) Domestic Economy centre.

The Finance Committee of the L.C.C. has sanctioned a loan of £2,618 to the Battersea B.C. for electricity mains.

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Lincoln.—The T.C. has applied to the B. of T. for consent to use overhead lines, in order to supply current to premises at Foss Bank.

Monaghan.—E.L. SCHEME.—A public meeting of ratepayers has authorised the Council to give consent to the Monaghan Lighting Co. to erect poles and wires in the streets for the introduction of electric lighting.

Newbridge (Co. Kildare).—HOSPITAL LIGHTING.—At a meeting of the Governors and friends of the Drogheda Memorial Hospital, it was announced that electric light was being installed in the institution.

Rawtenstall.—Large consumers of electricity for power and lighting have recently asked the Corporation to supply the current for lighting at the same rate as that for power, but the application has not been granted.

Rugby.—The T.C. has agreed to supply current for power purposes to the Rugby Sparking Plug Co., on terms varying from 1½d. per unit for under 10,000 units, to 1d. per unit for over 15,000 units per year.

Swinford (Co. Mayo).—In the annual estimate of expenditure by the clerk of the Union, £140 is allowed for electric lighting of the town in a special area fixed for that purpose.

Wallasey.—In regard to the failure of supply from the new generating station on January 11th, the engineer reports to the Council that it was due to stoppage of circulating water, and the plant was in operation again after three days.

West Ham.—The money now being required for current expenditure, the Finance Committee has recommended the Corporation to apply to the L.G.B. for a consent order authorising the raising of the unexercised balance of £2,000 of the loan of £17,500 granted in January, 1914.

Wigan.—E.L. FAILURE.—The Corporation electricity supply, which had been in a precarious condition all day, failed on Friday evening last. Anticipating trouble, a warning had been issued to consumers during the afternoon and the tramway service suspended. Apparently trouble has arisen owing to the hard water used for boiler feeding purposes and the non-delivery of new boilers, and the Electricity Committee is trying to arrange with the South Lancashire Tramways Co. for a temporary supply of current, as the company's cables practically meet those of the Corporation at Hindley.

It is calculated that the town will lose £1,000 in tramway revenue, in addition to the loss on lighting and power revenue.

Wolverhampton.—PROPOSED LOAN.—The T.C. is making application to the L.G.B. for its sanction to the borrowing of a sum of £1,780 for mains extensions in connection with the supply of electrical energy to certain manufacturers; and also for the Board's permission to the expenditure of £670, out of loans already raised in connection with the same extensions.

TRAMWAY and RAILWAY NOTES.

Argentina.—The inauguration of the No. 12 line of electric tramways at Rosario is reported. This line has been three years in the process of construction.

Ashton-under-Lyne.—FEMALE LABOUR.—The T.C. has granted conductor's licences to 10 females engaged by the Oldham, Ashton and Hyde Electric Tramway Co., Ltd.

Australia.—ELECTRIFICATION OF THE SYDNEY NORTH SHORE LINE.—The tunnel from Long Nose Point to Balls Head is nearly completed, the flooding having been successfully overcome, and it will be possible to lay the cables in a few weeks. At White Bay power house, machinery capable of developing 30,000 H.P. has been installed, and there is room for a further 60,000 H.P., or 90,000 H.P. in all, which is sufficient for the electrification of the whole of the suburban lines. It is estimated that the North Shore system can be electrified for £300,000; it is also considered that the White Bay power house should be utilised at the earliest possible moment for this railway, and that the building of the new electric railway stock should be commenced at once in order to be ready for the conversion of the suburban lines as soon as the power is available.—*Sun.*

SYDNEY CITY ELECTRIC RAILWAY.—The N.S.W. Minister for Public Works has intimated that the construction of the Sydney City Railway will be commenced in March. The plans specify that the overhead station at Circular Quay is to be moved nearer the Customs House, thus providing more room and involving the demolition of the Harbour Trust offices and the metropolitan fire station adjoining.

The Maryborough (Queensland) Council Tramways Committee has considered a report on the electric light and tramways questions, and has decided to pay Mr. E. J. Redmond £50 out of pocket expenses incurred in connection with his recent scheme. A further £50 was authorised to be spent in order to complete the information in connection with an up-to-date electric tramway system.—*Tenders.*

The Victorian Railway Commissioners are applying to Parliament for sanction to a loan of £800,000 towards the electrification of the Melbourne suburban lines, excluding the construction and structural alteration of rolling stock, but including the electrical equipment; the amount is part of the £3,110,000 loan for railway purposes.—*Age.*

The annual report of the Prahran-Malvern Tramway Trust states that the total length of track operated was 27·387 miles double and 3·280 miles single, which would be shortly extended by the completion of the Burke Road tramway. The car depôt and converter station at Kew were nearly completed, and would be available as soon as the battery was in position. In view of existing conditions and the increased cost of materials, it was recommended that no further extensions should be entertained until normal conditions prevailed. The gross revenue was £121,016, and the operating costs £110,493, leaving a surplus of £10,523, to which had to be added £3,168 for the loss on the Caulfield and Point Ormond extensions. The whole of the street lighting of the track was provided by the Trust, at a cost of £3,336. The balance to the credit of renewals, reserves, and sinking fund was £30,966, and the capital expenditure was £654,599. The number of passengers carried during the year was 18,350,503. The receipts on the Caulfield line were £7,226, and the expenses £10,394, leaving a loss of £2,942 to be repaid by Caulfield and £226 by St. Kilda. The transfer to reserve, sinking and loan funds amounted to £11,250, leaving a balance of £1,190 available for distribution as follows:—Prahran, £1,181; Melbourne, £9. During the year £1,050 has been paid to employés who had enlisted with H.M. Forces.

Bingley.—TRAMWAY EXTENSIONS.—The B. of T. has extended by two years, up to February 7th, 1918, the period allowed for the completion of the Bingley tramway past the Ryshworth Hall corner at Crossflats.

Blackpool.—TRAFFIC RECEIPTS.—The tramway figures for the month ending January 13th show receipts of £3,322, an increase of £497 over the corresponding period of last year, and passengers carried 758,418, an increase of 105,600. The receipts from the commencement of the municipal year amounted to £70,727, an increase of £2,136 over the corresponding period of the preceding year.

Bradford.—TRAMWAY COLLISION.—An accident occurred on the Thornbury section of the Corporation tramways on Thursday morning, last week, when an outward bound Bradford to Leeds car took the wrong points at a crossover road near the Thornbury tram sheds and crashed into a Leeds Corporation car proceeding to Bradford. Nine persons complained of injuries, the most serious cases being removed to the Royal Infirmary.

Continental.—SPAIN.—A scheme has been lodged at the Prefecture of Public Works, at Santander, for the construction of an electric tramway linking the seaside resort of Sardinero with those at Cabo Mayor and Cabo Mener. The line, which will have three branches, will have a total length of 3,618 m.

ITALY.—As far back as April 14th, 1914, the Consiglio Comunale of Spezia decided to exercise its legal right and take over the tramways owned by the Società Tranvie Elettriche della Spezia. Differences of opinion, however, existed between the company and the Commune as to the amount to be paid as compensation and for the plant, 2,469,130 lire and 4,500,000 lire representing the purchaser's and the seller's estimates respectively. The matter is now to be referred to arbitration for settlement.

In view of the near lapse of the concession enjoyed by the Società Romana Tramways-Omnibus, the Administration of the Municipal Tramways is drafting a broad scheme of tramway extensions and street improvements conjointly, which is to be undertaken when the whole of the city's network is under municipal control. Ten new lines are to be carried out and the Administration intends to "unfold a plan of underground tramway lines of moderate depth which will represent an intermediary stage between the existing aboveground network and the deep 'tube' line of the future, which must be constructed when the population of the city amounts to 1,000,000." The provisional moderate depth underground lines are, it is stated, an actual necessity, owing to the daily growing congestion of traffic in the streets of the city. The 10 new lines projected are to be constructed gradually, preference being given to radial trunk lines and the most active traffic routes. The total length of the new lines projected is upwards of 2,127 km.—*Rivista Tecnica d'Elettricità.*

Croydon.—FEMALE LABOUR.—The B.C. has authorised premises being rented to provide messroom and waiting accommodation for women conductors, of whom nine are being trained. It is reported that the receipts to date exceed by £5,332 those of the corresponding period of last year. The Committee has considered the suggestion of the Croydon Chamber of Commerce that a parcels delivery service should be tried but, owing to shortage of labour, did not consider it advisable or practicable.

Dover.—The T.C. has appointed a Sub-Committee to consider the question of women conductors, and to take the whole question of the tramways into consideration. The aggregate revenue of the undertaking from April 1st last amounts to £12,944, as compared with £10,730 for the corresponding period of the previous year.

Dudley.—INQUEST.—The inquest relative to the death of J. T. Evans, which resulted from injuries received in the tramway accident, mentioned last week, was opened on Thursday, last week. After evidence of identification, the inquiry was adjourned to February 3rd.

Ealing.—Owing to the bursting of a water main on Sunday, between Ealing Station and the Broadway, considerable damage was done to the roadway, causing the London United Tramway service to be suspended.

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Edinburgh.—The Tramways Committee of the T.C. recommends the provision of a motor for driving certain machinery at Shrubhill power station, at an estimated cost of £160.

London.—The traffic receipts of the L.C.C. tramways during the five weeks ended January 12th, 1916, amounted to £228,425, and the number of passengers carried to 54,291,778; for the corresponding period of 1914-15 the receipts were £221,171, and the passengers carried 52,860 313, showing an increase of £6,251 in the receipts, and 1,431,465 in the number of passengers carried.

SOUTH-WESTERN ELECTRIFICATION.—The difficulty which prevented the electric train service on the Waterloo to Kingston, Richmond, and Shepperton lines, on the L. and S.W. Railway, from being inaugurated on December 5th has now been overcome, and it is officially announced that the service will commence on Sunday, January 30th.

Manchester.—TROLLEY BOYS STRIKE.—The tramway department has recently experienced a shortage of boy labour, and, by way of experiment, four girls have been engaged as "trolley-girls." The trolley boys, being under the impression that the girls were receiving better pay than they were, went on strike at noon on Friday last week, their "demand" being that they should have an advance. Mr. J. M. McElroy, general manager, stated that he had received no application from the boys for an advance of wages. The trolley girls, he added, were being paid on exactly the same scale as the trolley boys. Ald. Jackson, of Salford, general secretary of the Tramway Workers' Union, said the boys ought not to have taken the law into their own hands, and his Union could not sanction such action as they had adopted. The trolley boys returned to work on Saturday. Altogether about 350 trolley boys are employed on the tramway system.

TELEGRAPH and TELEPHONE NOTES.

Argentina.—A concession for the installation of a new public telephone service at Buenos Ayres has been granted by the Municipal Commission of the City to Senor Alex. Schwimmer. The system is intended to provide news and electrophone service, and the concession lasts 30 or 50 years; the concessionaire will pay 6 per cent. of his gross receipts during 30 years, and 12 per cent. during the remainder of the term, to the municipality, with a fixed minimum annual payment of 50,000 Mexican dollars, and the maximum price per subscriber's station is fixed at $10 per month.

New Wireless System.—It is reported from Madrid that a new wireless telegraph system will be put in operation between Corunna and New York from February 1st. The system has been invented by Senor Branas, Professor of Oviedo University.

Russia and Rumania.—The Great Northern Telegraph Co., of Denmark, announces that an urgent service with Russia and Rumania has been introduced. The word "Urgent" must be inserted before the address and be paid for. The rate is triple ordinary rate—viz., to Russia 1s. 1½d., and to Rumania 1s. 3d. Urgent telegrams will receive priority of treatment over other private telegrams.

Week-End Messages to Australasia.—The Pacific Cable Board announces that during the suspension of week-end messages between the United Kingdom and Australasia (owing to interruptions on the Atlantic Cable system), messages will be accepted for transmission by post to Montreal and telegraphed from thence to destination, at the rate for week-end messages from Montreal to Australasia. Telegrams sent by this service will probably reach their destination in about 12 to 16 days, the period depending on the mail service between this country and Montreal, and may be posted to the Pacific Cable Board, Queen Anne's Chambers, London, S.W., together with remittance covering the cost at the following rates:—To Australia, 20 words, minimum charge, 11s. 8d.: each additional word, 7d. To New Zealand, Norfolk Island and Suva (Fiji), 20 words, minimum charge, 10s.; each additional word, 6d.

Messages must be prefixed P.W.T., which is counted and charged for as one word. These telegrams may also be handed in or posted to any of the offices of the Western Union Telegraph Cable system.

An arrangement is already in force in Australia and New Zealand for the acceptance of week-end messages to be telegraphed to Montreal, and posted thence to their destination in the United Kingdom.

Women Wireless Telegraphists.—A woman correspondent of the *Times* recently discussed the opportunities open to women to obtain employment in connection with wireless telegraphy. Already women are working on stations in the British Dominions and the United States, and the British Government has placed women in charge of stations at Rathlyn Island and the Isle of Mull; it is stated that the work is well within the compass of women, who make apt students and readily acquire the technical knowledge necessary to enable them to perform the duties of the wireless telegraphist.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—February 18th. Melbourne, Brunswick and Coburg Tramways Trust. Six radial trucks.*

April 15th. P.M.G. Common-battery multiple switchboard, or automatic or semi-automatic switchboard, and associated apparatus. See "Official Notices" December 31st.

BRISBANE.—February 28th. Deputy P.M.G. Gas engine, generator, battery, power board, &c., for the Post Office, Townsville, Queensland. (Schedule No. 370.) High Commissioner's Office, 72, Victoria Street, S.W.

April 26th. Deputy P.M.G. Five sections of trunk line switchboard for Toowoomba Exchange. (Schedule No. 342.)

MELBOURNE.—February 16th: 51 electric staff instruments. February 23rd: Two commutator slotting machines, for the Victorian Railway Commissioners.*

February 2nd. Agent-General for Victoria. Fuse distribution boxes and fuses, for the Victorian State Railways. See "Official Notices" January 14th.

March 22nd. Thermo-electric pyrometers, for the Victorian Government Railway Commissioners.*

SYDNEY.—February 7th. Metropolitan Board of Water Supply and Sewerage. For No. 1 pumping station at Ultimo. Two centrifugal pumps and electric motors (4,000 gallons per minute each), switchboards, starters, &c. Contract No. 1,301.*

February 28th. Municipal Council. Tenders for induction regulators. Specifications (11s. 6d.) from the Electric Light Department, Town Hall, Sydney.

April 10th. Municipal Council. Supply, laying and maintenance for six months of six 11,000-volt submarine cables, each 400 yards long, across Darling Harbour.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-KW. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.

Birmingham.—February 8th. Twelve months' supply of electrical stores, for the Birmingham Tame and Rea District Drainage Board. Forms of tender from the Board's offices, Tyburn, Birmingham.

Great Yarmouth.—February 1st. Corporation. Three, six or twelve months' supply of tramway stores. Specification from Mr. F. L. Turner, General Manager, Tramway Offices, Caister Road.

Halifax.—February 14th. Corporation. Twelve months' supply of electric lighting fittings and accessories, cables, telephone wire, meters, &c. See "Official Notices" January 21st.

Leicester.—February 5th. Corporation. Thirty tons 7-in. steel girder tramway rails, for the Tramways Committee. Particulars from Mr. E. G. Mawbey, Borough Engineer, Town Hall.

Leigh (Lancs.).—February 18th. Electricity Committee. 2,000-KW. turbo-alternator, 6,600 volts; surface condenser, set of pumps, 1,000-KW. rotary or motor-converter, with switchgear. See "Official Notices" to-day.

London.—BERMONDSEY.—February 10th. B. of G. Twelve months' supply of electric lamps. Forms of tender from Mr. E. Pitts Fenton, Clerk to the Guardians, 283, Tooley Street, S.E.

ISLINGTON.—February 17th. B. of G. Alteration to wiring, provision of switchboards, motor starters, &c., provision of motors, and purchase of old plant. See "Official Notices" to-day.

Manchester.—February 8th. Tramways Committee. Motor-'bus engines and chassis. Mr. J. M. McElroy, General Manager.

February 15th. Corporation. General stores, including cables, telephones, electrical accessories, &c., for the Tramways Department. See "Official Notices" to-day.

Middlesbrough.—February 7th. Corporation. Twelve months' supply of electric lamps. Specification from Mr. S. E. Burgess, Borough Engineer.

New Zealand.—AUCKLAND.—February 23rd. City Council. Centrifugal pumping electric motors, and automatic starting and controlling apparatus, for the four city pumping stations. Specifications from the office of the Water Board, Town Hall, Auckland.

DUNEDIN.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.

RAETIHI.—March 14th. Town Board. 40-H.P. hydro-electric generating set, switchboard, &c. Plans and particulars from Messrs. H. W. Climie & Son, Raetihi.*

WELLINGTON.—March 8th. Public Works Office. One 3,000-KW. generator and one 4,300-H.P. water turbine, at Lyttelton, for the Lake Coleridge electric power scheme. Specifications, &c., may be consulted by British firms at the office of the High Commissioner in London for New Zealand, at 13, Victoria Street, S.W.

Pembroke (Dublin).—February 7th. U.D.C. Twelve months' supply of electrical goods. Specifications from the Town Hall, Ball's Bridge, Co. Dublin.

Ross.—X-rays installation at the dispensary and cottage hospital. Superintendent.

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Swansea.—February 7th. Electric light installation, Brynmill School, for the Borough Education Committee. Mr. A. W. Holden, Clerk, 9, Grove Place (returnable deposit of £1 1s.).

Wigan.—February 6th. Tramways Committee. Twelve months' supply of tramway stores, including overhead material, &c. Specifications from Mr. F. Buckley, General Manager, Corporation Tramways, Market Place.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Australia.—The following tenders have been accepted :—

P.M.G.'s DEPARTMENT, SYDNEY.

180 cable boxes, 26 pairs, £146; 78 ditto, 39 pairs, £81.—O. Dorbauer.

P.M.G.'s DEPARTMENT, SOUTH AUSTRALIA.

80 miles rubber-insulated copper wire, No. 18, L.S.W.G., £244; 25 miles, No. 22, £105; 8 miles cotton-covered flame-resisting wire, £30.—W. T. Henley's Telegraph Works Co., Ltd.
60 miles twisted-pair, V.I.R., No. 20 copper wire, £1,158.—British General Electric Co., Ltd.

VICTORIAN RAILWAYS.

15-ton electric crane, including accessories and power derricking gear, £1,596.—Gibson, Battle & Co., Ltd.
60,000 flame arc carbons, £12 per 1,000.—Aust. Otis Engineering Co.
Electric lighting material for cars, at rates.—Aust. General Electric Co.
Two armature-banding machines, £340.—Gibson, Battle & Co.

—*Tenders.*

The Commonwealth P.M.G. has accepted the contract of the Commonwealth Art Pottery and Insulator Co. for the supply of 400,000 B insulators, to be delivered at the rate of 34,600 per month.—*Sydney Daily Telegraph.*

Cape Town.—Tenders were recently invited locally and in England for X-ray apparatus proposed to be installed at the new Somerset Hospital as a memorial to the late Sir Alfred Thompson, M.D. The tenders were submitted to Dr. Reynolds, the radiographer to the hospital, and on his advice the committee has accepted the tender of the British General Electric Co., Ltd., of Cape Town, at £386. The tender includes delivery and erection at the hospital and maintenance for three months.

The contract secured by Messrs. Sykes & Co., and mentioned in our last issue, was secured on behalf of Messrs. Bruce Peebles and Co., Ltd. It was for a Peebles motor-converter manufactured under the Peebles-La Cour patents, not a rotary converter. The Cape Town Corporation already has two 1,000 KW. Peebles motor-converters installed, and the present order is for a third of similar output.

East Ham.—The Electricity Committee has accepted the offer of Messrs. E. & A. Shadrack to supply 100 tons of Sherwood 1-in. nutty slack, at 22s. 3d. per ton, and 100 tons of Glasbrook best Admiralty smokeless Welsh coal, at 31s. per ton.

London.—ST. PANCRAS.—The Electricity and Public Lighting Committee has recommended the following tenders in connection with the extension of the King's Road generating station :—Concrete coal-bunkers and lift well : Messrs. W. King and Son, £2,764. Steel construction work : Messrs. E. C. & J. Keay, £7,615. Coal and ash-handling plant : Messrs. Strachan and Henshaw, £3,660.

ISLINGTON.—The Lighting Committee has communicated with contractors where, in its opinion, it would be in the Council's interest that existing contracts should be continued for a further period of 12 months, with a view to ascertaining which contractors would be willing to agree thereto. The only firm who are prepared to meet the Council in this respect, so far as contracts relating to the electricity department are concerned, are Messrs. Wm. Geipel and Co., who supply arc lamp carbons. The Council has been recommended accordingly.

New Zealand.—The Public Service Stores Tender Board, Wellington, has received the following tenders for 10,000 dry cells for telephones :—

Electric Construction Co.	(accepted)	£541
"		574
A. & T. Burt		588
F. W. Markman		578
P. R. Baillie & Co.	(for 5,000 only)	419
A. Ellis & Co., Ltd.		625
"		706
D. Riley & Co., Ltd.		663
Ramsay, Sharp & Co., Ltd.		750

The following tenders were also received for 1,000 yards of silk-covered cable, 33 wires; 2,000 yards of silk and cotton-covered cable, 66 pairs, and 2,000 yards ditto, 64 wires :—

Turnbull & Jones	(accepted)	£653
British General Electric Co.		584
A. D. Riley & Co., Ltd.		631
P. R. Baillie & Co.		688

—*New Zealand Shipping and Commerce.*

Walthamstow.—The tender of Messrs. W. T. Henley's Telegraph Works Co., Ltd., has been accepted by the U.D.C. for the supply of low-tension cables.

FORTHCOMING EVENTS.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, January 28th. At 7.30 p.m. At Bolbec Hall, Newcastle-on-Tyne. Ordinary general meeting.

Association of Mining and Electrical Engineers (Notts and Derbyshire Branch).—Saturday, January 29th. At 3.30 p.m. At University College, Nottingham. Papers on "Unusual Breakdowns in Colliery Electrical Plant," by Mr. R. Devine, and "Notes on Experiments with Battery Signalling Bells following the Senghenydd Explosion," by Mr. G. M. Harvey.

Rontgen Society.—Tuesday, February 1st. At 8.15 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Discussion on "The Injurious Effects produced by X-rays," to be opened by Dr. Sidney Russ.

Institution of Electrical Engineers (Students' Section).—Wednesday, February 2nd. At Victoria Embankment, W.C. Paper on "The Methods employed for the Wireless Communication of Speech," by Mr. P. R. Coursey.

Chemical Society.—Thursday, February 3rd. At 8 p.m. At Burlington House, Piccadilly, W. Lecture on "The Recent Work on X-rays and Crystals and its Bearing on Chemistry," by Prof. W. H. Bragg, F.R.S.

Royal Institution of Great Britain.—Thursday, February 3rd. At 3 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Industrial Applications of Gaseous Fuels derived from Coal," by Prof. W. A. Bone, F.R.S.

Greenock Electrical Society.—Friday, February 4th. At 7.45 p.m. At the Temperance Institute, 19, West Stewart Street. Paper on "Colliery Electrical Installations," by Mr. R. Gordon Campbell.

West of Scotland Iron and Steel Institute.—Friday, February 4th. At 7.30 p.m. At the Rankine Hall, Elmbank Crescent, Glasgow. Paper on "The Manufacture of Ammonium Nitrate, &c., from Waste Gases," by Mr. E. Kilburn Scott.

NOTES.

Diesel Engine Users' Association.—At the January meeting of the above Association, the use of tars and tar oils as fuel for Diesel engines was discussed. Mr. Charles Day, of Messrs. Mirrlees, Bickerton & Day, had been specially invited to attend this meeting, and, after referring to the recent very great increase in the price of fuel oil, he said that tars and tar oils had been successfully used on the Continent, the ignition difficulties having been completely overcome by injecting a small quantity of petroleum oil into the cylinder of the engine slightly in advance of the tar oil.

Mr. Day estimated that the cost of carrying out the necessary alterations to engines manufactured by his firm for adapting them to the use of tar oils, including a new needle valve casing, ignition pump, and device for controlling the pump, would be in the neighbourhood of £1 per H.P., and, taking petroleum oil and tar oils at present prices, the cost of this alteration would be paid for in the first year by the saving effected in the cost of fuel oil on an engine working for the average number of hours per annum. He had run Diesel engines quite successfully on whale oil.

On the invitation of the President to give some information on the subject of the crosshead type of Diesel engine being made by Messrs. Mirrlees, Bickerton & Day, Ltd., Mr. Day explained that its advantages, as compared with the trunk piston type, were, in the first place, the greatly reduced risk of piston seizure, due to the fact that the piston need not be such a close fit, as the transverse forces due to connecting-rod angularity were taken on the crosshead, and not on the piston. There was also reduced risk of piston cracking, and it was possible to give much better support in the crosshead type than in the trunk type to the centre of the piston, which was exposed to the greatest heat and to the maximum stress. Trouble with the connecting-rod top end would also be reduced, since this bearing was in a position quite away from the heat of the piston. To secure that the piston-rod should be kept cool, and to prevent any oil vapour rising from the crank chambers to the cylinders, or any smoke or dirty oil passing into the crank chamber, a cover was fitted between the cylinder and the crank chamber, with a water-cooled gland, which prevented transmission of heat to the crosshead. A further advantage was greater economy in lubricating oil, as any carbon or dirty oil was prevented from entering the crank chamber from the cylinders; the lubricating oil therefore retained its condition longer, not being splashed or thrown on to the cylinder walls, and was kept much cooler, and none of it being lost through the cylinders, a substantial saving would obviously result. The air on its way to the cylinders was arranged first to go underneath the pistons, so that any smoke or gas which had passed the pistons would be thoroughly cleared away, and a considerable amount of air cooling would also take place. The water-cooled gland mentioned would have none of the disadvantages of a water-cooled piston, since it did not introduce any additional reciprocating weight, and its stationary water joints would not be liable to cause trouble. The piston need not be made so thick and heavy as the trunk piston, which was liable to cracking and distortion if its thickness or weight were further reduced.

The next meeting of the Association will be held on February 23rd.

Appointments Vacant.—Chief clerk (temporary), (50s.), for the Corporation of Swindon electricity and tramways department; test-room assistant and meter mechanic (45s.), for Borough of Newport (Mon.) electricity department; station engineers (60s.), linemen jointers (50s.), wiremen (40s.), engine drivers (steam, gas or oil), 30s., and wiremen's mates (30s.), for the Military Camps, Western Command. See our advertisement pages to-day.

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Institution and Lecture Notes.—Association of Mining Electrical Engineers.—A joint meeting of the Scottish branches of this Association and the National Association of Colliery Managers, together with the Mining Institute of Scotland, was held at Glasgow on Saturday last. Prof. Daniel Burns, of the Royal Technical College, Glasgow, read a paper on "Electrical Shaft Winding," and said that in general the wider application of central supply schemes and the electrical equipment of groups of mines must inevitably lead to a more extensive use of electrical winding, but even the most sanguine advocate of the use of electrical appliances about collieries must recognise that many large colliery concerns produced a large quantity of low-grade fuel from their coal-cleaning processes, which was almost unmarketable, and had to be used for steam-raising purposes at the colliery in order to get rid of it. The necessity of thus having to dispose of the residue of the coal washer must, and probably always would, exert a powerful influence on the cost of steam raising, and would provide in many cases a factor in favour of steam winders which was entirely outside the merits of the two systems. Prof. Burns, in conclusion, remarked that the employment of electricity for winding had now been perfected, and colliery owners need have no hesitation in adopting this type of electrical machinery when suitable conditions existed for its application.

From the foregoing report, extracted from the *Glasgow Herald*, it would seem that some colliery owners are content to use their boiler furnaces as refuse destructors in preference to employing the most efficient means of raising coal. The economic folly of this policy needs no demonstration. How to avoid it may be learned from a visit to the North-East Coast.

Institution of Electrical Engineers.—On Thursday last week a paper was read by Mr. H. H. Harrison on "The Principles of Modern Printing Telegraphy," and a discussion followed.

The same paper was read and discussed at a meeting of the MANCHESTER LOCAL SECTION on Tuesday last. The President of the Institution, Mr. C. P. Sparks, was present and addressed the members, expressing his pleasure at being there. He said that a good deal of agitation and correspondence in the Press had taken place on the subject of "Alien Enemies." The Institution had power to deal with this question under Article 41 if the matter was raised by 10 members, but the matter had not been raised by any 10 members. The Council, however, had appointed a Committee of vice-presidents to consider this matter, and would act within a very short time.

Dealing with the work of the Institution generally, he mentioned the Research Committee. Considerable sums had been set aside for it, with the approval of the members, and good work had been done. Recently, at the request of a Committee of the Privy Council, they presented a report naming nine subjects on which they considered research should be undertaken. Up to the present the Privy Council had only considered two of the nine subjects, and he was pleased to say that the Government had granted the sum of £1,050 per annum towards the cost of research on these subjects. There was no reason to think that the other seven subjects would not receive similar treatment.

The Wiring Rules Committee had completed its work, and he hoped the revised rules would be published within a few weeks.

Dealing with the question of examinations, the President said it was not the wish of the Council to keep out any desirable candidate. If a person could not pass examinations, but was otherwise qualified, and could pass other tests, he would be elected. During the war period the examinations were suspended, and those candidates who were on active service or engaged on munition work would be elected Associate Members at an early date. A hearty vote of thanks was accorded to the President for his address.

Fatality.—A boy while on his way to school at Nitshill, Renfrewshire, came into contact with a fallen live wire of the Clyde Valley Power Co. and was instantaneously killed.

Volunteer Notes.—ENGINEERING INSTITUTIONS' VOLUNTEER ENGINEER CORPS.—Orders for week commencing January 31st, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commandant.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Saturday, January 29th.—Uniform Parade, 2.45 p.m.

Monday, January 31st.—Sections 1 and 2, Technical; Sections 3 and 4, Lashings and Trestle Bridging, Signalling Class and Recruits.

Tuesday, February 1st.—School of Arms, 6 to 7 p.m.

Thursday, February 3rd.—Shooting for Sections 3 and 4.

Friday, February 4th.—Sections 3 and 4, Technical; Sections 1 and 2, Lashings and Trestle Bridging; Signalling Class and Recruits.

Saturday, February 5th.—Adjutant's Instruction Class at 2.30 p.m.

E. G. FLEMING,
Company Commander and Acting Adjutant.

3RD BATT. (OLD BOYS) CENTRAL LONDON REGIMENT (VOLUNTEERS).—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, January 27th, 1916:—

Week-end Parades.—Saturday—The Battalion, less Platoons Nos. 6, 9, North London and Blackheath, will parade at Wembley Park at 3.15 p.m. All "Derby" recruits will parade with this party. The members of the Officers' Instruction Class will also parade at Wembley Park at 3.15 p.m., under the Battalion Sergt.-Major.

Sunday.—The Battalion, less Platoons Shooting at Acton, will Parade at the Low Level entrance, G.E.R., Liverpool Street Station, at 9.30 a.m., and will proceed by train for Entrenching duties. Members will carry their own lunch. The Battalion will return to town about 6 p.m.

Musketry.—The Inter-Platoon Competition will be continued on Saturday next, the 29th inst., and on Sunday, the 30th inst., in accordance with the orders published on Monday last. The competing platoons to parade punctually, in uniform with bayonets, at the hours named in the before-mentioned orders.

A. G. JOINER, *Major and Adjutant*, O.B.C.

National Trade Policy.—In the House of Commons on Wednesday, Sir A. Spicer asked the Prime Minister whether the Government were prepared to appoint at once a number of small committees to undertake, for the leading industries of the country, inquiries similar to those recently made by the special sub-committee of the Advisory Committee on Commercial Intelligence of the Board of Trade, and to appoint upon the report of such committees a Royal Commission, representative of various schools of fiscal opinion and of the leading oversea Dominions and India, to make recommendations as to the commercial policy of this country consequent upon the war.

According to the *Daily Telegraph*, Mr. Runciman, who replied, said he proposed to arrange for inquiries similar to that in question to be taken shortly in a number of groups. He was not in a position to state what subsequent action would be taken.

In reply to a request from Sir Philip Magnus for delay, Mr. Runciman said, "Some of these things cannot wait."

Educational.—UNIVERSITY COLLEGE, LONDON.—Owing to circumstances arising out of the war, Mr. Kilburn Scott's course on the "Electrical Production of Nitrates for Fertilisers and Explosives," announced to begin on Wednesday, January 26th, will not be held.

Patents and Alien Enemies.—The Worthington Pump Co., Ltd., has applied to the Board of Trade for the avoidance or suspension of Patent No. 19,609/10, granted to Meyer, in respect of valves for pumps.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—The East Ham Tramways Committee propose to increase the salary of Mr. T. C. WINGFIELD, works superintendent, from £250 to £275 per annum.

The Luton T.C. has been recommended to increase the salary of the electrical engineer's chief clerk, Mr. R. HARDING, from £130 to £143 per annum.

The Poplar B.C. has been recommended to increase the salaries of the following officers of the electricity department as from January 1st:—Mr. F. TAIT, assistant manager, £275 to £287 10s.; Mr. V. H. CRUICKSHANK, station engineer, £250 to £262 10s.; Mr. E. R. INGRAM, mains engineer, £250 to £262 10s.; Mr. E. E. FARRANCE, sales manager, £237 10s. to £250; Mr. A. H. VINCENT, junior clerk, £71 10s. to £78; Mr. J. FORSYTH, charge engineer, £175 to £185; Mr. C. W. COPPINGER, charge engineer, and Mr. A. E. RICKETTS, sub-station engineer, £162 10s. to £185 each.

Mr. G. SCHOFIELD, late constructional superintendent of West Ham Corporation, has concluded his services with West Ham and taken the position of chief assistant engineer to the Nairobi Power & Lighting Co., Nairobi, East Africa. He sailed on the ss. *Comrie Castle*, which left Marseilles on January 25th.

General.—Mr. C. G. STANESBY, F.C.I.S., has been appointed secretary of the Charing Cross, West End & City Electricity Supply Co., Ltd., in succession to Mr. Edward Wilmot Seale, who has retired after 26 years' service.

The *London Gazette* contains the following notice:—"Territorial Force: The London and Tyne Electrical and Mechanical Company. The announcement of the transfer of the undermentioned officers, which appeared in the *London Gazette* of December 1st, 1915, is cancelled:—Captain (temporary Major) Arthur E. Levin; Second-Lieutenant (temporary tain) Hugh C. C. Tufnell; Second-Lieutenant (temporary tain Hugh C. C. Tufnel; Second-Lieutenant (temporary Lieutenant) Frederick H. Bowers."

Mr. G. A. MENSHALL, leading electrical fitter and machinery attendant on the staff of the L.C.C. Highways Committee at Rotherhithe tunnel and Deptford Creek bridge, has resigned.

Mr. W. H. WALTON, late of the staff of the electricity department of the Marylebone T.C., and formerly at Blackpool Corporation works, has obtained a commission in the R.N.V.R. He has been in the Anti-Aircraft Corps, and served for five months at the Dardanelles.

Mr. C. W. SALT, borough electrical engineer at Torquay, who recently joined the London Corps of Electrical Engineers, has been promoted to the rank of corporal.

The electricians and other members of the engineering staff of Messrs. M. Oldroyd & Sons, Ltd., woollen manufacturers, of Bradford Road, Dewsbury, last week presented an illuminated address and gold watch to Mr. G. H. HARROP, on his

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retirement after 32 years' service with the firm. Mr. Harrop has been chief engineer to the firm for 23 years.

In the absence of the President of the Royal Society of Arts, H.R.H. the Duke of Connaught and Strathearn, K.G., Dr. Dugald Clerk, F.R.S., Chairman of the Council, on Monday afternoon, at a meeting of the Council, presented the Society's Albert Medal to Prof. Sir J. J. Thomson, O.M., D.Sc., LL.D., F.R.S., "for his researches in chemistry and physics, and their application to the advancement of arts, manufactures, and commerce."

Mr. Eric Smith, who has just joined the Electrical Signalling Department, Cable Company, Canadian Contingent, was electrical engineer on the Santa Fé Railway, and was at New Mexico, U.S.A., before coming home to join the Forces.

Mr. S. R. Booth has been appointed to the staff of the Adelaide University, South Australia, as Lecturer on Accountancy. He has for some time been a Member of the Senate of the University.

Roll of Honour.—Mr. E. J. Dutch, secretary to Messrs. H. J. Cash & Co., Ltd., electrical and heating engineers, of Westminster, who enlisted in the 2nd King Edward's Horse in August, 1914, and who was twice wounded in 1915, has now been discharged from hospital for the second time, and has been gazetted Second-Lieutenant in the 14th Royal Fusiliers.

Corporal W. J. Bolt, of the 8th Battalion South Staffs. Regiment, who has been killed in his dug-out by a shell whilst asleep, was, until his enlistment, on the staff at the Ocker Hill electrical works, Tipton.

Corporal S. C. Parish, of the Queen's Surrey Regiment, who was serving his articles at the Croydon Municipal electricity works when he enlisted, has been killed in action. He was 20 years of age.

Lance-Corporal Geo. Nash, of the 10th Battalion Gloucestershire Regiment, who has been killed in France by shell fire, was, prior to his enlistment in October, 1914, on the electrical staff at Norchand Colliery, Lydney.

Trooper Oliver Goldsmith, of the Hampshire Yeomanry, who has died in hospital at Tidworth from septic poisoning set up by an accidental wound to the hand, was, prior to his enlistment last August, on the staff of Messrs. Cooper & Co., electrical engineers, of Bournemouth.

Mr. Lee, late tramway inspector at Colchester, who joined the Royal Army Medical Corps, has been awarded the French Military Medal for conspicuous service in the field. He had just spent a brief furlough at Colchester.

Sergeant-Major Dan Harrop, who was employed as an electrical engineer in the testing room at the Hyde Road tramcar depôt, Manchester, has been promoted to the rank of Second-Lieutenant in the 12th Loyal North Lancashire Regiment for zeal, devotion to duty, and bravery in the field.

Captain Arthur B. Layton, A.M.I.E.E., who has been gazetted temporary Lieut.-Colonel in the Prince of Wales's Volunteers (South Lancs. Regiment), has been electrical engineer and departmental manager for 13 years past to the firm of Messrs. Joseph Crosfield & Sons, Ltd., Warrington.

Private Jonathan Cookson, of the 1st Battalion Lancashire Fusiliers, who was formerly employed at the British Westinghouse Works, Trafford Park, has been wounded in the shoulder, but has now left hospital and returned to the Front.

Sergeant J. Bromiley, who has just been killed in action in France, was employed by Messrs. Ferranti, Ltd., before he enlisted.

Mr. Wm. A. Ellis, formerly of Northwich (Cheshire), and now an electrician in the Royal Navy, has been awarded the D.S.M.

Lance-Corporal R. Barber, 1st Cheshire Field Company, Royal Engineers, who was, prior to his enlistment, on the staff of the electricity department of Lever Bros., Ltd., Port Sunlight, has been awarded the D.C.M. On January 15th he visited the works and was presented by Sir Wm. Lever with a gold watch as a memento of his being the first employé of the firm to win the D.C.M.

The County of London Electric Supply Co., Ltd., send us the following information respecting the doings of County men with the Forces:—Mr. H. A. Moncrieff, of the secretarial department, who had formerly been serving in France in the "Queen's Westminsters," has obtained a commission as Second-Lieutenant in the 3rd Dorsets. Mr. F. H. Howell, of the secretarial department, formerly a bombardier in the 7th County of London, R.F.A., has obtained a commission in the Royal Field Artillery. Mr. N. F. Gadstone, after service in France, has obtained a commission as Second-Lieutenant in the 4th Essex. Mr. Sydney A. Knight, of the secretarial department, after service in France, has been gazetted Second-Lieutenant in the North Somerset Yeomanry. Mr. C. E. Scott, of the Putney local office, and serving in the 23rd Middlesex Regiment, has been promoted to Regimental Quartermaster-Sergeant, and is now a Second-class Warrant Officer. Mr. Alan Leigh, of the mains department, has been granted a commission as temporary Second-Lieutenant of the 14th Service Battalion East Surrey Regiment. The following employés in the mains department of the company have been killed in action, all of the 9th Battalion Buffs (East Kent): H. Bexley, T. Hyam, and R. Reeves.

Obituary.—Mr. R. F. Venner.—We regret to record the death, which occurred on Sunday morning last, at the age of 54 years, of Mr. R. F. Venner. The deceased gentleman had been unwell for some time, and his death was not unexpected. Mr. Venner was a son of the late Captain Venner, and he was educated at Malvern College. He was one of the earliest students in the Hammond Electrical Engineering College, now Faraday House, his course beginning there in 1883. He was subsequently with the Hammond Co., and about the year 1886 he took charge of an exhibit of Messrs. Shippey Bros. & Co., at Antwerp. From 1895 to 1897 he was in partnership with his life-long friend, Mr. A. M. Sillar, in the firm of Venner and Sillar. Later the business of Venner & Co., electrical engineers and agents, at Westminster, energetically pushing the sale of Chamberlain & Hookham meters and Venner time-switches, brought him into touch with large numbers of our readers. The affairs of that business have been conducted by Mr. E. E. Sharp for several years, and he will continue to conduct them pending the making of new arrangements. Mr. Venner had in recent years been interested in electric signs and in electric heating and cooking apparatus. Failing health, however, interfered with his securing that measure of success which he once anticipated in the cooking apparatus field.

Mr. Fredk. James Jones, of the Eastgate, Chester, in business as an electrician and electrical engineer, died on January 19th at the age of 55. He was a native of Dublin, and studied electrical engineering while in New Zealand. Nearly 30 years ago he commenced business at Chester. About three years ago he underwent an operation, and he had been ailing since that time. Mr. G. D. Jones (son) succeeds him in the business.

Wills.—The late Mr. Alfred Binns, of Messrs. J. and A. Binns, Ltd., wire manufacturers, Halifax, left £13,101 gross and £9,932 net.

The *Times* states that Montague Hayes Bythway, R.N.A.S., of Hale, Cheshire, electrical engineer, who died in St. George's Military Hospital, Malta, on active service, left £10,944.

NEW COMPANIES REGISTERED.

F. R. Wade and Co., Ltd. (142,761).—This company was registered on January 19th, with a capital of £1,000 in £1 shares, to take over the business of F. R. Wade & Co., to carry on the business of engineers, manufacturers of electrical instruments and machinery, etc., and to adopt an agreement with F. R. Wade. The subscribers (with one share each) are: F. R. Wade, 95, Colmore Row, Birmingham, consulting engineer; P. W. Wade, Wembley, Stoney Lane, Yardley, Birmingham, engineer. Private company. The number of directors is not to be more than five. F. R. Wade is the first life director. Solicitor: C. Orton, Guildhall Buildings, Navigation Street, Birmingham. Registered by Jordan & Sons, Ltd., 116-117, Chancery Lane, W.C.

General Engineering Co. (King's Cross), Ltd. (142,760).—This company was registered on January 19th, with a capital of £1,000 in £1 shares, to take over the business carried on at 97, Caledonian Road, King's Cross, as the General Engineering Co. and/or A. V. Bond, to carry on the business of scientific and experimental engineers, model and tool makers, smiths, joiners, woodworkers, builders, electricians, electrical, hydraulic and gas engineers, etc. The subscribers (with one share each) are: A. V. Bond, 97, Caledonian Road, King's Cross, N., engineer; H. C. H. Braun, 236, Pentonville Road, N., consulting engineer. Private company. The first directors are A. V. Bond and H. C. H. Braun. Qualification (except first directors), £25. Registered office: 97, Caledonian Road, King's Cross, N.

H. E. Jackson, Ltd. (142,778).—This company was registered on January 20th, with a capital of £2,500 in £1 shares, to take over the engineering business carried on at Churchgate, Leicester, as H. E. Jackson & Co., to carry on the business of ironfounders, mechanical and electrical engineers, electricians, suppliers of electricity for light, heat, motive power, or otherwise, etc., and to adopt an agreement with H. E. Jackson, E. H. Kirk, and C. H. Kirk. The subscribers (with one share each) are: H. E. Jackson, 225, East Park Road, Leicester, mechanical engineer; E. H. Kirk, 106, St. Saviour's Road East, Leicester, manufacturer; C. H. Kirk, High Barn, Letchworth Road, Western Park, Leicester, manufacturer. Private company. The number of directors is not to be less than two or more than five; the first are H. E. Jackson (managing director), E. H. Kirk, and C. H. Kirk (all permanent). Solicitor: B. Wynn Edwards, 33, Friar Lane, Leicester. Registered by Jordan & Sons, Ltd., 116-117, Chancery Lane, W.C.

Shepherd's Parging Block Co., Ltd. (142,756).—This company was registered on January 18th, with a capital of £2,000 in £5 shares, to take over the business of a manufacturer of patent tramrail parging blocks carried on by W. Shepherd at Milkstone, Rochdale, Lancs., as Shepherd's Parging Block Co., together with the benefit of certain existing inventions relating to improvements in connection with the laying of setts with respect to tramway lines or rails and blocks or sections used in connection therewith. The subscribers (with one share each) are: W. Shepherd, Spartheliffe, Manchester Road, Rochdale, road contractor; Mrs. R. Shepherd, Spartheliffe, Manchester Road, Rochdale; E. Shepherd, 14, Exeter Street, Rochdale, contractor; H. Shepherd, 36, Hare Street, Rochdale, contractor. Private company. W. Shepherd is first permanent director, subject to holding one-eighth of the ordinary share capital. Registered office: Exeter Street, Milkstone, Rochdale.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Muirhead and Co., Ltd. (82,270).—Capital, £50,000 in £10 shares. Return dated December 29th, 1915. 3,382 shares taken up; £10 per share called up on 382; £3,820 paid; £30,000 considered as paid on 3,000 shares. Mortgages and charges: £13,500.

Larne Electric Light Works, Ltd. (46,962).—Capital, £4,000 in £1 shares (500 5 per cent. cum. pref.). Return dated November 24th, 1915. All shares taken up; £500 paid on the pref.; £3,500 considered as paid on the ord. Mortgages and charges: £2,700.

Enfield Electric Cable Manufacturing Co., Ltd.—Mortgage on certain freehold land at Brimsdown, Enfield, with factory and other buildings, etc., thereon, dated December 31st, 1915, to secure all moneys due or to become due from the company to London County & Westminster Bank, Ltd., not exceeding £10,000.

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David Anderson and Co., Ltd.—Issue on January 10th, 1916, of £2,200 debentures, part of a series of which particulars have already been filed.

Keynsham Electric Light and Power Co., Ltd.—A memorandum of satisfaction in full on December 31st, 1915, of third debentures dated December 24th, 1913, securing £1,000, has been filed.

City of Oxford Electric Tramways, Ltd.—A memorandum of satisfaction to the extent of £1,100 on December 17th, 1915, of charge dated February 20th, 1914, securing £46,000, has been filed.

North Wales Power and Traction Co., Ltd.—Particulars of £30,000 debentures, created by resolutions of January 31st, 1912, June 19th, 1913, and June 30th, 1915, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, amount of the present issue being £9,000. Property charged: The company's undertaking and property, present and future, including uncalled capital, subject to prior charges. No trustees.

Barbados Electric Supply Corporation, Ltd. (104,367).—Capital, £60,000 in 40,000 pref. and participating and 20,000 ord. shares of £1 each. Return dated November 11th, 1915. 35,172 pref. and 20,000 ord. shares taken up; £34,672 paid on 34,672 pref.; £20,500 considered as paid on 20,000 ord. and 500 pref. Mortgages and charges: £12,500.

Blackpool and Garstang Electric Light Railway Co., Ltd. (62,150).—Capital, £10,000 in £5 shares. Return dated December 31st, 1915. 861 shares taken up; £4 per share called up; £1,707 paid (including £323 received on application for further shares not allotted), leaving £60 calls unpaid. Mortgages and charges: Nil.

Amazon Telegraph Co., Ltd. (44,532).—Capital, £250,000 in £10 shares. Return dated Nov. 30th, 1915. All shares taken up; £250,000 paid. Mortgages and charges: £272,900.

CITY NOTES.

Yorkshire (West Riding) Electric Tramways Co., Ltd.

SIR H. S. LEON presided on January 21st, at 31, Throgmorton Street, E.C., over the annual meeting. He said the revenue for the year amounted to £81,086, against £69,768 in the previous year, but the working expenses were £3,474 more, which equalled a percentage of 10.7 over those of 1914. The percentage of expenses to receipts was 44.25, against 43.72—an increase of .53 per cent. Compared on a car mileage unit basis, the working expenses in 1914 were 4.373d. per car mile, but in 1915 they rose to 4.882d., an increase of a little over ¼d. After deducting the working expenses from the gross receipts they had a balance of £45,208, being equal to 55.75 of the gross receipts. The income per car mile was 10.001d. in 1914, and 11.034d. in 1915. The tramway revenue had grown steadily, being £38,051 in 1905, and £81,086 in 1915. The increase in gross income for the year of nearly £7,000 was quite satisfactory, and, so far as they could see, was not due to war conditions, and there was no doubt that they were reaping some of the fruits of the good seed sown in the past. The general increase in expense, however, must be seriously borne in mind, and to what extent it was likely to be permanent he could not say. Under the present abnormal conditions an increase of 11.7 per cent. was not excessive, particularly as they had to pay so much more for wages and for all necessary supplies. As an instance, he might mention that they were now paying 14s. 6d. a ton, instead of 8s. 6d., for a class of coal little, if any, better, and this item alone meant an increase of £2,000. As a result of the year's trading, £45,208 was carried to the net revenue account, and after deducting debenture interest, etc., £29,310 was carried to the appropriation account. To this, £10,725 brought forward from the previous year had to be added, giving a total of £40,035. The board had dealt with this by paying a dividend of 6 per cent. on the cumulative preference shares, which absorbed £12,027; setting aside £5,511 to the depreciation and renewals fund; crediting £2,000 to the insurance fund; by writing off £450 preference shares set aside for the Wood's accident claim; by placing £5,000 to the general reserve fund; and carrying £15,045 forward. He had before fully explained the policy of the board with regard to the substitution of granite setts for the soft granite stone setts, and a considerable amount of the work yet remained to be done as soon as they could get the labour and materials. It had been found necessary to renew the battery at their Castleford power station, and they availed themselves of the opportunity to install a larger one, and had entered into a maintenance agreement with the manufacturers by which 100 per cent. efficiency was guaranteed for ten years. Their capital expenditure was £783,425, £769,810 of which had been expended on lines open for traffic and £13,196 on the Pontefract lighting. They commenced the supply about a month before the war broke out, and there was every prospect of their building up a very good business. The results, even under the present unfavourable conditions, were quite encouraging. No one could say what the conditions in the district they served would be after the war, and the board felt that they must regulate their affairs with due regard to future contingencies. If they were to maintain and improve their services a considerable sum of money must be spent, and the policy of the board was to collect as much money as possible, so that at the earliest date they might be in a position to begin the work and pay cash for it. In the past their relations with the local authorities had been of a most amicable character, but during the past year some of the local councils had pressed them to make considerable modifications in the fares. The general manager and himself saw one of the boards and pointed out the impracticability and financial unsoundness of the requests, and now the local authorities were taking a sort of revenge by raising the road maintenance question. However, the company did not take offence at that, and had met the authorities very reasonably, and it was possible that in due course they would recognise that the company were justified in refusing to lower the fares. Last year he promised that the board would consider if any scheme could be formulated for dealing with the arrears on the 6 per cent. cumulative preference shares, and they had done so, and he hoped a scheme would be prepared when they felt justified in placing one before the shareholders. That moment, however, had not yet arisen. It would be a deplorable thing to put forward a scheme which would be acceptable to the shareholders and then to find that, owing to circumstances entirely beyond their control, they were unable to fulfil the obligations incurred. He asked for the forbearance of the shareholders until the country returned to more normal conditions. In conclusion, the CHAIRMAN referred to the admirable work done by Mr. H. England and the staff.

Mr. G. E. LEON seconded the motion.

Mr. DAVENPORT asked the board if they would accept a resolution to invite Dr. Moody and Mr. Lock to confer with them in regard to dealing with the arrears on the cumulative preference shares, but the CHAIRMAN intimated that he was not prepared to do so, and Mr. DAVENPORT proposed as an amendment that a committee, consisting of Dr. Moody and Mr. Lock, be appointed to meet the board.

After some discussion the amendment was not pressed, and the resolution was carried.

London Underground Railway Meetings.

ON Friday last extraordinary general meetings were held by the Metropolitan District Railway Co., the London Electric Railway Co., the City & South London Railway Co., the Central London Railway Co., and the London General Omnibus Co., at which resolutions were passed sanctioning an agreement between these companies with respect to the application of their receipts and the payment into a common fund of the half-yearly balances after meeting expenses. The Chairman, Lord George Hamilton, said that the agreement was made in pursuance of an Act passed last year. The five companies will afford to each other all reasonable facilities for through passenger traffic, through bookings, through fares, and interchange of traffic. In 1914 the five companies carried 819 million passengers, only 42 millions of whom were through passengers between the systems concerned. The new arrangement would lead to a simple and effective system of through or interchange tickets.

Companies Struck off the Register.—The following have been struck off the register, and are accordingly dissolved:—

Brabbins Fuelless Engine Syndicate.
Budleigh Salterton Electric Light & Power Co.
Economic Coaling Appliance Co.
Emanda Engineering Co.
Power Syndicate of South America.
Russian Wireless Telegraph Trust.
Telenews.
Vacuum Electric and Gas Heating Appliances.
Walker Reversible Turbine Co.

St. James' and Pall Mall Electric Light Co., Ltd.—The directors recommend a balance dividend of 3s. 6d. per share on the 7 per cent. preference shares for the half-year to December 31st, and 4s. 6d. per share on the ordinary, making, with the interim dividend, 8 per cent. for the year, as compared with 10 per cent. for 1914.

Australia.—The Kempsey Electric Light and Power Co., Ltd., in December advertised a prospectus in the Sydney newspapers offering 8,500 £1 shares for issue. The company was to take over the rights, etc., of Kynoch, Ltd., of Sydney, to supply electricity for public and private lighting in Kempsey.

Westminster Electric Supply Corporation, Ltd.—The directors recommend a dividend at the rate of 8 per cent. per annum, less tax, for the half-year ended December 31st (making 7 per cent. for year, as against 9 per cent. for 1914).

STOCKS AND SHARES.

TUESDAY EVENING.

The main interest in Stock Exchange markets is still confined to rubber shares. In that market, the volume of business has taken on a fresh lease of activity; and those people who are intimately connected with it find all their energies taxed to deal with the business that has sprung up. Some part of it, at all events, is mere speculation, in spite of the Treasury regulations to the contrary. The activity has developed into something of a gamble; and, as always happens in such cases, the strength of prices in good companies has brought to light various concerns of doubtful reputation.

The working man spends his money—or so, at least, we are told—upon cheap pianos, amusements, jewellery, furs, putting his war wages into these illusory investments; while the people of a different rank who, especially in the Midlands and

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Northern Counties, are making big profits out of the war, are spending their wealth in the purchase of rubber shares, which they can at least justify by the expectation that good dividends will accrue thereon, but which every broker knows are bought in numbers of cases with a view to quick appreciation in capital value.

Meanwhile, the application for Exchequer Bonds goes on steadily, though not to an extent which might reasonably be expected by those who have means for seeing what large amounts are being expended in the purchase of the shares named above. The investment markets remain overshadowed by the Exchequer issue, for the closing of the lists in which no date has yet been officially announced. In the circumstances, it is surprising to find Consols improving; but it is a pleasant surprise, since improvement in Consols spells firmness for all gilt-edged securities, extending beyond debenture stocks to the good-class preference shares in industrial companies.

The electric lighting dividends will be making their appearance before long and there is speculation in the market as to how these will materialise. It is thought that the County of London will maintain its previous distribution, and that the City will follow suit—or, at any rate, make but a small cut in its dividend. But as regards the West End undertakings less certainty is felt; indeed, there are some who think that reduction of one to two per cent. is almost inevitable, in view of the conditions under which the industry has worked during the past six months.

It is pointed out that the fatalities caused by the darkening of London's lights are greater than those which might have been brought about by Zeppelins—a matter of mere speculation, of course; though, having regard to the practical certainty that the Zeppelins would not come in mid-winter, there is point about the complaints which have been raised with reference to the official attitude on the subject. The batch of electric dividend announcements is awaited with a much more general interest than ordinarily—not only by shareholders in these companies, but also by those who have been, and are, hampered and inconvenienced by the lighting restrictions. Chelsea 4 per cent. debenture stock is a little lower, but otherwise there are no changes in the list of quotations this week.

The news from Mexico is read as being unfavourable, and once more there are small falls in the principal bonds of companies working in the country. The reports of American citizens having been murdered gave rise to the assurance that President Wilson would have more work to do in the dictation of notes as dignified as they are vain. Nobody supposes that the United States will trouble about the lives of a few citizens while those of so many thousands of others are being spent in the glorious pursuit of dollars that flow in so readily from the belligerent European countries.

Brazilian Tractions have recovered further; and the market seems to be a better one than it has been for some time past, although the rate of exchange has not helped matters appreciably. Reassurance with reference to the dividend has stiffened the price more than anything else; and a few buying orders which came in at low figures found the supply of shares on offer was quickly exhausted.

The Telegraph market shows more changes. Western Telegraps have risen again, and now stand highest of the trio in which they, with the two Eastern Extensions, command respectful attention from the investor. Eastern Extensions are a shade up. Small rises have occurred in Anglo-American Telegraph stocks. Cuban Submarine preference have been rather pressed for sale, and at 14¼ show 10s. fall.

In the Telephone department, New York Telephone 4½ per cents. are wanted by the Government at 100¾. Sales that are made to the Treasury in connection with the mobilisation scheme are done free of commission, through a broker, the Treasury paying the charges—which, by the way, are half those which the Stock Exchange Committee officially permits its members to make. Chili Telephones are ⅜ down at 6¼; and United River Plates have eased off to 5¼. Some of the 4 per cent. debenture stocks in this department are lowered to 79, at which the return on the money is about £5 1s. per cent.

Babcock & Wilcox have risen 5s. to 2 11/16, on persistent buying based upon reports that the company is making excellent progress, and that it will have big profits to divide, after making allowance for the excess tax and all possible reserves. British Westinghouse preference have gone back. The dividend in their case is due very soon. Last year 3s. was paid—that is to say, 7½ per cent., the shares being of the nominal value of £2 each. It is expected that they will get 10 per cent. this year. Edison & Swan fell 1s. to 7s. 6d.; but Electric Constructions continue to creep up, and are again 6d. to the good at 15s.

Marconis are a slightly duller market, and interest has again subsided for the time being. The American shares, which rose to 18s. 6d., reacted to 17s. on a general fall of securities in America, due mainly to the difficulties in Mexico. Canadian Marconis, after touching 7s. 9d., lost the pence; and the activity that was stirred lasted but a few days.

Rubber shares are holding their prices with marked tenacity; and although the quotation for the raw stuff gives no particular indication of rising again to 4s. 3d., at which it stood a fortnight ago, the reports and dividends now being published are sufficiently good to keep alive interest and to encourage fresh buying in this department.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Jan. 25, 1916.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.				
Brompton Ordinary	10	7½	—	£6 18 4
do. 7 per cent. Pref.	7	7	—	5 0 0
Charing Cross Ordinary	5	8½	—	7 2 10
do. do. do. 4½ Pref.	4½	8½	—	6 0 0
do. do. City Pref.	4½	8	—	5 10 0
do. 4 Deb.	4	75	–8	5 6 8
Chelsea	5	4	—	6 5 0
do. 4½ Deb.	4½	87	—	5 3 6
City of London	9	12½	—	7 7 8
do. do. 6 per cent. Pref.	6	11	—	5 9 1
do. do. 5 Deb.	5	98	—	5 2 0
do. do. 4½ Deb.	4½	85	—	5 5 0
County of London	7	10	—	7 0 0
do. do. 6 per cent. Pref.	6	10½	—	5 17 8
do. do. 1st Deb.	4½	85	—	5 5 0
do. do. 2nd Deb.	4½	83	—	5 8 9
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	1⅜	—	6 3 4
do. do. 6 per cent. Pref.	6	4½	—	7 1 2
do. do. 4 Deb.	4	75	—	5 4 0
Metropolitan	8½	2½	—	7 15 7
do. 4½ per cent. Pref.	4½	8	—	7 10 0
do. 4½ Deb.	4½	85	—	5 6 0
do. 3½ Deb.	3½	70	—	5 0 0
St. James' and Pall Mall	10	6	—	8 6 8
do. do. do. 7 per cent. Pref.	7	6	—	5 16 8
do. do. do. 3½ Deb.	3½	70	—	5 0 0
South London	5	2⅜	—	7 5 6
South Metropolitan Pref.	7	1 7/16	—	6 14 0
Westminster Ordinary	9	6	—	7 10 0
do. 4½ Pref.	4½	4	—	5 12 6
TELEGRAPHS AND TELEPHONES.				
Anglo-Am. Tel. Pref.	6	99½	+ ¼	6 1 0
do. Def.	83/6	21⅜	+ ⅛	7 14 3
Chile Telephone	8	6⅜	—	6 10 8
Cuba Sub. Ord.	5	7⅜	—	6 9 0
do. Pref.	10	14⅜	— ⅛	6 18 0
Eastern Extension	7	13⅜ xd	+ ⅛	*6 7 0
do. 4 Deb.	4	79	–1	5 1 0
Eastern Tel. Ord.	7	127½ xd	—	*6 5 0
do. 8½ Pref.	8½	64⅜	–1½	5 8 6
do. 4 Deb.	4	79	–2	5 1 0
Globe Tel. and T. Ord.	6	10⅜	—	*6 12 2
do. Pref.	6	10½	—	5 17 1
Gt. Northern Tel.	22	88⅜	+ ½	6 10 4
Indo-European	18	49	—	6 15 4
Marconi	5	1⅛	—	5 3 1
New York Tel. 4½	4½	100¾	+ ¾	4 9 1
Oriental Telephone Ord.	10	1⅜	—	5 6 8
do. Pref.	6	8	—	6 17 2
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	8	5⅛	— ⅛	*7 19 0
do. Pref.	5	4⅜	—	5 8 1
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	12¾	+ ⅛	*6 4 6
do. 4 Deb.	4	79 xd	—	5 1 6
HOME RAILS.				
Central London, Ord. Assented	4	70	—	5 14 4
Metropolitan	1⅜	25½	—	4 18 0
do. District	Nil	15⅛	— 1	Nil
Underground Electric Ordinary	Nil	1⅜	—	Nil
do. do. "A"	Nil	6/6	—	Nil
do. do. Income	6	83	+ 1	*8 5 8
FOREIGN TRAMS, &c.				
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
do 5 Deb.	5	96	—	5 5 0
Anglo-Arg. Trams, First Pref.	5½	4⅛	—	6 13 6
do. 2nd Pref.	5½	8⅝	—	8 8 0
do. 4 Deb.	4	71	— ⅛	5 12 8
do. 4½ Deb.	4½	77	—	5 17 0
do. 5 Deb.	5	86⅜	—	6 4 0
Brazil Tractions	8½	52⅛	+1⅛	6 12 8
Bombay Electric Pref.	6	10½	—	5 17 1
do. 4½ Deb.	4½	83	—	5 8 0
British Columbia Elec. Ry. Pfce.	5	59 xd	—	8 9 6
do. do. Preferred	—	40	—	Nil
do. do. Deferred	—	85	—	Nil
do. do. Deb.	4½	64	—	6 12 10
Mexico Trams	Nil	89	—	Nil
do. 5 per cent. Bonds	—	46	–1	Nil
do. 6 per cent. Bonds	—	59	–1	Nil
Mexican Light Common	Nil	99	—	Nil
do. Pref.	Nil	18	—	Nil
do. 1st Bonds	—	47	—	—
MANUFACTURING COMPANIES.				
Babcock & Wilcox	14	2 11/16	+ ⅛	5 4 1
British Aluminium Ord.	5	22/6	—	4 9 0
do. Pref.	6	18/-	—	6 13 4
British Insulated Ord.	15	10⅜	—	7 2 10
do. Pref.	6	5⅜	—	5 11 7
British Westinghouse Pref.	7⅜	44/8	–9d.	6 16 4
do. 4 Deb.	4	69	—	5 14 10
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	11½	—	6 13 4
do. 5 Pref.	5	4½	—	5 17 8
do. 4½ Deb.	4½	90	—	5 0 0
Castner-Kellner	20	7½	—	6 8 0
Edison & Swan, £8 pd.	Nil	7/6	–1/-	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	60	—	6 13 4
do. do. 5 % Deb.	5	60	—	8 6 8
Electric Construction	6	15/-	+6d.	8 0 0
do. do. Pref.	7	1	—	7 0 0
Gen. Elec. Pref.	6	9½	—	6 8 1
Henley	20	18½	—	*8 12 6
do. 4½ Pref.	4½	4½	—	5 6 0
do. 4½ Deb.	4½	92	—	4 17 9
India-Rubber	10	9½	—	*13 13 0
Telegraph Con.	20	85	—	*7 16 6

* Allowance made for dividends being paid free of income-tax.

L.C.C. Loan Interest Rate.—The Finance Committee of the L.C.C. has decided that until further notice the rate of interest to be charged by the Council for loans to local authorities shall be 5 per cent.

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EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING DECEMBER, 1915.

The December return of electrical exports and imports marks the close of a year which will be noteworthy for many years to come. For some time the monthly statements indicated a continuous improvement in electrical export business, but the December total of £349,409 shows a considerable falling away from the high level of the preceding month, £522,059. The electrical imports showed a similar, though less marked, tendency, the total for December £238,691 comparing with £250,343 in November. The re-exports were valued at £24,382, as compared with £30,560 in November.

A glance through the various sections of the exports shows that the falling off in values was wide-spread, and most conspicuous in cables, telegraphic material, and machinery exports. On the other hand, both machinery and cable imports were on an extended scale in December, and this also applies to imports of lamps and parts which reached nearly £30,000 in value. Telegraphic and telephonic imports were practically halved, and battery and carbon imports also fell off in value.

The Australian Commonwealth, New Zealand, and India were all good markets during the month, the former being credited with as high values as during pre-war days.

To France also we supplied considerable material. American electrical imports fell off by some £30,000, as compared with November, while Dutch imports included over £20,000 worth of lamps and parts.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports	Electrical goods and appliances.	Wires and cables rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	2,976	3,362	150	270	3,065	914	11,239	...	2,080	456	1,298	396	26,206
German West Africa	...	33	...	3	...	...	...	...	...	...	55	...	91
Netherlands, Java and Dutch Indies ...	241	10,752	377	116	6	34	1,530	16	243	255	338	1,675	15,583
Belgian Congo	8	4	...	6	...	...	8	...	...	...	...	...	26
France	1,785	153	474	177	144	648	8,003	752	960	299	2,652	7,832	23,879
Portugal	358	125	53	139	...	111	192	20	...	9	222	176	1,405
Spain, Canary Isles and Spanish N. Africa...	166	5	52	96	27	651	3,179	90	249	110	72	2,044	6,741
Switzerland, Italy and Austria-Hungary ...	...	110	142	4	...	13	2,202	184	418	43	93	7,492	10,701
Greece, Roumania, Turkey and Bulgaria ...	12	38	6	7	...	6	...	...	11	...	5	...	85
Channel Isles, Gibraltar, Malta and Cyprus...	128	137	103	62	...	...	3,283	...	22	3	34	506	4,278
U.S.A., Philippines and Cuba	264	...	74	16	...	10	2,303	...	2	...	...	48	2,717
Canada and Newfoundland	305	513	22	423	7	966	821	7	114	45	...	24	3,247
British West Indies and British Guiana ...	184	88	155	65	12	24	129	7	45	15	2	82	808
Mexico and Central America	6	5	11	9	...	5	...	7	34	3	186	345	611
Peru and Uruguay	35	581	19	20	...	16	58	2,030	8	15	...	37	2,819
Chile	51	737	143	192	...	708	75	1,053	97	2	4,243	180	7,481
Brazil	81	199	150	422	213	...	194	716	174	4	...	195	2,348
Argentina	596	5,947	1,087	145	93	463	2,250	3,099	564	20	870	179	15,313
Colombia, Venezuela, Ecuador and Bolivia...	96	39	29	143	...	249	490	13	2	...	272	110	1,353
Egypt, Tunis and Morocco	121	776	56	18	7	18	1,093	90	133	13	112	3,470	5,907
British West Africa	169	94	22	91	16	20	154	...	41	14	156	495	1,272
Rhodesia, O.R.C. and Transvaal	456	777	600	1,593	...	31	260	105	1,280	23	8	8	5,141
Cape of Good Hope	968	3,507	75	85	...	191	2,625	6	731	48	788	607	9,631
Natal	24	453	142	35	...	...	4,823	59	45	...	...	237	5,818
Zanzibar, Brit. E. Africa, Mauritius & Aden	391	128	8	64	...	32	425	12	49	25	52	64	1,250
Azores, Madeira and Portuguese Africa ...	62	125	7	3	...	...	533	...	50	5	...	18	803
French African Colonies and Madagascar ...	34	19	13	5	...	...	...	...	...	16	...	90	177
China and Siam	426	506	912	77	21	991	553	17	206	23	438	638	4,808
Japan and Korea	3,292	23	18	5	259	463	2,462	173	126	21	...	1,100	7,942
India	1,539	10,572	4,829	1,156	22	1,874	15,036	1,992	3,398	98	3,155	2,144	45,815
Ceylon	60	423	299	140	...	68	18	3	28	...	71	37	1,151
Straits Settlements, Fed. Malay States and Sarawak	312	702	66	113	12	34	125	237	323	20	184	284	2,412
Hong Kong	76	6,437	352	113	24	266	1,306	398	3	8	154	170	9,307
West Australia	113	974	576	1,196	...	1,416	71	464	274	193	96	...	5,373
South Australia	84	1,010	77	2	5	3	928	...	243	3	526	87	2,968
Victoria	4,943	15,493	2,666	698	...	500	19,101	...	923	1	3,151	330	47,806
New South Wales	1,161	12,039	607	857	61	1,552	2,507	6	394	40	60	1,503	20,787
Queensland	102	213	368	366	...	317	271	...	22	145	910	27	2,741
Tasmania	10	278	...	...	5	9	40	...	6	...	38	8	389
New Zealand and Fiji Islands	986	6,863	1,615	1,814	136	6	5,861	269	2,472	...	21,673	504	42,219
Total, £	22,621	84,240	16,355	10,746	4,135	12,609	94,078	11,825	15,770	1,975	41,913	33,142	349,409

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	...	806	104	310	476	...	17,772	12,411	1,169	855	2,357	36,260
Germany	...	...	...	...	...	...	...	...	...	...	...	...
Holland...	...	1,913	229	16,741	3,328	...	125	...	807	...	...	22,143
Belgium	...	...	...	...	...	...	840	...	...	...	...	840
France	420	84	...	1,994	264	713	386	...	8,353	2,990	244	15,448
Switzerland	1,683	...	805	340	9	4,314	1,401	...	575	109	180	9,416
Italy	40	4,464	...	...	...	...	310	645	...	...	...	5,459
Austria-Hungary	...	...	...	...	...	...	...	...	...	...	...	...
United States	9,309	4,863	4,335	4,654	2,480	569	41,790	49,150	10,278	5,942	13,889	147,259
Total, £	11,452	12,130	5,473	24,039	5,557	5,596	62,624	62,206	21,182	9,896	16,670	236,825

Additional imports.—Spain, carbons, £374; Japan, flash lamps, £97; Canada, electrical goods, £432; wires, £390; telephone and telegraph apparatus, £573.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above... ...	2,814	8,916	...	2,856	11	60	2,130	...	319	578	6,698	24,382

Total Exports: £349,409 Total Re-Exports: £24,382 Total Imports: £238,691

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

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ELECTRICAL EXPORTS AND IMPORTS DURING 1915 AND PREVIOUS YEARS.

SINCE the year 1909 it has been the practice of the ELECTRICAL REVIEW, at the commencement of the year, to publish a graphic summary, showing the value month by month of the British electrical exports and imports during the last and previous years, the curves of values being based on the monthly statistics which are a regular feature of this journal.

The steady progress which had, on the whole, characterised both branches of business—but particularly the exports—for some years, was brought to an abrupt conclusion with the opening of the great European war in the beginning of August, 1914, the immediate effects of which were discussed in our last yearly summary,* and strikingly indicated by the curves of business for the preceding 12 months.

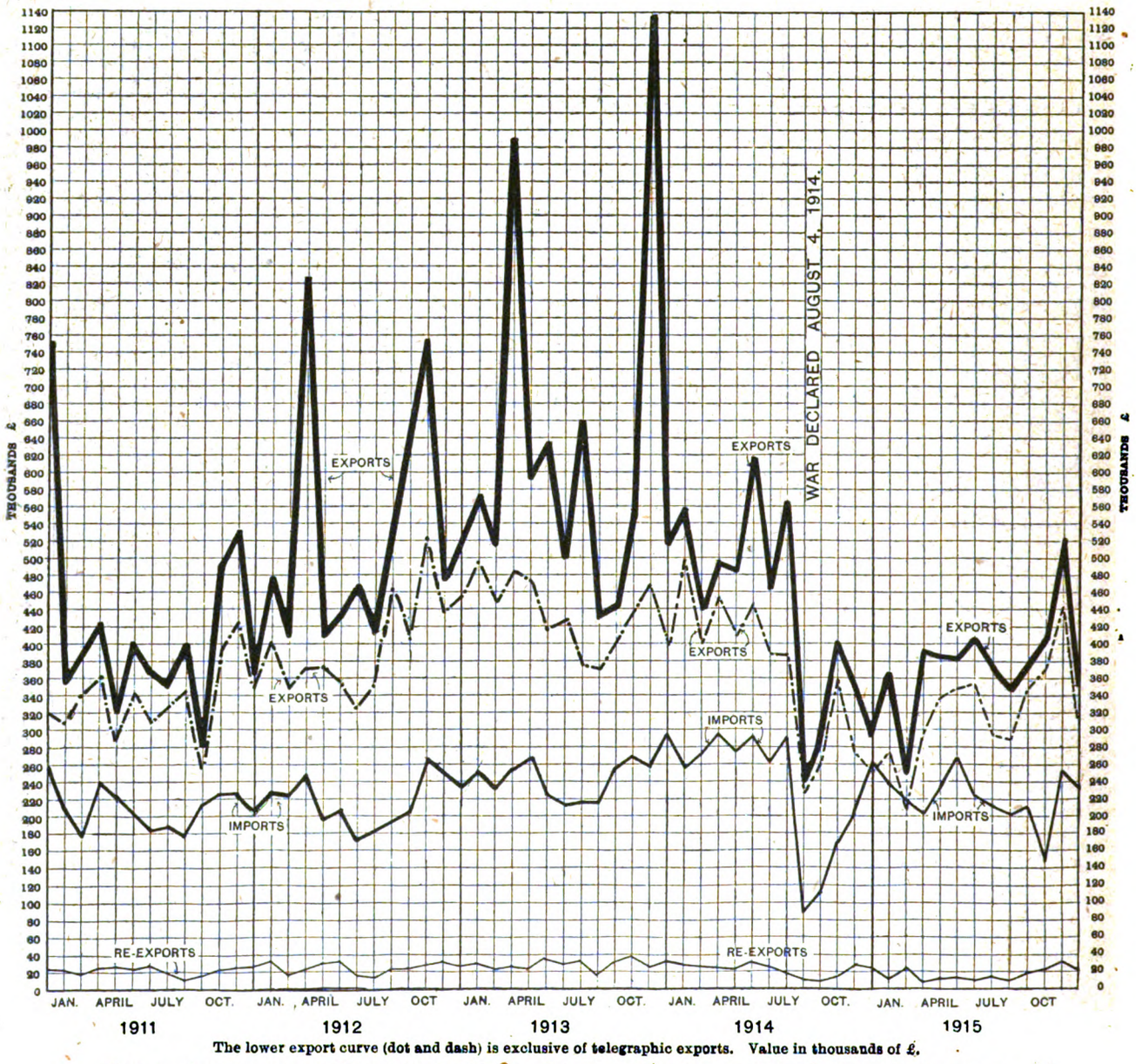
fact that despite the war this section of our export trade was but little inferior to that of 1911.

It will be a matter of interest to many and satisfaction to most that the electrical imports curve, on the whole, shows a declining tendency, after the rapid recovery to almost normal values at the end of 1914.

The re-export curve shows the depressed condition of this class of business—in any case of small amount—during the greater part of the year, pre-war values being reached only during the last two months.

The gross values of our electrical exports and of the telegraphic material included therein for the period covered by the curves shown in fig. 1, were as follows:—

1911	...	Gross	£4,600,000	Telegraphic	£560,000
1912	...	,,	6,300,000	,,	1,500,000
1913	...	,,	7,568,000	,,	2,388,000
1914	...	,,	5,189,000	,,	835,800
1915	...	,,	4,564,000	,,	690,300


THOUSANDS £
WAR DECLARED AUGUST 4, 1914.
EXPORTS
IMPORTS
RE-EXPORTS
JAN. APRIL JULY OCT. JAN. APRIL JULY OCT JAN. APRIL JULY OCT. JAN. APRIL JULY OCT. JAN. APRIL JULY OCT
1911 1912 1913 1914 1915

The lower export curve (dot and dash) is exclusive of telegraphic exports. Value in thousands of £.

FIG. 1.—CHART SHOWING MONTHLY ELECTRICAL EXPORTS AND IMPORTS DURING THE PAST FIVE YEARS.

Since that time the British nation, and indeed the British Empire as a whole, as well as practically the whole of industrial Europe, has been engaged in a war of ever-increasing magnitude, which has more or less involved the concentration of the entire financial and industrial resources of the countries concerned on war measures, to the exclusion almost of normal trade. Moreover, the financial dislocation of Europe has affected the purchasing power of probably every commercial country in the world, and to this can be added the very pressing difficulties of shipping—the conditions, in fact, being extremely unfavourable to overseas engineering trade of any kind. It is therefore with satisfaction that we can point to the unlooked-for steady expansion of electrical export business during the past 12 months of war, as shown by the two upper curves in fig. 1. Although the extreme fluctuations in telegraphic export values which characterised former years were absent in 1915, yet a steady business remained, and a comparison of the electrical export business (with and without telegraphic exports) of the year, with previous years, reveals the

These figures represent a monthly average of general business—as shown by the dot-and-dash curve, for 1911, of £338,000; 1912, £400,000; 1913, £432,000; 1914, £362,000; and 1915, £323,000. It should be noted that during the first half of 1914 export values were at a high level.

The total value of electrical material imported into this country during 1915, according to our published returns, was £2,646,000, as compared with £2,767,000 in the previous year, and £2,946,500 in 1913; these figures represent monthly averages for the three years referred to of £220,500, £230,000 and £245,500 respectively, showing that a steady falling-off has occurred during this period, despite the preoccupation of home manufacturers.

The re-exports languished during the greater part of the year, reaching a total value of only £198,800, and a monthly average of £16,500, which compares badly even with the £265,200 total and monthly average of £22,000 in 1914, when the first effects of war were felt.

Fig. 2 shows the trend of values in two of the most important sections of the exports—viz., machinery and cables.

Business in the former exhibited a fluctuating tendency

* ELECTRICAL REVIEW, January 29th, 1915, pp. 158-161.

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and the position shows but little recovery since the outbreak of war. The cable exports, on the other hand, have shown a remarkable recovery, under the circumstances, and in falling away to insignificant proportions during the early part of the year, recovered normal values in November, while lamp imports have steadily increased in value over the 12 months.

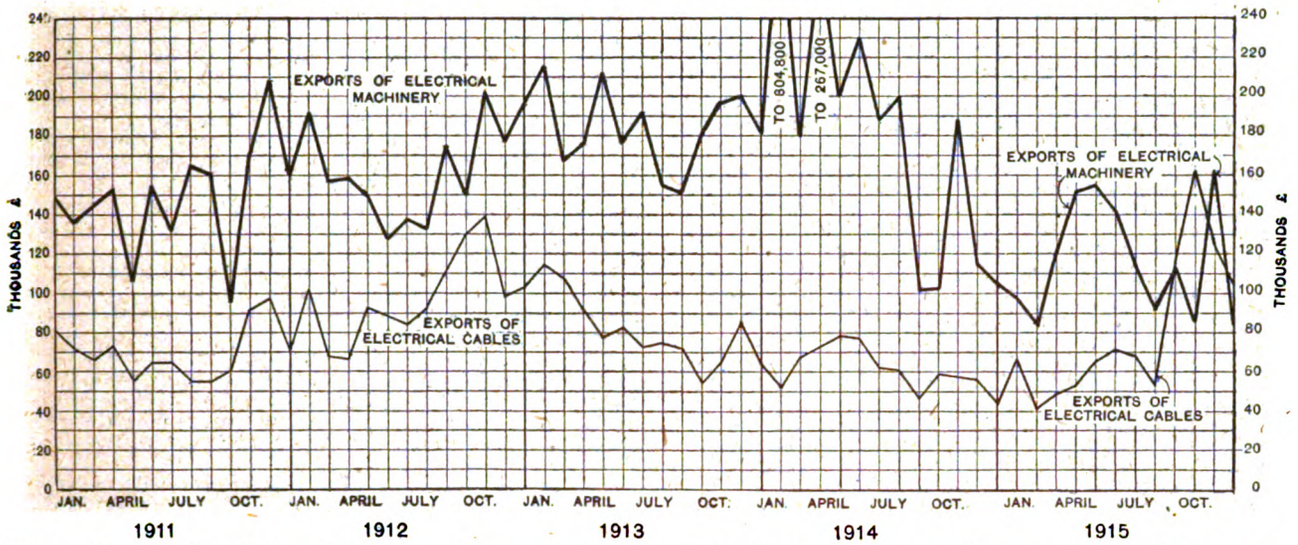


FIG. 2.—MONTHLY EXPORTS OF ELECTRICAL MACHINERY AND ELECTRICAL CABLE—OTHER THAN TELEGRAPHIC AND TELEPHONIC CABLE—DURING THE PAST FIVE YEARS.

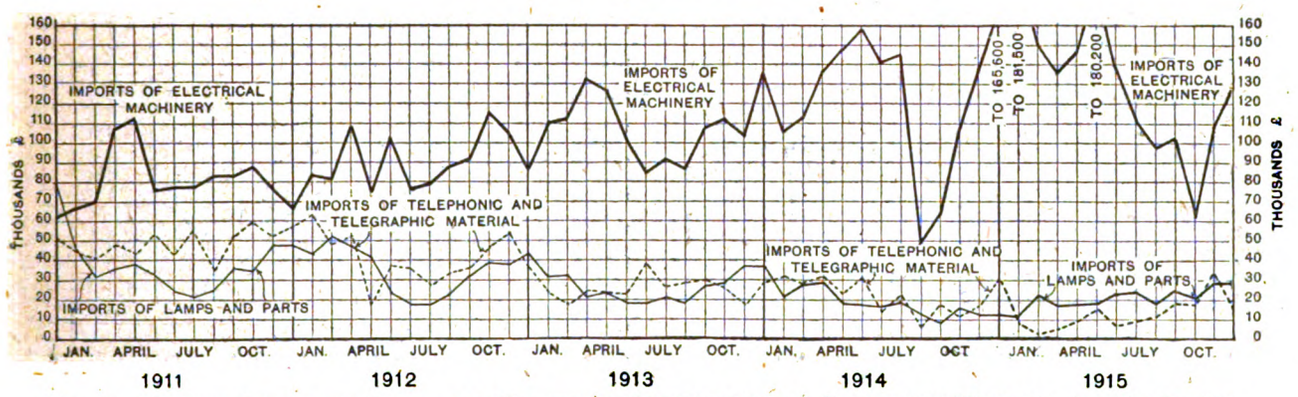


FIG. 3.—MONTHLY IMPORTS OF ELECTRICAL MACHINERY, TELEGRAPHIC AND TELEPHONIC MATERIAL AND CABLE, AND ELECTRIC LAMPS AND PARTS DURING THE PAST FIVE YEARS.

November last reached a record total, only approached on one former occasion, in 1912. Taken over the whole year, the machinery exports reached a total value of £1,482,000, as against £2,154,000 in the previous year: while the cable exports, exclusive of telegraphic and telephonic cable, which are included in their own sections, were valued at £916,000, as compared with £741,000 in 1914.

Turning to the imports curves shown in fig. 3, it will be seen that the machinery imports reached record values in January and May, but during the latter half of the year values fell off rapidly. The importation of telegraphic and telephonic material, after

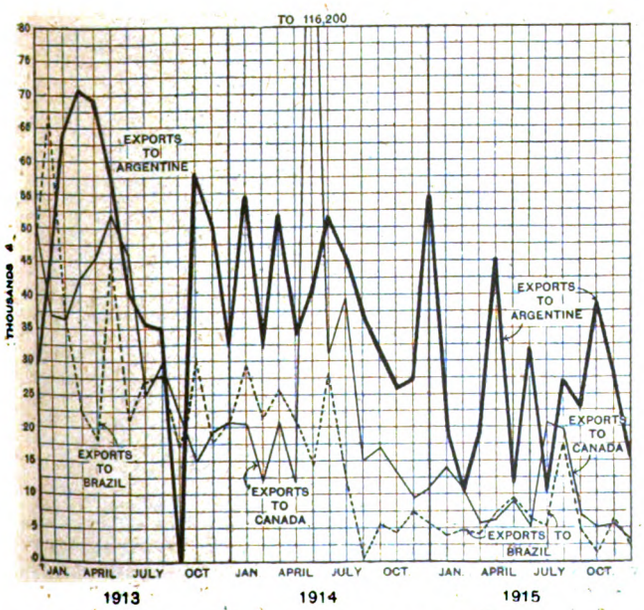
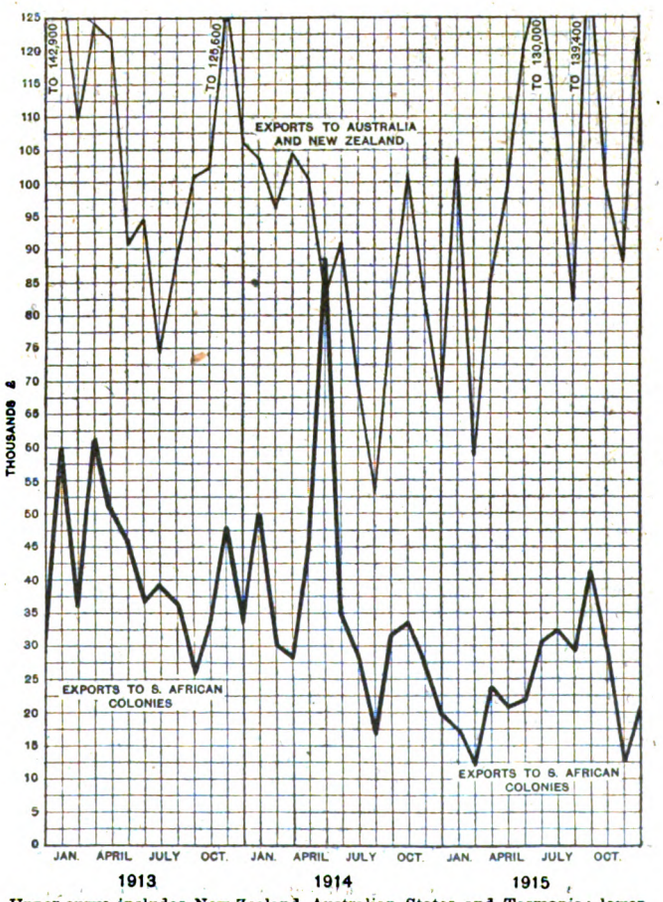


FIG. 4.—ELECTRICAL EXPORTS TO CANADA, ARGENTINA AND BRAZIL, 1913-15.



Upper curve includes New Zealand, Australian States and Tasmania; lower curve includes Cape, Natal, Transvaal, Orange River Province and Rhodesia.

FIG. 5.—ELECTRICAL EXPORTS TO AUSTRALASIA AND SOUTH AFRICA, 1913-15.

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Electrical machinery imports totalled £1,543,000 in value, imports of telegraphic and telephonic material amounted to £154,600, and of lamps and parts to £256 600, during the year; these figures comparing with £1,476,000, £267 500 and £215,000 respectively for the same branches of business in 1914.

Purchasing Countries and Importers Into the United Kingdom.

Of the remaining countries shown in figs. 4 to 7, the first three, showing the course of business with what are ordinarily some of our principal overseas customers, will be viewed with interest.

Fig. 4 indicates that our Argentine business has been falling off since March, 1913, and this process has been to some extent accelerated in 1915, while both Canadian and Brazilian business has

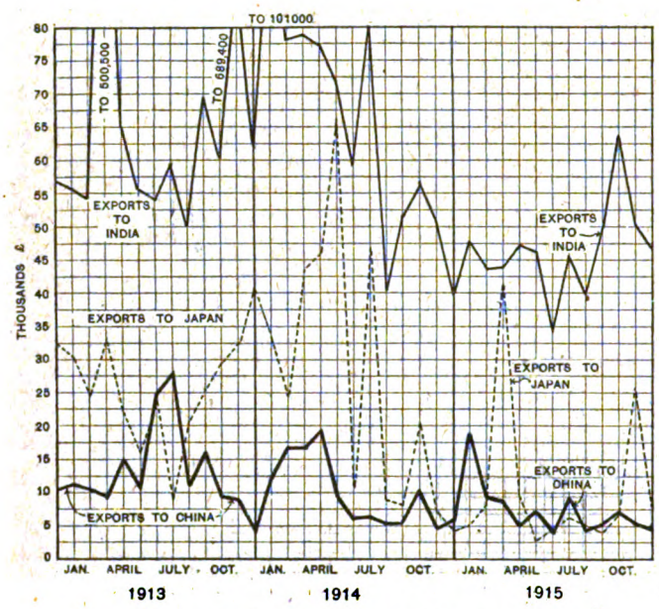

FIG. 6.—ELECTRICAL EXPORTS TO JAPAN, INDIA AND CHINA, 1913-15.

slumped since the war, a position which one would expect, knowing the conditions that exist, particularly in Canada.

Turning to fig. 5, our Australian and New Zealand electrical exports represent the one bright feature of these curves, business in these directions at least being normal; the South African business, also shown in fig. 5, had an improving tendency for many months, but fell away to a low figure towards the end of the year.

Fig. 6, dealing with Far Eastern business, shows that our electrical exports to India only began to show signs of recovery from the effects of the war in the last month or two of the year, while Japanese business, with the exception of one or two spasmodic revivals, remained at a low ebb throughout the year, being in fact exceeded in some months by business with China, a country in which, so far as we are concerned, electrical trade expectations appear to be accompanied by progressively disappointing results. The gross values of our export business to the countries above mentioned for the years 1913 (before the war), 1914 and 1915 (in which the full effects of the war were felt) were as follows:—

	1913.	1914.	1915.
	£	£	£
India	1,769,000	784,000	557,000
Australia and New Zealand	1,283,000	1,032,000	1,234,000
Argentina ...	558,000	448,000	279,000
South Africa ...	508,000	434,000	293,000
Canada	392,000	318 000	112,000
Japan	309,000	320,000	128 000
Brazil	350,000	176,000	73,000
China	159,000	117,000	88,000

One of the effects of the war has been considerably to increase the to-and-fro electrical trade between this country and neutral and allied countries of Europe. Thus our electrical exports to France during 1914 were valued at over £150,000, while in 1915 they rose to £321 000; the monthly average for the first six months of 1914, before the war, £17,700, compares with £26,700, the corresponding average for the whole of last year.

In a similar manner our export business with the Scandinavian countries and Russia for 1914 amounted to £253,000, but only reached a total of £110,000 and a monthly average of £18,300 during the first half of the year, while for the year 1915 a total of £465,000, and a monthly average of £38 800, are recorded, Russia being a preponderating purchaser, no doubt for military reasons, as was probably the case with France.

Our last curve, fig. 7, shows that during 1915 the United States more than equalled Germany before the war as an electrical importer into this country.

That this would probably be the case was indicated in our last annual summary, when her unique position as the only really free manufacturing nation in the world, able to undertake exporting, was mentioned.

French imports into this country, which were naturally hard hit when war broke out, have made an excellent recovery to a position, if anything, better than they were in before the war, while Belgian imports are, of course, practically unrecorded—only four items occurring during the year, having a total value of £1,600.

The total value of electrical material entering this country from the United States during 1915, according to our returns, was £1,855,000, an average of £155,000 a month, representing twice the value of the corresponding business in 1914, during the first six months of which, however, German electrical imports into this country reached record proportions. These figures are, of course, in excess of normal German imports before the war, which during 1913, for instance, were valued at £1,632,000, or a monthly average of £136,000. From our ally, France, we received £167,000 worth of electrical material, or rather more than in 1914, when the total was £122,000.

Apart from the countries above mentioned, the neutral countries of Europe—Sweden, Norway, Denmark, Holland and Switzerland imported a greater value of electrical material into this country during last year than in 1914. In the case of Sweden, Norway and Denmark together, this business was valued at £180,000, as against £166,000 for the previous year. Dutch electrical imports reached a total value of £153,000, as compared with only £60,000 in 1914, and a considerably less amount in 1913; while Swiss electrical imports were also valued at £153,000, as against only £88,000 in 1914.

The greater part of the Dutch imports represent lamps and parts, of which during the year some £125,000 worth entered this

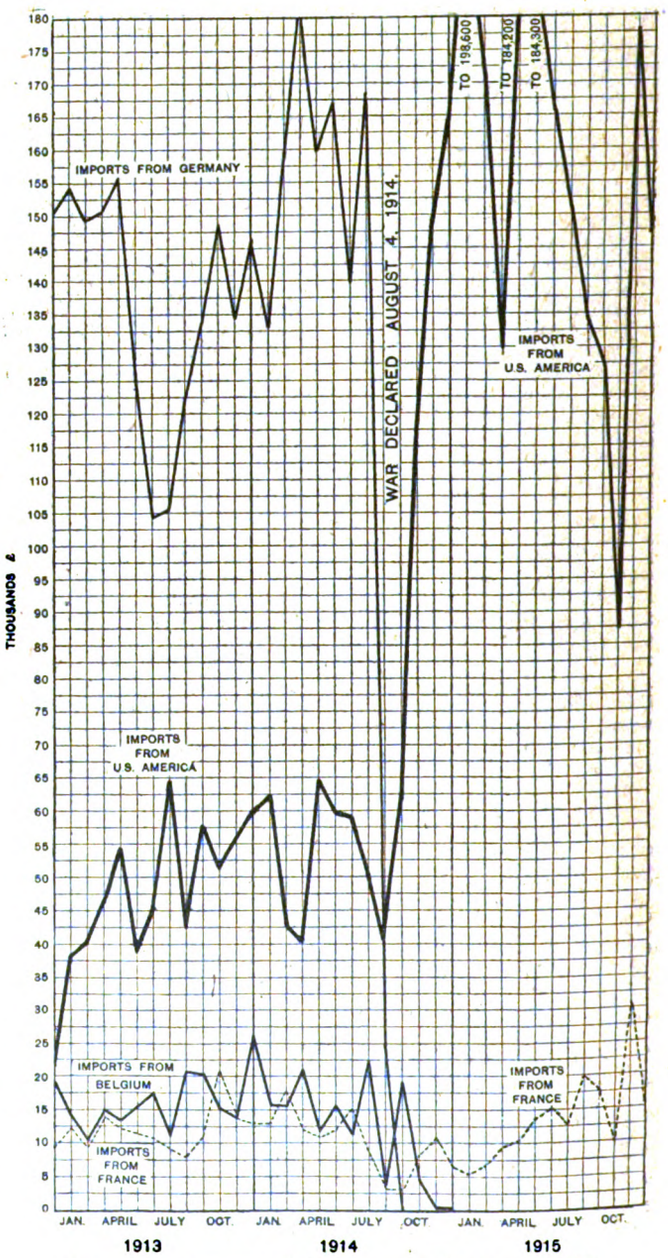

FIG. 7.—ELECTRICAL IMPORTS FROM GERMANY, U.S.A., BELGIUM AND FRANCE, 1913-15.

country; in other words, we have been buying over £10,000 worth of lamps per month from Holland during the last year, as compared with £1,400 worth before the war.

General.—In view of the adverse circumstances which prevailed throughout the whole of 1905, the marked revival of our electrical export business was a most welcome, and, we confess, unlooked-for feature of the year, in connection with which, however, it must be

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remembered that relative values show a considerable increase on pre-war days. Of the future it is difficult to say anything; but as it appears that despite the intensive development of munition making and concentration on war work, the British electrical industry possesses a sufficient surplus manufacturing capacity to enable it to make a very effective bid for overseas, as distinct from European war business, there is some ground for hoping that the present year will not compare unfavourably with 1915, so far as export business is concerned. The strong position of the American electrical importer into this country, in the absence of effective European competition, was, of course, foreseen; what the effect of this may be after the war is an interesting speculation, especially if it should happen that an adverse tariff handicaps German efforts in this country. For the present, however, there is little doubt that the Americans will retain their position as importers.

THE PREDETERMINATION OF THE PERFORMANCE OF DYNAMO-ELECTRIC MACHINERY.

PROF. MILES WALKER'S paper was read before the BIRMINGHAM LOCAL SECTION of the INSTITUTION OF ELECTRICAL ENGINEERS, on January 12th. An abstract of the paper appeared in our last issue.

Mr. R. OBSETTICH said that Prof. Walker's calculation sheet was the shortest he had ever seen; in his opinion it was cut down too far. He also thought the design sheets should be drawn up to include results of tests. Some reference should have been made in the paper to observations of temperature rises by means of detectors, as information on this subject was of great importance.

Prof. G. KAPP said that he had suspected for a long time that a flat cooling slot was not satisfactory. He found that the conduction across a group of laminations was about 100 times less than along the laminations, hence the cooling along a radial slot was not much good. A tube cutting across the laminations was more satisfactory.

Mr. W. MARDEN said that probably the more correct criterion for deciding if the thermal limit of the frame size had been reached, would be the product of A_g B and $I_a Z_a$, a term proportional to the output per revolution, though this also would not be constant where a large range of speed was covered on the same frame. The ratio of the magnetic loading to the current loading would also differ when for convenience the same frame was used both as a synchronous generator and an asynchronous motor, due to the necessary change in magnetising characteristics. The advantage of the author's calculation sheet over the methods in which the flux per pole was dealt with was not marked, since in this case also it was usual to employ as a guide the value either of the total armature current turns per centimetre periphery, or the figure for this value corresponding to the particular pole pitch. His constant K_c was a combination of various factors, each of which could be separately influenced by changes of design. The fact that the actual value did not change largely for a given type, direct-current generator, alternator, or asynchronous motor, was perhaps fortunate, but it was better to keep well in view each of the separate factors that were subject to change.

Mr. R. G. JAKEMAN said that in calculating the magnetising current of induction motors as shown, Prof. Walker advocated the use of the maximum flux density. It was well known, however, that if the field-form constant, K_f, was taken the same throughout, this method gave entirely wrong results if there was high saturation in the magnetic circuit. Hence it was necessary to take a different value of K_f (the ratio of the mean density to the maximum) according to the amount of saturation. It was his experience, however, that the method published by Dr. Kloss and Dr. Smith, which, considered the density one-third of the way along the pole pitch instead of in the middle, gave excellent results for the magnetising current, and was entirely independent of the saturation in determining the flux density in the teeth of an alternator or direct-current machine. It seemed to him quite as easy to estimate the virtual number of teeth per pole, as to estimate the value of K_f, since the latter could not be worked out in each case.

The paper was also read and discussed by the INSTITUTION OF ELECTRICAL ENGINEERS in London on January 13th.

PROF. S. P. THOMPSON, in opening the discussion, expressed appreciation of the valuable material contained in the paper. It seemed possible to be too minute in calculation in view of the practical limits with which they had to deal, but it was necessary to have the theory well in hand. He agreed with the author's summary of practical design methods, which could not be better stated. The empirical formula KW/B.P.M. $= d^2 l$, brought before the Institution some 30 years previously by Mr. Esson, and based on experiments with machines of different size, speed and output, was found to be scientifically correct, with the addition of a suitable constant. The author had shown how to build up graphically the curve of electromotive force for any single conductor which the rotor pole was passing, and this had been done in another way for years. But whatever method was adopted, the important point was the working result. The author's arithmetical method of finding, for a distributed winding, the E.M.F. form which results from a pole field form of particular shape, simplified the old graphical method of plotting a number of identical displaced curves along a base line and finding from them a resultant wave form. He doubted whether it was wise to use the same machine schedule for all types of machine; it would probably be better to use a schedule for each type.

MR. EVEREST said the author had divided his subject into four parts. He urged the value of uniformity of calculation methods, which was desirable, but he (the speaker) thought impossible until the professors agreed to adopt identical methods, including formulæ and symbols. As a rule, it was necessary now to translate from one to another, and much time was lost in finding what it was all about. There seemed to be no reason why symbols should have different meanings in so many cases, as one had to think what they meant. He felt it was really not advisable, from the point of view of the design office, to use a single calculation sheet for a number of different machines. The essential characteristics of a machine should appear prominently, as also any factors assisting to produce them; it was a mistake to combine several coefficients in one expression. The author compared the advantages of using maximum air gap density as against total pole flux as a basis of design, and he (the speaker) preferred the latter, as also the mean density across the total pole pitch, which enabled them to obtain the magnetic loading. As regarded cooling with narrow ducts, he suggested that the cooling value of a duct was really determined by the ratio of the surface to the cross-section.

MR. H. BURGE said designers of electrical machines were still worried by limits set by engineers to current density in armature and field windings; the author, however, made no reference to this in connection with temperature rise. A good deal could be said for the proposal to boil down the E.M.F. formula to one standard form for all types of machines, but he did not agree with it.

MR. HAWKINS agreed that almost all classes of machines could be designed on similar lines, and that it might be advantageous to use one design-sheet, simply from the facility gained by using the same method; he did agree that much would be gained by comparing the quantities of different types of machines on one sheet. The author had advanced strong arguments for retaining the maximum value of B_g in an expression of the fundamental E.M.F. equation, based on the total flux, one reason being the ease with which maximum flux density on the teeth could be calculated, but it had its drawbacks.

DR. S. P. SMITH was glad the author had suggested that they should arrive at some common method of designing machines, and wished the paper had been confined to that only. He proceeded to show that Esson's expression for the output of a machine gave them the relation between the two methods referred to by the author.

MR. H. ROTTENBURG asked whether the Institution could not arrange to collect a list of symbols in use and publish them in parallel columns, so as to bring home the absurdity of the present situation.

PROF. WALKER briefly referred to one or two points raised, but reserved his reply to the discussion.

THE DESIGN OF HIGH-PRESSURE DISTRIBUTION SYSTEMS.

The paper by Mr. J. R. Beard was discussed at a meeting of the SCOTTISH LOCAL SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS, in Glasgow, on January 11th.

Mr. A. PAGE (Glasgow), noting that Mr. Beard advised that the area to be served should be as large as possible, recalled that Mr. Lackie, in his presidential address to the Institution of Shipbuilders and Engineers last year, said that, in his opinion, the supply for the whole of Scotland could be best undertaken from three power stations. In connection with the cost of sub-stations, in Glasgow they were employing girls as switchgear attendants and finding them do the work very satisfactorily. In his remarks on switchgear, Mr. Beard again confirmed that the load which had to be carried had really very little to do with the design—the gear must be capable of dealing with a heavy short-circuit current. Far too much shoddy sub-station switchgear had been installed. Dealing with the economical section of mains, Mr. Page said that in Glasgow they seldom took into consideration the exact requirements of a small consumer. They had standard sizes of cables, and one was selected which might have little relation to the immediate load, but was laid down for flexibility and future development in the way of sub-stations or public works *en route*. He had worked out for Glasgow the following figures corresponding to those given by Mr. Beard in his paper:—Pressure actually adopted, 6,600 volts; number of switches per mile of main, 2.78; average max. kilovolt-amps. per mile of main, 1,000; most economical voltage, 8,000, *i.e.*, 1,400 above the voltage which Glasgow was actually employing. Sooner or later they must go to higher voltages if they were going to deal with heavier loads.

Mr. WHYSALL (Greenock) expressed the opinion that protective gears of the balanced type were extremely effective and satisfactory in operation. In Manchester it meant the addition of another current transformer and a relay, but nothing more was needed in many cases. The Merz-Price gear was extremely satisfactory, and one was particularly interested in

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this type because of the possibility of applying it to systems which were already in existence, and had been designed without any thought of protection such as was desired to-day.

The CHAIRMAN (Mr. D. A. STARR) said his impressions a few years ago were that overhead lines were more subject to breakdown than underground cables, but his subsequent experience with more than 50 miles of 11,000-volt overhead transmission had been sufficient to satisfy him that when overhead lines were well designed and regularly patrolled they were as reliable as underground cables, particularly in Renfrewshire and Lanarkshire, where they were subject to subsidences. With a good complete balanced protective gear they had not had any trouble for a long time. Wayleaves had been the cause of much trouble in the south, but if the proprietors were judiciously approached, much more satisfactory results might be achieved. He could not see the necessity of making switchgear absolutely fault proof.

Mr. W. W. LACKIE (Glasgow) said there was a similarity between the system advocated by the author and the Glasgow low-tension network. They had made a practice for many years of laying down a definite size of network in each street, irrespective of the immediate demands, and as the load grew in any particular district they laid a new feeder to a point mid-way between two adjacent feeders. The system of interconnecting extra-high-tension mains had only been rendered possible by the work of Messrs. Merz, Price, and Hunter. The main switches should be of the very best design, as they had to stand enormous strains. In Glasgow the problem was rather different from that discussed in the paper, as they were dealing with sub-stations each containing between 5,000 and 6,000 KW. of plant, which necessitated at least one feeder to each sub-station.

Mr. BEARD, in the course of his reply, said that air cushions and vent pipes on switches were of little good apart from the fact that a vent pipe took away gases from switches and made it safe to operate switches for the second time; otherwise, owing to gas hanging about, the switch might be damaged at the second closing. His opinion had been confirmed that earthing feeders formed the cause of innumerable mistakes in pulling out the wrong feeder, and the danger to employés in this direction was a serious one. Some of the interlocking arrangements which had come out lately were not very complicated. In taking the cost of the distribution system, he took two-thirds of the fixed charges, and not two-thirds of the cost. The regulation of wattless current and load between the power stations on the system he had shown was carried out by the whole operation being centred in one man named the "system engineer," who told the various stations the load to run at and the wattless current they had to run on—the wattless and governing machines being adjusted accordingly. Between the sub-stations the load factors were kept by ammeters, and in a few cases where it had been found advisable some form of adjustment bus-bar had been installed. He thought on the whole working, however, the number in use at present was about a dozen. This was not a very serious problem, and in many cases they were only operated at 20,000 volts, though in some systems now being laid out a higher voltage would be adopted. The balanced current system which he referred to in the paper was the Merz-Price system, and he dealt with the balance protective gear which one got by connecting three transformers together. Most people had two with the main earth leakage protection. They had used this much for tail ends, and also had adopted it to transformer protection to make it more sensitive to faults to earth. It was only suitable for tail-ends, however, and did not detect faults between phases, which, of course, were most important on big systems. In Newcastle, overhead mains were found not too reliable, although very great attention had been paid to them. He understood that in South Wales where, like Mr. Starr's district, they were troubled with subsidences, cable faults were three or four times as numerous as those upon the North-East Coast system. The wayleave question was one which had brought about pretty general trouble, but he understood the Institution purposed taking some action as soon as things returned to normal. He could not agree that America was now in the front with switchgear. There were certain cases of small lighting distribution where they had put in automatic control which kept the voltage constant on the sub-stations. These gave perfect satisfaction, but for the power supplies the need did not arise, for the H.T. voltage could quite readily be kept within reasonable limits.

ELECTRIC HEATING.

Mr. S. WILKINSON's paper on "Electric Heating: Its Present Position and Future Development," was discussed at a meeting of the SCOTTISH LOCAL SECTION of the INSTITUTION OF ELECTRICAL ENGINEERS in Edinburgh on December 14th, 1915. An abstract of the paper was given in our issue of December 24th, p. 828.

Mr. WEAVING said he had carried out a number of experiments which confirmed the opinion that a high loading was economical, and with the aid of a thermostat still higher loadings might be used and still further economy effected. Previous thermostats, while they might look after the temperature of the atmosphere, required a great deal of attention themselves. The thermometer and breaker described in the paper were very simple and, speaking from experience, seemed reliable. He had found it to break with ease 30 watts at 200 volts. Manufactured in quantities, the apparatus should be inexpensive. The principal feature of Mr. Wilkinson's thermostat was that it dispensed with a battery. As a result of experiments, he (Mr. Weaving) had found that for heating purposes electricity at ½d. per unit was equal to gas at 2s. 3d. per 1,000 cu. ft. The large proportion of electric fires sold as compared with lamp radiators left no doubt in his mind as to which would be the survivor.

Mr. W. W. LACKIE (Glasgow) said that the principal recommendation in favour of the electric radiator was that it could be placed exactly in the position where the heat was wanted. The author gave some figures showing the quantity of electric power necessary to heat a room, viz., 1½ to 2 watts per cu. ft. While this amount might be necessary to heat a large area, there were many places where less would do. For instance, in a dining room of 3,600 cu. ft. he found a radiator taking one unit per hour placed under the dining-room table, give as good results as a big coal fire. In November, 1914, the Glasgow Corporation rented premises for the administration of the Prince of Wales Relief Fund, and the electricity department were called upon to supply the necessary heating. The principal apartment was 60 ft. x 36 ft. x 12 ft. high, having a total capacity of 25,000 cu. ft. By arranging the radiators alongside individual desks, ample heating was found to be provided by the installation of radiators taking a total of 10 KW. The premises were occupied for practically a year, and the consumption of energy was 17,000 units, which at ½d. per unit gave a bill of £55, or a return of £5 10s. per KW. It was generally admitted that radiators should give off a large percentage of radiant heat. A captain on a 4,000-ton tramp steamer had a 4-element 1,000-watt dull radiator fitted in his cabin, and complained of feeling cold with an air temperature of 67 deg. F. Two of the 250-watt elements were removed and replaced by one radiant element taking 230 watts; with an air temperature of 57 deg. F. he said: "Now we are nice and warm!" That was to say, 730 watts gave him more satisfaction than 1,000 watts did. The Glasgow Corporation opened a showroom about three months ago, and in the first ten weeks that showroom sold 450 pieces of electrical apparatus representing 752 KW., whilst contractors and firms who dealt in such appliances stated that increased custom had been traced to advice given by the showroom staff. In a Glasgow suburb called Dumbreck, eight villas had been equipped electrically throughout. The size of these houses varied from 7,000 cb. ft. to 12,000 cb. ft., and each house had 10 to 12 KW. of heating appliances, including water heating. The largest consumption for any one of the houses for the year ending May, 1915, was 14,000 units, giving a bill of £40; in other cases the annual consumption was only half of this. Speaking broadly, however, the consumption of electrical energy in a house might be anything from 10 to 50 times what it would be if lighting only were taken. These eight villas were all on one main. The aggregate maximum demand, taken on one of the recent very cold days in November, was only 17 KW., which gave a diversity factor of 5 on the total of 80 KW. installed. This was practically the same diversity factor as they had in lighting. In Glasgow they had 10,000 domestic consumers, and 2,500 of these had heating appliances of some kind; their total consumption for lighting was 500,000 units, and for other purposes, 1,000,000 units. A large number of street lavatories in Glasgow had water heaters installed, taking from 3 to 10 KW. each. The annual bill for these varied from £7 to £30 per annum, depending on the size of lavatory, and they had had no complaint about the cost nor serious trouble with the apparatus. Mr. Goslin, the electrical engineer to the Glasgow Corporation Tramways Department, had given some very valuable information with regard to the electrical heating of the head office of the department. They had had electric heating installed for ten years. At first a hot-water system was installed, but it was found unsuitable owing to the various hours' work in the different offices. Mr. Goslin had found that the question of electric heating was bound up with the question of ventilation. Where heating was adequate without the accompanying provision of ventilation, complaints were soon heard of dry throat and other forms of discomfort and irritation. Mr. Goslin's conclusions, briefly, were that with thermostatic control the saving might be anything from 43 to 87 per cent.; without thermostatic control he found a room heated to a temperature of 74 deg. F., whereas with automatic control the temperature was kept between 59 deg. and 60 deg. F. Mr. Goslin had carried out a very comprehensive experiment in a test room where he had 36 thermostats scattered throughout the room at different heights. He found that there was as much as 10 deg. difference of temperature between a place near the ceiling and one near the floor level; also that there was a difference of 5 deg. between the temperature near a window and that of an adjacent wall. This pointed to the fact that the thermostat must be very carefully placed in a room. He also established the very practical fact that one watt-hour raised 100 cu. ft. of air 1 deg. F. Mr. Goslin recommended large low-temperature heaters and automatic air regulators.

Mr. R. ROBERTSON (Glasgow) contended that the industry got a big set-back some years ago by the installation of radiators much too small for the work they were put to. Mr.

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Wilkinson's minimum figure of 1½ watts per cu. ft. to be heated was very nearly correct. In making up data in an experiment similar to that of Mr. Wilkinson's, he was struck with the divergent results obtained in different rooms due to the position of doors, windows, fireplaces, etc., some rooms requiring as much as 25 per cent. more than others per cubic foot. He agreed that the best results were to be obtained by the installation of a small luminous radiator for cheerful effect and a large controlled radiator for temperature rise and maintenance. For the thermostat and circuit-breaker, as outlined by Mr. Wilkinson, to be a success, one would require to be installed in each room of a house. If a saving of anything approaching 75 per cent. could be got, as in the case of gas, a case was clearly made out for thermostatic control, and any extra capital cost would be more than justified.

In replying, Mr. WILKINSON said that the thermostat could be made suitable for the regulation of temperatures in water or in ovens. It was marvellous what results could be obtained when a radiator was properly placed and controlled. The figures given by Mr. Lackie as to the sales from his showroom proved conclusively the soundness of the business policy in opening such an establishment. The cost of the thermostat was 52s. 6d., with 2s. 6d. for the resistance. What was wanted for domestic heating was a large black heat convector and a small luminous radiator.

AMERICA AND FOREIGN TRADE.

THE Chief of the Bureau of Foreign and Domestic Commerce, U.S.A., Dr. E. E. PRATT, has recently issued his first report. According to the official summary of this statement published at Washington, Dr. Pratt says that the European war has suddenly thrust before the eyes and imagination of the American business community the subject of foreign trade. A large part of the report is devoted to a discussion of commercial conditions brought about by the war and to constructive suggestions for further extensions of American trade abroad.

After describing in detail the growth of U.S. foreign trade during the first twelve months of the war, Dr. Pratt asserts that the American business community should guard against any sense of safety in their present prosperity in so far as that prosperity is based on business connected with the belligerent activities in Europe. He warns business men to carefully discount the continuance of so-called war orders and avoid basing future calculations upon conditions which they bring into existence. Two of the great problems that must be solved if the United States is to make the most of its present opportunities receive much attention in the report, namely, financing foreign trade, and the problem of educating men to carry on such trade.

In spite of the fact that Americans are making headway in financing their foreign trade the report insists that they can never hope to gain the really big prizes in foreign trade until they are prepared to loan capital to foreign nations and to foreign enterprises. "The big prizes in foreign trade are the public and private developments of large proportions, as, for example, the building of railroads, the construction of public-service plant, the improvement of harbours and docks, the digging of canals, and many others which demand capital in large amounts. New countries are generally poor. They look to older and richer countries to supply them with the capital to make their improvements and to develop their resources. The country which furnishes the capital usually sells the materials and does the work. In the last analysis it comes to this: The country that wants the business must finance the purchases, since the improvements will be made and the materials paid for out of the money loaned."

The other problem of commanding importance in the development of U.S. international commerce is the education of men for foreign trade. "It is absolutely necessary that we train men to carry on our foreign trade, for we find ourselves to-day without an adequate supply. This problem may be regarded as the very fundamental of success in this field. Our banks cannot establish branches because they have not the men with which to man them. Our manufacturers find it difficult to secure salesmen. Our investors cannot find competent advisers on foreign offerings."

The report takes up such questions as the necessity of a definite foreign commercial policy for the United States, the revision of commercial treaties, the much-discussed subject of a merchant marine, co-operation in foreign selling, free ports, and commercial preparedness. It is stated that the effectiveness of the Bureau's work in promoting American trade in foreign countries is best shown in the definite practical results obtained. To prove that such results have been well worth while, the report takes up in detail a number of the largest contracts that American firms have closed as a result of the Bureau's activities. Perhaps the largest order of this kind resulted from placing representatives of a Russian concern in touch with American exporters of raw cotton. One of these exporters reports that it has closed a five-year contract for 40,000 bales of cotton annually, which will amount to two or three million dollars annually, or between ten and fifteen million dollars during the life of the contract. The report continues:—

"We are also informed of four other specific instances of orders, each one of which amounted to a million dollars or more, the information concerning which was first published in our foreign trade opportunity service. These are: A railroad for the island of Formosa; a coal-handling plant for the port of Durban, South Africa; battleships for a South American republic; and arsenal machinery for the arsenal at Hang Yang, China.

"Recently we were informed by a large milling concern in the West that a little over two years ago they formed a business connection with a concern in Turkey. The name of this concern had been obtained from the Bureau. During the past two years the amount of business done with this one concern has amounted to over $800,000.

"Numerous instances have come to our attention where the results in each instance have been smaller, but nevertheless important. For example, information published on foreign trade opportunities resulted in a contract for a new telephone system for Bergen, Norway, amounting to $201,000; a contract for a petroleum pipe line at Bucharest, Roumania; a contract for the construction of the capitol of Taihoku, Formosa."

As a result of a conference with the King of Spain, a commercial attaché of the Bureau opened up markets for about 3,000,000 tons of American coal annually. This conference resulted in the removal of the Spanish transport tax on American coal that had previously been a great obstacle to gaining a foothold in this market. Dr. Pratt calls special attention to the new and important commercial-attaché service made possible by an appropriation of $100,000 by the Sixty-third Congress, and urges that a still greater expansion of the Bureau's work abroad is imperative under present conditions and under the conditions sure to exist in the future.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AMENDMENTS.

SWEDEN.—Exportation of the following articles has been prohibited: Copper (manufactured or raw) refined from raw material (not from scrap) at a Swedish factory; nickel scrap, cast anodes of nickel even if provided with ears with or without hole; nickel wares, viz., sheets and hoops, rods, nails and rivets, also bolts, pipes and tubes, wire and wire cloth.

SWITZERLAND.—The Board of Trade has been informed that the Société Suisse de Surveillance Economique at Berne began operations on November 16th. The electrical and similar articles of which the Society will take delivery, and for which it will in future be the only authorised consignee in Switzerland, are enumerated in the accompanying list. These articles can only be consigned to the Society if its written consent has first been obtained by the ultimate consignee. Consequently, no export or transit licences will be granted in respect of such articles unless the application is accompanied by the document proving the consent of the Society. Articles destined for Switzerland from the United Kingdom, France, Italy, and Russia in respect of which export licences have been granted or conditionally authorised before November 16th, and articles from neutral countries in respect of which transit permits have been similarly granted, may be exported or allowed to pass in transit without being consigned to the Society, in virtue of the special guarantees already given by the Swiss importers. All applications to the War Trade Department for licences which have not yet been favourably considered or conditionally authorised should be renewed, and accompanied by the document proving the consent of the Society. The following are among the articles referred to:—

Accumulators, electric, and accumulator glasses.
Aluminium in all forms and aluminium manufactures.
Asbestos, crude and manufactured.
Cable, insulated.
Celluloid, raw, in bulk, sheets, rods, tubes, clippings and waste.
Detonators.
Electrical firelighters.
Electrical carbons.
Electrical insulated wire and cables.
Electrodes, piles, and component parts.
Graphite.
Instruments, nautical, observation, geodetical, and optical.
Machine tools and parts thereof.
Machinery for use in marine and aerial navigation.
Machinery, electrical, electric dynamos, and motors.
Magnetos.
Mica, rough and worked.
Rubber, vulcanised, in sheets.
Surgical instruments and apparatus, including rubber gloves.
Telegraphs, material for.
Tungsten in all forms.
Vehicles of all kinds used in military or naval transport.

MOROCCO.—With reference to the prohibition of the importation of enemy goods into the French zone, the Board of

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Trade understand that certificates of origin are required for all goods imported into that zone, and that so far as British goods are concerned the authorities will accept certificates issued by Chambers of Commerce in the United Kingdom if drawn up in the form which is accepted by the French Customs authorities in the case of certificates issued by Chambers of Commerce in respect of certain goods for which they are required in France. The signature of the issuing authority must, however, be legalised by the local French Consular Officer.

URUGUAY.—A Degree, dated September 13th, lays down regulations respecting certificates of origin in respect of goods shipped to the Republic of Uruguay. The Decree provides as follows:—

Article 1.—The Uruguayan Consular Agents are authorised to issue—when requested to do so—certificates of origin and nationality in respect of goods destined to be imported into the Republic of Uruguay.

Article 2.—The certificates must be presented in duplicate to the Consular Agents, must be drawn up in Spanish or in French, must be signed by the consignor of the goods, and must indicate the marks, numbers, and quantity of the packages, the nature of the receptacles, the nature of the goods, the gross weight, the origin or nationality of the goods, name of the consignee (in the case of goods not declared "to order"), and the ports of shipment and of destination. Each certificate may relate to only one consignor and consignee.

Article 3.—The Uruguayan Consul at the port of shipment may also issue certificates of origin for goods to be shipped with the option of being unloaded at either a foreign or Uruguayan port, provided the goods are consigned to a firm established in Uruguay.

Article 4.—Consular Agents shall *viser* certificates of origin, return the duplicate to the consignor of the goods, and send the original at once to the Uruguayan Consul at the port of shipment, informing the consignor that the duplicate should be transmitted to the respective shipping agent at that port, in order that the agent may present it, together with the respective manifests, bills of lading or "parcel-receipt," to the Uruguayan Consul there. The Consul shall make the necessary verifications, affix the original of the certificate of origin to the copy of the bill of lading or "parcel-receipt," which is to be delivered to the master of the vessel, and shall send the duplicate certificate, along with the other documents required by the Uruguayan Consular Regulations, to the Customs Department at Montevideo.

Article 5.—The Consul at the port of shipment, after checking the certificates of origin from the shipping documents, shall note on both (the original and the duplicate) the name of the ship on which the goods were loaded.

Article 6.—In the case of goods sent by parcels post, the duplicate of the certificate shall be sent to the Customs Department at Montevideo and the original returned to the interested party in order that it may be attached to the postal dispatch note.

Article 7.—Consular Agents shall charge the following fees for the visa of certificates of origin or nationalisation of goods, viz.:—

For the visa of each certificate in respect of goods to be accompanied by bill of lading or "parcel-receipt"	1 peso.
For the visa of each certificate in respect of goods to be sent by parcel post	20 centavos.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

412. "Switching devices for starting internal-combustion engines." R. Bosch (firm of). January 10th.

417. "Telephone transmitters or microphones." International Electric Co. & R. G. le Noir. January 10th.

425. "Electrical heating apparatus." H. Burgess and A. H. Taylor. January 11th.

436. "Magneto-ignition devices." G. R. Salt. January 11th.

440. "Means for applying electrical treatment." A. Vernon-Ward. January 11th.

455. "Apparatus for the external shaping of clay in the manufacture of telegraph insulators, etc." H. L. Doulton & W. Podmore. January 11th.

465. "Electric rotary converters." British Thomson-Houston Co. & F. P. Whitaker. January 11th.

469. "Electro-magnetic therapeutic apparatus." E. Bachelet. January 11th.

471. "Electrical condensers." C. S. Franklin & Marconi's Wireless Telegraph Co. January 11th.

483. "Electric hand-lamps." H. Biggleston. January 11th.

487. "Magnet systems for magneto-electric machines for ignition purposes in internal-combustion engines." W. Schmidt. January 11th.

492. "Electric arc lamps." H. T. Harrison. January 11th.

494. "Telegraphs." W. D. Kilroy January 11th.

503. "Cable clamps for electric wiring installations." G. S. Boothroyd and Callender's Cable & Construction Co. January 12th.

519. "Secondary batteries." G. Pearson. January 12th.

541. "Ignition dynamos." C. T. Mason. January 12th.

572. "Electric street pillar-boxes, etc." British Insulated & Helsby Cables, Ltd., & B. Welbourn. January 13th.

577. "Lamp-shade for electric lamps." L. A. Priestley. January 13th.

579. "Dynamo-electric machinery." J. Mould. January 13th.

581. "Electrical apparatus for producing hot and cold currents of air for drying hair, etc." E. B. Wright. January 13th.

599. "Radio-receiving circuits." C. J. Close. January 13th.

622. "Electric cigar-lighting outfit." R. K. Hearn. January 14th.

640. "Electric heating element, and method of making same." W. H. Lewers & B. A. Tapp. January 14th.

660. "Galvanic eyeglasses and spectacles." T. Carr. January 15th.

661. "Electric motor starters and controllers." E. Schattner, T. G. Travis, & J. R. Walton. January 15th.

665. "Machines for making electric cables, etc." Macintosh Cable Co. and P. W. Sankey. January 15th.

679. "Mountings for electric switches." H. E. Mitchell. January 15th.

681. "Alternating-current electric apparatus." British Thomson-Houston Co. & P. C. Whitaker. January 15th.

PUBLISHED SPECIFICATIONS.

1914.

24,792. Induction Motor Meters. W. Hamilton & Ferranti, Ltd. December 30th.

24,837. Alternating-current Dynamo-electric Machines adapted for Synchronous Working. L. J. Hunt & Sandycroft, Ltd. December 31st.

24,838. Dynamo-electric Machines. L. J. Hunt & Sandycroft, Ltd. December 31st.

24,839. Alternating-current Dynamo-electric Machines. December 31st. L. J. Hunt & Sandycroft, Ltd. December 31st.

1915.

41 Fluid Flow Measuring Devices. British Thomson-Houston Co. (General Electric Co., U.S.A.). January 6th.

130. Magneto-electric Machines. R. B. North & A. M. Allen. January 4th.

491. Systems of Electric Motor Control and Controllers therefor. British Thomson-Houston Co. (General Electric Co., U.S.A.). January 12th.

723. Stray-wave Protection Devices for Electric Circuits. Siemens Schuckertwerke Ges. January 16th. (June 17th, 1914. Patent of addition not granted.)

2,344. Bonding Connector for Bonding the Armouring of Electric Cables. C. J. Beaver & E. A. Claremont. February 13th.

2,570. Means for Protecting and Indicating the Condition of Electric Circuits. F. S. Grogan & the British Electric Transformer Co., Ltd. February 17th.

6,685. Coin-operated Electric Supply Apparatus. P. Wessel. May 4th. (May 4th, 1914.)

6,997. Dynamo-electric Machinery. Siemens Schuckertwerke Ges. May 10th. (May 11th, 1914.)

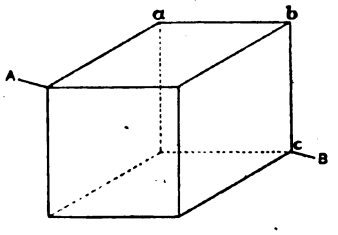
7,923. Slot-closing Devices for Dynamo-electric Machinery. Siemens Schuckertwerke Ges. May 28th. (May 30th, 1914.)

9,386. Casings for Electricity Meters. W. Hamilton & Ferranti, Ltd. June 26th. (Divided application on 24,792/14, December 30th.)

10,231. Vibrators for Induction Coils and the like. A. E. Beattie. July 14th.

10,676. Alternating-current Ampere-hour Electricity Meters. Landis and Gyr, Akt. Ges. July 22nd. (July 22nd, 1914.)

Two Interesting Problems.—The *Wireless World* recently propounded the following problem, which had been set to an advanced class of electrical engineers in a well-known college in Liverpool":—"Consider the cube to be constructed of a series of wires representing the edges—*i.e.*, *a* to *b* = one wire, *b* to *c* is



another, &c. Each has a resistance of 1 ohm. What is the total resistance A to B? If, instead of being constructed of a series of wires, the cube were made of sheet metal, each side having 1 ohm resistance, what would be the resistance between A and B?"

Another little problem presented by our contemporary is the following:—"Given two steel rods exactly alike in appearance, you are told that one is a magnet. How would you tell which piece was the magnet if you had nothing with which to suspend the rods, no point to poise the rods upon, no other pieces of iron or steel to attract, and no instruments of any kind?" This problem was submitted by Electrician H. Christie, R.M. of H.M.S. *Bonaventure*.

Both problems are puzzling at first sight, but yield to simple methods of attack.

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NOTICE.

IN view of the recent Increase in the Postal Charges, our Subscription Rates for Great Britain and Canada will until further notice be increased to £1 1s. 8d. and £1 3s. 10d. respectively.

THE DILUTION OF LABOUR.

A FORTNIGHT ago Mr. Asquith made an announcement in the House of Commons of far-reaching importance. He pointed out that "the adoption of dilution, that is to say, the employment during the war period of semi-skilled and unskilled and female labour on any class of work upon which it can be usefully employed, so as to set free skilled workmen for the work which they alone can perform, offers the only prospect of securing a sufficient supply of munitions to enable the war to be brought to a speedy and successful conclusion." He went on to point out that we cannot rely upon foreign supplies, because the demands upon our financial resources and our shipping would present insuperable difficulties. He also said: "The necessities of the war have been pointed out both to the owners of controlled establishments and to the representatives of the great trade unions, and they have loyally pledged themselves to support the Government in the scheme of labour dilution, the necessity for which has arisen from the national requirements and not from any demand by employers."

We have little doubt that the employers, so far as in them lies, are ready and willing to redeem their pledge. Wholly apart from the war, they have been striving for years past to get rid of the arbitrary distinction between skilled and unskilled labour. They have so striven in the interests of Labour itself. To them competition, whether at home or abroad, has been a reality; to the worker, the fact that the employer has been able to carry on at all is sufficient guaranty that the existing trade union rules are satisfactory in their operation.

We have no doubt either that the representatives of the great trade unions will do their best to redeem the pledge; but will those whom they purport to represent to their part? That is the real point. It is satisfactory to learn that during the last few days in various industrial centres the "dilution" process has at last been permitted to make some headway—for the period of the war. Perhaps Monday night's air-raid of industrial works may serve to hasten the rate of progress!

In the electrical industry where employers and men have played so prominent a part in the manufacture of munitions, we have no doubt that, given the necessary desire, the skilled men of to-day could do work more highly skilled, while the less skilled could soon, with practice, be made more adept. What the present "skilled worker" fears, we presume, is increased competition, and therefore lower wages, in that dim and distant epoch after the war. But we think he may set his mind at rest on that score. Increase the number of skilled workers up and down the country, and you necessarily increase the general capacity of the working community. Increase the capacity of our factories, and you increase output; and increase of output will be sorely needed after the war. If the worker at peaceful industry can be transformed into a munition worker, so the munition worker can, with equal facility, be transformed into an all-round artisan.

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It is the abuse of the right of free speech which appears to hamper the Government in bringing the case-hardened trade unionist to see reason. There is the suggestion that no form of compulsion should be brought to bear upon the working man until there is "conscription of capital"; until the so-called rich man is made to surrender all his property to the Government. The "man on the barrel" who preaches such doctrines does not go on to remind his audience that income-tax has been increased by about 150 per cent., and that a Cabinet Minister has stated that the country may have to spend about half its entire income before the war can be brought to a successful conclusion. Nor does he pause to consider or explain what is being done in the Central Empires—how every man, woman, and child in Germany and Austria has been mobilised for war; how the great populations which are at war with us are content to bear deprivation and hardship, consoling themselves by the reflection that, if their lot is hard, it is heavenly compared with that of the soldiers in the field. These considerations are relegated to the background when it is suggested that the working men of England shall "scorn delights and live laborious days" until the war be ended.

Amongst our enemies the people have been taught to believe (howsoever erroneously) that they can win through by sheer industry. Many efforts have been made to teach the same lesson here; and if the worker can only be made to grasp the fact that he is as important a unit as the man in the firing line, we are satisfied that the Government need bring no pressure to bear in the form of compulsion. Great things have already been done; old England, which the Germans thought incapable of waging a war with her population, has already to a large extent proved the contrary. The vast majority of the working men are doing their share in the field and at the bench; it only remains for the minority to abandon their private interests in the interest of their country.

AN INFLUENTIAL APPEAL TO THE GOVERNMENT.

The Guildhall meeting on "Trade and Employment after the War," convened by the Lord Mayor at the suggestion of a number of organisations interested in the subject, and held on Monday last, was a most impressive event. So far as the speeches were concerned, while they were all good, there was nothing either new in their substance or in the desire and determination that they expressed, but the representative character of the gathering cannot fail to carry weight when the enemy hears of the proceedings, nor should it fail to convince our own Government of the necessity for it to adopt. and that without further delay, a very strong policy in regard to after-the-war trade and the problem of employment. We have Mr. Runciman's assurances that by the time the war ends very complete measures will be found to be ready for safeguarding the interests of British trade against enemy onslaughts. We welcomed the speeches of the President of the Board of Trade because we thought we recognised therein a very definite and thoroughgoing Government policy. We, however, must not lose sight of the fact that the Board of Trade as it exists to-day is choked with work, and cannot with suitable facility take up the new duties that the situation and traders demand. For instance, the Registration of Firms Bill, which came before the House of Lords last week, had to be turned down, at any rate for the present, almost entirely because the Board of Trade was too busy with other duties to carry out the investigations, etc., that the measure would have involved. Yet almost every business-man has known during these eighteen months of war how great have been the difficulties of obtaining information respecting private firms — whether they were "enemy" businesses or not. The conviction that found expression in Monday's meeting was that the Board of Trade should continue its various duties for the regulation, control, and administration of trade, but that the Government should appoint a new Minister of Commerce to be responsible for the *promotion* and *encouragement* of trade. It was not the desire of the gathering to cast reflections upon the Board of Trade. We can re-echo the sentiments of one of the speakers who said that those who from experience knew the Board of Trade best knew well enough that it was not the officials of the Board who were to blame—it was the organisation, which was compelled to handle such various and vast concerns. What a commentary upon our national conservatism lies in the circumstance that it is more than 46 years ago since the commercial men of the United Kingdom first asked for a Ministry of Commerce! Before the German industrial menace or the Prussian military menace had any bearing in our direction—even before the Franco-German war! Yet since then our business men have appealed to Parliament again and again; the Press, including our own modest selves, have urged, in season and out of season, the necessity for action; and all this time we have been congesting the Board of Trade more and more until, as was truly said on Monday, it is too choked to do all that it ought to be doing for the encouragement of trade in these very important days. We wonder what would have happened had there been a Minister of Commerce in office when the war broke out! He and his department might have been able to settle down at once to deal fully with a unique situation full of splendid opportunity. Perhaps, if we dare look further back, we should have had. even before the war, such an investigation of our industrial affairs and such an intelligent grasp of the dangers that threatened, that we should have been better prepared in connection with those "key" industries upon which we are now promised a report.

However, vain regrets will not assist us; resolutions for timely reform are more to the point. and Government action following those resolutions is what we must look for. Reflections on the Board of Trade and the saying of stupid and bitter things about the Department and about Ministers are peculiarly unsuited to the present situation. Other means are more likely to be successful, and we are glad that the Guildhall meeting suffered no loss of dignity in its utterances. The object of the gathering was to show a united front to the enemy and to tender a united appeal to the Government. It is difficult to convey an adequate idea of the importance of the gathering; perhaps we can best do so by stating that there were present seven lord mayors, 70 mayors, representatives of 51 Chambers of Commerce. and 89 trade and industrial associations, eleven High Commissioners and Agents from the other parts of the Empire, ten banks, and many others representing all phases of commercial and public life.

In the course of the speeches, though detail was avoided, reference was made to the need for reforming the consular service—paying consuls well and allowing them a bonus upon the increased trade of the place under their care—the need for educational (technical and commercial) reform and for the extension of commercial banking, and so on—all subjects which have been done to death in the Press. but have perhaps never before been expressed in a public gathering which had such force and authority behind it. The Lord Mayor, in opening the pro-

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ceedings, said that Mr. Runciman's speech, already referred to, showed that the Government was in a "friendly mood." We hope that that friendly mood will not only permit the Prime Minister to give an appropriate reception to the City's deputation when it goes to lay the meeting's resolutions before him, but that it will rapidly develop into such a zeal in the interests of British industry and trade as will allow the Houses of Parliament to adopt measures for substantially assisting the business world when it again meets its enemy competitors in the trade war.

One of the resolutions adopted by the meeting called for immediate steps to be taken by the Government and by commercial organisations, to ensure co-operative action for the defence and improvement of trade and employment after the war; recommended full discussion of fiscal, legislative, and other steps for meeting the situation: and suggested the establishment of a Ministry of Commerce to carry out a constructive commercial policy for this country. Another resolution urged close co-operation to improve the commercial relations between ourselves, our Colonies, and our Allies, and to prevent Germany ever again acquiring an undue influence upon our trade and employment.

The meeting was not a "Tariff Reform" demonstration, but the speeches of men of eminence, and of totally different shades of thought in normal times, showed that all were now united in the resolve to "smash Germany" commercially, and wished to acquaint the enemy with that determination of our Empire.

Germany's Submarine Cables After the War.

The important question of the fate of the submarine cable system of Germany after the war has just been raised by a French contemporary, which also refers to one or two interesting matters of past history. It is first pointed out that what can be considered to be one of the vital points of Germany is situated about 25 miles distant from Emden, namely, the island of Borkum, where begin most of the submarine cables which connect—or which connected until they were cut by Great Britain—the Empire with the world. But this opportune destruction of the cables, in the opinion of the French newspaper, will not be solely a war measure, as it rests with the Allies whether the network shall be reconstituted. This depends upon France above all others. During the course of the 15 years which preceded the present conflict, France gave proof of incomprehensible incoherence from this point of view. Whilst politically the country was practising with complete loyalty the Franco-British understanding, telegraphically if it can be so expressed, a Franco-German understanding was being established, which was so obliging on the part of the French that Prince Bulow in 1912 saw in it a reason for hoping for something better. M. Charles Lesage, inspecteur des finances, narrated in a recent work the extraordinary advantage of the South American Cable Co., a British company which, he says, only had a single shareholder—the French Republic—and whose concession was sold by this improvident shareholder to the German South American Telegraph Co. Germany lacked a submarine connection between the Coast of Africa and Pernambuco; she acquired it in this way at little expense. Not only so, but the matter of the cable to the Azores, although still older, is none the less sad. It appears that Portugal at first refused to grant landing rights to the Germans for a cable which would have been an extension of that from Vigo, but finally a concession was given to the Felten & Guilleaume Co. In this way a French company which held an earlier concession, found itself turned out. These incidents are pointed out in order to prevent any future relapse. M. Lesage states in this connection that if in the dogma of Germanism there were not perceived the principles of universal domination, the assistance rendered by other nations to the German Empire in executing their plan of submarine telegraphy would not be regretted. But German Imperialism has become a fetish, and like all fanaticisms, it wishes to conquer in order to enslave. The French newspaper concludes that the world will only really be liberated if the network at Borkum is not re-established, or at least if it is reformed only under the control of the victorious Allies.

Lead.

There has been no substantial alteration in the position of the lead market. The scarcity of supplies available for disposal renders the market exceedingly tight, and buyers have manifested no new interest in the article, while there seems little chance of any radical change in the fundamental conditions for months to come. The main difficulty is, of course, the shipping situation which appears to become more and more aggravated from week to week. It should surely be possible, by the exercise of elementary foresight, to prevent vessels which reach this country to discharge cargoes having to wait for weeks on end before they can get a berth, and commerce discharging. The utter futility indeed of the labour policy of the authorities of this country is more responsible than anything else for the rise of prices of all commodities. Meantime, the equanimity with which the shipping interests in the House of Commons and outside seem to regard the state of affairs, which has been brought about by official incompetence augurs ill for any remedial action which may be planned having practical effect. If vessels could discharge their cargoes and get out to sea again without the wholly unreasonable delay at present entailed, there would be a 50 per cent. drop in freight rates. Not only does the congestion here, arising from preventible causes, complicate matters, but it at the same time prevents shipments of fuel from the United Kingdom to Spain, and thus further retards the production of lead at its source. America has lately been selling a little more freely, but here again the shipping question presents an apparently insoluble problem to the powers that be. The leading brokers state that many thousands of tons of lead delivered for shipment to Archangel in the late months of last year will not reach that port until navigation is reopened. It seems almost incredible that the bungling and blundering which characterised 1914 and 1915 can still be running riot. Meanwhile, a tight finger is being held upon the trade, and the authorities have given due warning that if any speculative movement develops they will place lead under the Defence of the Realm Act, a proceeding which would entirely stop all market business. It is very doubtful whether the speculation carried on in lead during the last few months deserves any notice whatever, but if it does, effectual steps have certainly been taken to repress such undesirable transactions.

The Wire-Drawing Industries.

The abnormally high price of electrolytic copper has resulted, as was in some measure to be expected, in a slight easing-off in the demands on copper wire and strip manufacturers recently. The War Office and Admiralty requirements, however, continue to be heavy, and there is not much likelihood of a lessening in demands in this section as regards the immediate future. In the export section the increased licensing difficulties, and the transport problem, have, between them, made it almost impossible to look adequately after the interests of regular overseas customers. The securing of export trade hitherto done by German wire manufacturers has, consequently, proved practically out of the question; but we are informed that the subject of German competition after the war is receiving the most careful attention of British wire manufacturers, and it is hoped that the German firms will find, when the war is over, that their former success in this country, and in overseas markets, will not easily be repeated.

The High-Conductive Copper Association, which comprises many of the most important copper wire-manufacturing firms in the country, has in the past considered it not worth the expense and competitive sacrifice to root out the growing menace of German undercutting and subsidisation, as, in order to do so, it would have had to resort to similar questionable tactics.

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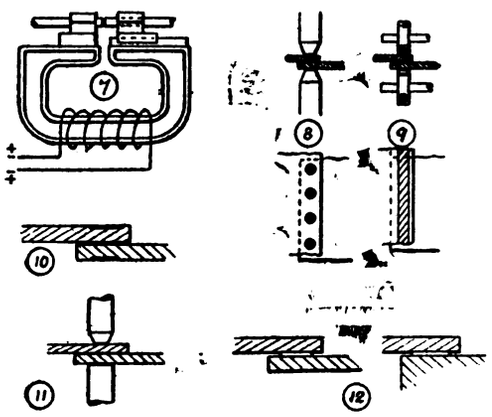
NOTES ON ELECTRIC WELDING PRACTICE.

(*Continued from page* 92.)

Resistance Welding.—Resistance welding is not autogenous in nature. The pieces to be welded are held together in the desired position and a heavy current is passed through the contact. Heat is thus generated in the plane of the joint itself, and directly welding temperature is reached additional mechanical pressure is applied to complete the union and current is simultaneously cut off. Though the necessary current density is high, the voltage required to produce it is low, so that A.C. supply is used for economy, and the transformer forms an integral part of all modern welding machines, the welding jaws being mounted on the ends of a single-turn "secondary" casting, on one limb of which the primary is wound (fig. 7).

The uniform production of heat right across the joint is a very important advantage, and this of all welding processes is the one most easily adapted to machine operation by unskilled labour—it is essentially a *manufacturing* process, and is applicable to almost every metal and pair of metals used in practice, and to sections ranging from 15 sq. in. or more of steel down to wires of 1-16 in. or less diameter (though such small sections can frequently be treated more advantageously by percussive welding). Resistance welders up to 200 or 300 KW. capacity are used in rail welding.

The welding of copper and aluminium, so frequently required in electrical work, can only be performed



FIGS. 7. 8, 9, 10, 11 AND 12.

satisfactorily by electrical methods. The difficulty is, of course, that aluminium, copper, and brass are molten at welding heat, and very susceptible to oxidation. Butt welding by its rapid action gives no time for any considerable degree of oxidation to occur, and the mechanical action of the welding machine ensures that the joint is completed and cooling commenced directly after welding heat is attained; also that oxide or other foreign material in the joint is expelled at the moment of "closing."

For maximum quantitative and qualitative results, the weld should be closed automatically both in respect of time and force. At various dates and for various purposes and metals, hand gear, dead weight, balance arm, spring-operated and hydraulic mechanism has been used to provide the "upsetting" force in butt welding machines. Automatic spring closing gear is useful for small sections and for copper and aluminium, which must be upset just at the right moment and in the right manner; also for zinc and lead, which are not incandescent at welding heat, and hence cannot easily be judged as regards the correct closing temperature and force. Hand closing is quite suitable for most metals between ¼ in. and 1 in. diameter, and hydraulic gear is necessary for large sections. The closing pressure necessary is about 600 lb. per square inch for copper, twice as much for mild steel or wrought iron, and three times as much for tool steels.

By maintaining considerable closing pressure during relatively slow heating by moderate current, there can be formed a weld with a practically smooth bulge or "upset" which in many cases need not be removed. On the other hand, by just maintaining contact pressure and passing a heavier current, metal in the vicinity of the joint is quickly brought to welding heat, and additional closing force being then applied suddenly, there is produced a ragged fin which must generally be ground smooth. The second or "flash" method is safest for metals liable to burning or oxidation, since metal at the contact is forced out at the moment of closing; this method is alone applicable to such metals as aluminium, and though the current consumed is heavier the welding time is shortened and less of the stock metal is taken up in the weld.

There is no fundamental difference between Thomson's first "nutcracker" welder (with a clamp on each leg and the weld where the nut would be) and the latest types of butt welders, but the latter are much more efficacious, due to mechanical improvements such as parallel jaw slides, quicker setting and clamping, and more complete control to suit all classes of work, particularly repetition work. The commercial success of the butt welder may be dated from the time when it was realised that it should be designed and used as a specialised machine tool.

Though the simplest butt welding operation is to join two initially distinct pieces together end to end, even small hoops or links can be butt welded (though with increased current consumption), notwithstanding the short-circuit provided by the continuous part of the work. There are also many special cases of butt welding two distinct pieces which demand special attention to the arrangement of the current-carrying clamping jaws and, in some cases, to preheating. Valuable applications of butt welding pieces at an angle are to be found in building up all kinds of metal frame, rod and strip work; and among miscellaneous operations often involving angle welding and the union of pieces of very different sections, but resulting in satisfactory construction and material manufacturing economy, may be noted butt welding of heads on to bolts, footplates on to pedal levers, rods on to disks to form gear blanks, pole shoes on to magnet cores, flanges on pipes, and metal handles on knives and forks (fig. 26).

Spot and Seam Welding.—Both spot and seam welds are of essentially the same nature as butt welds, but can often be applied where the latter is unsuitable, as, for instance, in building up thin sheet goods. For both spot and seam welds, one piece is lapped over the other and welded together *either* at intervals (fig. 8) by nipping between circular electrodes (thus producing the equivalent of rivets), *or* continuously (fig. 9) by passage between roller electrodes. Mechanical pressure or an intermediate filling disk or strip is depended on to concentrate heating; the second method being the more effective and the first the simpler. Current supply is again through a step-down transformer with single-twin secondary.

As compared with riveted joints, spot welds do not loosen or tear, but are actually a source of added strength. Generally the electrodes leave a distinct depression (some of the metal tending to flow sideways between the plates and hold them slightly apart, as exaggerated, fig. 10); a larger electrode on one side (fig. 11) generally prevents any depression showing there, and to keep both sides at the original level a "filling-disk" of metal may be inserted before welding (fig. 12). A filling disk to serve this purpose and to concentrate heat at the welding spot is specially desirable when welding thick sheets or attaching sheet to solid parts. Another alternative, often desirable, is to weld a dummy rivet head on one or both sides of the joint at the same time that the spot weld itself is made. The strength of the joint

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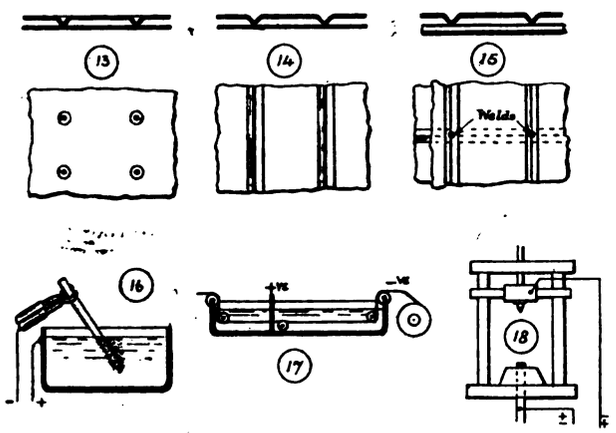
is entirely in the weld. In passing, it may be noted that a spot-welder (which is simply a butt welder with electrodes and general arrangement adapted to the work in hand) can be used to heat and close ordinary rivets if desired. The resistance surfaces are then at top and bottom of the rivet blank, consequently most heat is developed just where maximum mechanical deformation (for head-forming) is required. The process is silent, and it is easy to secure correct thermal and mechanical conditions during closing.

A spot (or seam) welding machine is easily applicable to a great variety of work, including much that could not be dealt with practically by ordinary butt welding. On spot welding galvanised iron, the zinc coating volatilises from the welding contact, thus ensuring a true iron to iron weld without affecting the protective coating beyond the joint. There is no action, however, comparable with the "upsetting" of a butt weld in its displacement of dirt or oxide from the welding surfaces, so that it is necessary to have the latter clean to ensure a sound joint, and also to prevent abnormal contact resistance which, when it breaks down, permits a rush of current burning the work and electrodes.

For repetition work in hardware construction and other light work it is easy to design a nearly or quite automatic spot or seam welder with motor-operated moving parts. Four or five times the output obtainable with riveting (say 15 to 20 spot welds, or 3 ft. or so of seam weld per minute in light work) can generally be relied upon.

A special variety of spot welding is obtained by forming dents in a thin sheet (using a blunt punch) and then resting this sheet, on the apices of its dents, on a flat sheet (fig. 13), after which the two are



Figs. 13, 14, 15, 16, 17 and 18.

welded together by current passing from one to the other. Using large electrodes, a number of welds may be completed at a time. Alternatively, one sheet or both may have ridges rolled in them in the form of shallow corrugations, line welds (fig. 14) or point welds at the crossings of corrugations (fig. 15) being thus formed. If desired, the dents or corrugations may be so shallow as to be flattened in the process of welding, this being an arrangement alternative to the use of filling disks.

The methods mentioned in the last paragraph may be used to build double sheet air-casings for stoves, etc., sheet metal pulleys, and, in fact, any parts requiring sheets in close contact or a short distance apart. Current being concentrated at the welding points the process is rapid and economical.

Electrolytic Welding.—The Hohe electrolytic welding process is interesting, but not, so far as the writer is aware, of any great practical importance. The work to be heated is connected as kathode (or held in tongs with insulated handle) in an electrolytic vat (fig. 16) which may have a special anode plate or be itself the anode. The electrolyte may be diluted sulphuric acid; a solution of sodium carbonate; a solution of borax and potassium carbonate; or a solution of sodium and potassium chlorides and carbonates. The only requirements are that it be a low resistance electrolyte and yield hydrogen on electrolysis. The heating vat is connected in a 100-200-volt circuit, and the work rapidly becomes coated with a layer of gas bubbles which offer such resistance that white heat is easily attained. The process is, however, only a heating process, and welding is supposed to be done on an anvil, so that the method is practically limited to wrought iron and mild steel.

Obviously there is necessarily considerable loss of heat, to the detriment of efficiency. The most useful application of the method appears to be to annealing and tempering—either rods, tools or wire. The work is heated as above, and quenched simply by cutting off current altogether, or, in the case of wire, by passing the latter beyond the current-carrying zone (as shown in diagram, fig. 17). Whilst hot, the work is encased in a film of reducing gas, so that scaling and blistering is impossible.

Electropercussive Welding.—The electropercussive system of welding invented, or rather discovered, about ten years ago by Chubb, possesses many unique features. The explosive discharge of a large electrolytic condenser is used to fuse the contiguous surfaces of pieces to be joined, and the weld is then completed by the momentum of one piece, which is moving rapidly by the time it reaches the other and completes the condenser discharge circuit.

Due to the *extremely* local nature of the heating and the explosive violence of the electrical discharge which blows out oxide, etc., from the weld, reliable joints can be produced between practically any pair of metals, irrespective of difference in thermal conductivity, melting point and liability to oxidation. Local heating as ordinarily understood, as produced, for instance, by arc welding, is liable to set up severe thermo-mechanical stresses, but the heating produced by electropercussive welding is so intensely local that no more than a film of metal is affected. Extremely intimate contact is secured in the film, so that the union is satisfactory, but the thickness of weld metal is so small that it makes no appreciable difference whether it be soft, hard, or even a brittle alloy. The whole thickness of metal heated to any considerable degree is of the order of two or three-thousandths of an inch. Practically, the method gives cold welding with all the advantages and none of the disadvantages of autogenous welding at the actual joint.

In its most successful form the electropercussive welding machine is built as a miniature pile driver (fig. 18), the "monkey" being the moving contact jaw carrying one of the pieces to be welded. Welding can be done at a distance (50 ft. or more if necessary) from the condenser and charging generator. Pre-eminently, the method is useful for welding small wires (1-16 in. diameter or less) together or on to plates; for attaching platinum contacts to screws and springs; for building thermo-couples and other light work which cannot be done easily or at all by other means. If found desirable, the method can doubtless be extended to heavier applications.

Light load losses in the condenser charging set constitute the chief item of power expenditure. Some tens of kilowatts may be operative in the weld at the moment of discharge, but as the discharge lasts somewhere about one-thousandth of a second the effect produced is absolutely local, and the actual energy consumption is almost negligible; conduction and radiation losses are nil. An application of particular interest and importance to the electrical engineer is the welding of copper to aluminium—whether in field coil leads or strand by strand in cables; in the latter event, a copper insert suitably protected against electrolysis, forms an excellent method of interconnecting two aluminium lines.

(*To be continued.*)

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A LABORATORY FOR RESEARCH ON HEATING AND VENTILATION.

WHILST the lighting of buildings has received a vast amount of attention, and has given rise to innumerable researches, the allied subjects of heating and ventilation in relation to the well-being of the inmates of public and private buildings have notoriously been neglected, even by architects, who, we should think, of all professional men, ought to have studied exhaustively matters of so great and personal moment to their clients. Only within quite recent years, as we pointed out not long ago, has this wide field for investigation been invaded with the aid of scientific method, and there are still very few workers engaged in the assault upon these admittedly difficult problems, although the results already obtained are so interesting and unexpected that they should attract the attention of all who are concerned with the erection of buildings, and the manufacture of the appliances used for heating and ventilating them.

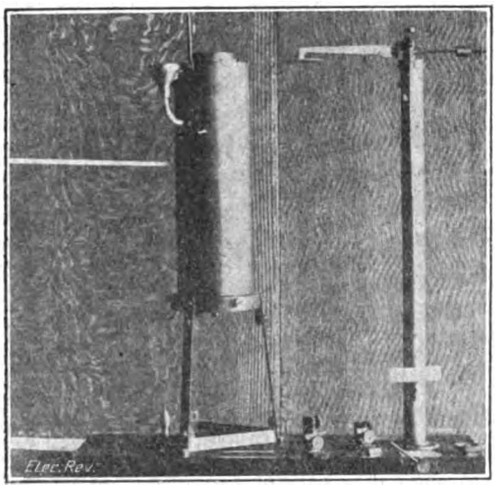

FIG. 1.—APPARATUS FOR MEASURING THE TRUE TEMPERATURE OF THE AIR.

FIG. 2.—APPARATUS FOR MEASURING CONVECTION AND RADIATION.

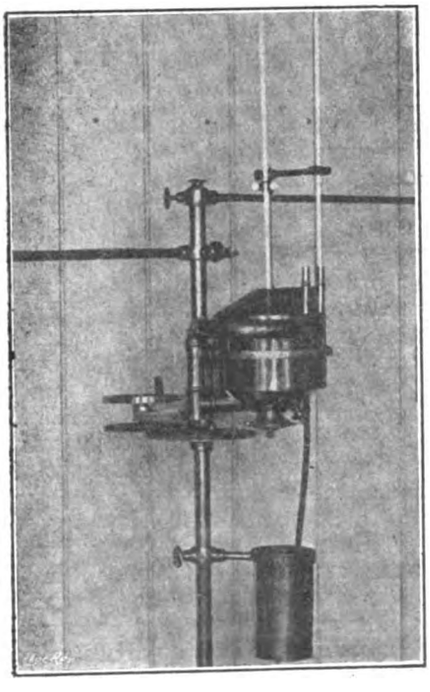

FIG. 3.—APPARATUS FOR MEASURING RADIATION TEMPERATURE.

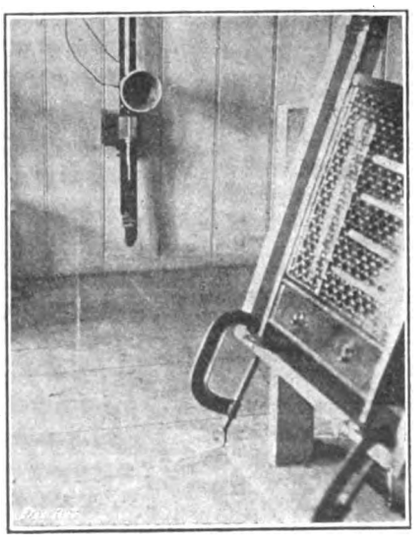

FIG. 4.—THERMOPILE FIXED ON WALL; RADIATOR MOUNTED ON CRADLE.

In our issue of December 17th we published an abstract of an address delivered at University College by Prof. A. H. Barker, one of the few investigators who have tackled the subject with determination and enthusiasm, and we were recently privileged to pay a visit to his laboratory and to be initiated into the mysteries of the science which he has made his own. The laboratory is situated close to University College, Gower Street, no room being available within the precincts, but in all probability accommodation will eventually be provided at the College itself, for the value and importance of the investigations which have been carried on in the temporary laboratory, under very great difficulties, have been appreciated by the authorities; in fact, a new department of heating and ventilation has been created as the direct outcome of this work, and Prof. Barker has been appointed the first lecturer, as was his due. The Institution of Heating Engineers has given valuable support to the new departure by supplying research students and in other ways.

In the address above mentioned, Mr. Barker explained how he had succeeded in separating the apparent temperature of the air in a room, as indicated by a thermometer, into two component parts—one, the *true* temperature of the air, the other the effect of radiation to the thermometer from the walls and furniture of the room. The problem was one of exceptional difficulty, but has now been thoroughly analysed and solved, with the aid of instruments devised by Mr. Barker for the purpose.

In the first place, the true temperature of the air is ascertained by varying the temperature of a column of air in a vertical tube by means of a water-jacket until the density of the air inside the tube is the same as that of the room; when this is not the case, the air in the tube will either rise or fall, and to detect the existence of such a current a delicately suspended diaphragm, nearly filling the top of the tube, was employed (fig. 1). When all is steady, and the detector shows that there is no current of air up or down, the temperature of the air inside the tube as read by a specially calibrated and shielded thermometer is the true temperature of the air in the room.

To determine the "radiant temperature" a somewhat similar apparatus is used (fig. 3), but in this case the temperature of the water-jacket is raised or lowered as may be necessary, with continual stirring, until the reading of a thermometer within it is the same as that of a thermometer suspended in the surrounding air, when the temperature of the jacket

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water represents the average temperature of the surfaces radiating heat to the thermometer; obviously this measurement is affected by the position of the external thermometer with regard to its surroundings, when the latter are not at a uniform temperature—near a cold window, for instance, the mean radiant temperature will be lowered—and this effect has been carefully studied. An approximation to the true air temperature can be obtained by surrounding a thermometer with a specially designed vacuum jacket on the Thermos principle, which cuts off practically all radiant heat, and this has greatly simplified the work. Experiments are now in progress with a view to obtaining an equally simple means of arriving at the radiant temperature, by the use of thermometers with large bulbs, which are warmed up and then allowed to cool, the rate of cooling being a function, *inter alia*, of the amount of radiation.

An elaborate investigation of the conditions obtaining in the House of Commons, one of the most

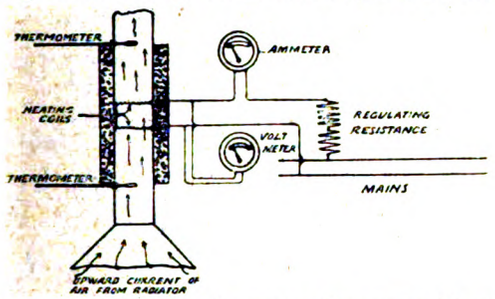


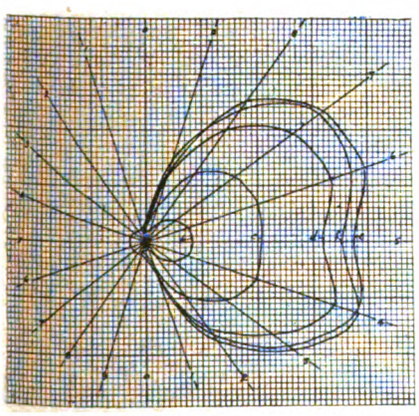
Fig. 5.—Method of Measuring Convected Heat.

adequately heated and ventilated chambers in the world, but a very uncomfortable one nevertheless, was performed by Prof. Leonard Hill and Mr. Barker with water-jacketed apparatus of the type above described, and their recommendations were on the point of being carried out when the outbreak of war necessitated the postponement of the work.

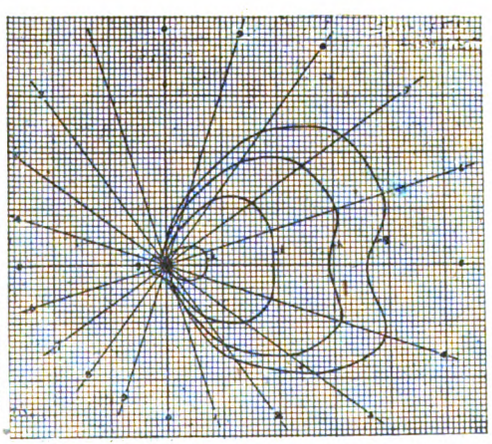
The bearing of such investigations on the design and application of electric radiators was explained in the address to which we have referred; briefly, it was shown that for occasional use a radiator was preferable to a convector, and that with radiant heat supplied, the occupants of the room might be perfectly comfortable although the "temperature of the room," as indicated by a thermometer, was even below 50° Fahrenheit. In connection with this subject Prof. Barker undertook an investigation of the performance of electric radiators, by measuring the amounts of heat evolved respectively by radiation and by convection. This research involved the construction of a variety of special apparatus.

In order to capture all the hot air rising from the heating apparatus, a kind of hood, or cowl, was devised, in the shape of a well-lagged pyramid, to the apex of which a flue was attached (fig. 2); to ensure that no eddies should escape capture, it was found necessary to draw air gently through the flue with an electric fan. To measure the rate of flow of the air, a grid of resistance wires was fixed in the flue and supplied with sufficient electrical energy at a known rate to keep its temperature slightly above that of the air current. The arrangement is indicated diagrammatically in fig. 5. By measuring the temperature of the air below and above the grid, knowing the specific heat of the air and the rate of dissipation of energy by the grid, the rate of flow of the air could be accurately determined, and the amount of heat energy which it received from the radiator could then be ascertained, the true temperature of the surrounding air being known.

To measure the heat radiated in any given direction, an iron bar bent to the arc of a quadrant was fixed with the radiator at its centre, and a movable device for measuring the radiant heat was attached to the arc, as in fig. 2, thus giving readings at all angles in a vertical plane through the radiator; by shifting the arc round the radiator, the radiation at a series of angles in other vertical planes could similarly be measured, and the result was a map of the space surrounding the radiator, showing the intensity of the radiant heat at points on the surface of a sphere of five feet radius—a distance taken as standard in these investigations. The radiation detector first used consisted of an absorber one square foot in area, composed of blackened coils of metal tubing through which water flowed; the temperature of the water at inlet and outlet being measured, and the rate of flow being known, the amount of heat absorbed per second could be determined. This, however, proved to be an excessively tedious and cumbersome method of test, and has been replaced by an electrical method. A thermopile was standardised and substituted for the absorber, and in conjunction with a galvanometer has given the greatest satisfaction as a radiation measuring device. Moreover, to avoid the necessity of moving the thermopile about the radiator, a cradle was made for the latter, by means of which it was made possible to explore the field of radiation by rocking the radiator into various positions whilst keeping the thermopile fixed (fig. 4). Thus a very great improvement in method was achieved. The thermopile was calibrated to give watts per square foot at five feet radius. Unfortunately it is not possible to rock gas radiators about so freely as electric radiators, and consequently the former have to be tested by moving the thermopile and not the radiator.



Left-hand Side, Zones *a* to *f*.



Right-hand Side, Zones *g* to *l*.

Figs. 6-7.—Readings in Vertical Planes.

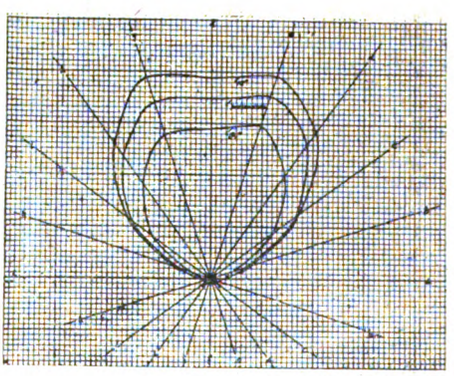


Fig. 8.—Lateral Distribution of Radiation (at angles of 18°, 0°, and 54° with the horizontal plane).

By means of these arrangements Mr. Barker has been able to account for the whole of the heat developed by a radiator, within two or three per cent., in spite of the obvious difficulties of the work. Many types of electric radiator have been tested exhaustively, and we are indebted to Mr. Barker for the examples of plotting illustrated herewith, as well as for the photographs from which we have reproduced

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illustrations of his equipment. The latter includes a recording ammeter, and an ingenious attachment to the pointers of an Aron meter to give a closer record of the amount of energy consumed at a given moment than could be read directly from the dials.

In the foregoing account we have only dealt with a portion of the resources of this laboratory, which is equipped also for testing gas and coal fires, a thermostatic arrangement for keeping the temperature of the room constant for long periods, means for testing hot-water radiators and pipes, instruments inserted at various depths in an external wall to obtain the temperature gradient in the body of the wall, an isolated section of the wall provided with a water-jacket and electrical means for determining the rate of loss of heat through it, and a series of wires stretched upon a wall for the purpose of heating the wall electrically for experimental purposes. A system of gauges to show the pressures at various points in a hot-water pipe system, and a micrometer gauging device to measure the rate of flow of water under low heads, have also been devised by Mr. Barker, as well as an elaborate and very sensitive apparatus based upon the principle of the Wheatstone bridge for measuring the resistance of air ducts, cowls, etc., in terms of definite units. With these our readers are less concerned than with the apparatus described above, but we have said enough to show that the subjects of heating and ventilation are now being dealt with in a manner which promises to elucidate many of the problems with which all civilised peoples are so intimately concerned; and we are glad to record that a British University and a British scientist are the first, we believe, to embark upon the study of these important matters.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The I.E.E. and Alien Enemy Members.

The "Six Borough Electrical Engineers," in their statement of last week, have most ably voiced the feelings of, I am sure, the majority of the members of the I.E.E. on the above subject.

It now only remains for a definite movement to be set on foot to give effect to the principles enunciated, and I would suggest that the six engineers should consent to receive the names of others who are in sympathy with them with a view to supporting a formal notice to the Council, asking for an extraordinary general meeting to be called to deal with the matter.

If members in the various local centres would act simultaneously the whole question could be settled in a very short time. I enclose my card and remain, for the moment,

Alien-ate(r).

I was pleased to see, in last week's issue, the very ably-written letter signed by "Six Borough Electrical Engineers," and to see that irrespective of the "hidden hand influence" which exists, and which has used every endeavour to prevent any action being taken towards the exclusion of members of alien enemy origin, whether naturalised or not, certain members of the Institution do not intend to allow the matter to rest.

As a contrast, one sees from the statement of the President of the Institution that the Council has appointed a committee of Vice-Presidents to consider this question, and still maintains that Article 41 gives it power to deal with it, but that no ten members have yet brought forward a definite charge against any corporate member of the Institution.

It has previously been pointed out that under Clause 80 the Council could have called a general meeting of the Institution members to consider whether any alteration in the by-laws should be made so as to exclude all corporate members who were of alien enemy origin. From the fact of its not having done so, it is clear it is not desirous that these people should be excluded, and, according to information which I have from time to time gathered from people interested in the movement, or who have acted on behalf of associations who have communicated with the Secretary on this point, there is a great lack of sympathy shown, whilst no assistance is afforded at all. There is, further, a rumour that a petition for a deputation and general meeting has been received, but I do not see any public announcement of it.

It is a well-known fact that the Council of the Institution dare not take a plebiscite of the members by ballot through the post on this point, for it knows full well the decision would be whole-hearted exclusion of all alien enemy members, whether naturalised or not.

I think it is viewed, should a general meeting be forced on the Institution, that the movement for the exclusion of such alien enemy members may be killed, either by reason of the lack of members, or the fact that the members then present will be marked men for the future, and, if in commercial houses, their positions may be jeopardised, which would not be the case if a plebiscite were taken.

To think that an institution like the Institution of Electrical Engineers has failed so much in showing a patriotic spirit is, I think, a severe reflection upon its membership. I can only recommend each member of the Council, when considering the exclusion of such members as may be thought worthy of its consideration under Clause 41, personally to read (as the writer has done) the *Appendix to the Report of the Committee on alleged German Outrages presented to Parliament by command of His Majesty*, Cd. 7895; price 1s. 9d. This, I believe, is expurgated, inasmuch as the more revolting and disgusting outrages are not therein referred to (if we can conceive such). I trust that, after having done this, they will realise that the outrages have been committed and authorised by a class of people essentially of the professional class, and of a class equivalent or superior to those members of the Institution referred to, and, further, have been committed by people of the same generation.

I trust, in conclusion, that members will refrain from paying their subscriptions until some definite attitude has been adopted by the Institution, and that the members, as a whole, will have every opportunity of deciding for themselves whether such a policy is right or not, and that such decision will be made in such a manner that they may, without fear of jeopardising their positions, do so.

Station Engineer.

The Problem of the "Point-Five" Tariff.

I have been interested in your communicated article dealing with the above in your issues for October 1st and 8th last. The article is mainly a criticism of the Norwich rating tariff system, also in use in conjunction with the "Point-five" tariff. One would have liked to see a criticism of the equity and the financial soundness of the "Point-five" tariff, and also an alternative to the Norwich system. It is true some suggestion was made that a more consistent system would be one in which the fixed charge was based on an *estimated* maximum demand. This seems likely, however, to have many of the defects that the Norwich system has.

With many others, I have always held the view that the Norwich system was a very crude approximation; in fact, one might as well base the fixed charge on a man's wages or income as on the rating of his house. To base the fixed charge on the actual maximum demand is no doubt the soundest and most consistent method, and the many critics of the "Point-five" enthusiasts would, of course, require that this maximum demand should be based on the total demands for lighting, heating, and cooking combined.

In Australia, owing to the comparatively mild climate and the disadvantages of cooking by ordinary methods during our hot summer months, electricity for heating and cooking should have a particularly good field. Notwithstanding this, there are, I believe, few, if any, engineers out here who favour, or believe in the financial soundness of, the "Point-five" tariff, or a figure in the neighbourhood of this, as a means for tapping this demand. The recent revelations from those undertakings which have had some experience of the "Point-five" tariff will hardly help to advance this system.

Radiators are greatly on the increase in many Australian undertakings, and, although they are only used during a few months of the year, still they have in many cases a better load factor than cooking would have. They have shown, however, that they create a distinct peak of their own, and it is questionable whether they are a payable proposition at prices per unit very considerably higher than the "Point-five" tariff.

The effect of the "Point-five" tariff on the stability of an undertaking can only be judged when the demand has reached large proportions. In the many cases quoted, the units sold on this system bear such a small proportion to the whole that their effect on the peak, and on the capacity of the mains and power station, is but small.

With a tariff in the neighbourhood of the "Point-five," coupled with satisfactory heating and cooking appliances, it is pretty safe to assume that in many of the undertakings at home, lighting, and even power supply, will be altogether secondary to heating and cooking. Those undertakings in which motive power does not predominate must, when this time arrives, find their peak load very seriously affected by the heating and cooking load which is superimposed on their lighting. Where power load predominates, many undertakings find that their peak is in the neighbourhood of noon, and the mid-day heating and cooking load, when fully ad-

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vanced, must in consequence create a very decided and important peak of its own.

In your communicated article it would have been interesting to see some consideration given to the Norwich system coupled with the introduction of the half-watt lamp. It has been stated that those who have adopted a fixed-charge system, such as the Norwich, will be in a much better position to face the problem that arises from the introduction of the half-watt lamp than those who have a tariff of a certain price per unit without a fixed charge. This is very questionable. Take the Norwich system coupled with the "Point-five" tariff, and assume that the fixed charge, plus ¼d. per unit, is equivalent to 4d. per unit for lighting. If we assume, for argument, that the half-watt lamp halves the consumption, which, fortunately, at present it does not, then on the above tariff the consumer would be paying for his lighting on the equivalent of 3¾d. per unit. Those consumers who have not changed over to the Norwich system, such as shops, public buildings, etc., who cannot very well be offered the Norwich system, would, instead of paying the 4d. per unit, be getting their lighting on the equivalent of 2d. per unit. It would, therefore, pay many consumers where cooking and heating units are not a very large item to discard the Norwich system and demand any heating or cooking power they require on the ordinary rates. A great inconsistency would ensue; in fact, very unfair preference might be claimed. Why, for instance, should the shop and many public buildings, who are among our most unremunerative consumers, get their lighting at the equivalent of 2d. per unit, and the private house, which is one of our best consumers, owing to its higher load factor, be charged at the equivalent of 3¾d.?

The fixed-rate system with a much higher price per unit would lessen some of the above defects, but where would the "Point-five" tariff be?

The war has, no doubt, delayed the advance of the half-watt lamp, but it is to-day an important factor for shops and public buildings lighting, where the larger units can be employed. It is, however, only a question of time when the same will occur in the case of private house lighting, and then the Norwich system will be faced with many of the same difficulties that other tariffs will have to consider.

The half-watt lamp is bound again to raise the standard of lighting in the same way, but hardly to the same extent, as the metallic-filament lamp did, but this will in all probability not be the case with the majority of our private house consumers. The 16-c.p. standard of carbon-lamp days was, in very many cases, too low, and has been replaced by the 50-c.p. standard. It is hardly conceivable in the case of the majority of private houses, except where indirect or semi-indirect lighting is introduced, that the standard will be raised much beyond 50 c.p. Some alteration in the tariff, to meet the problem which must result from the introduction of the half-watt lamp, seems inevitable, particularly so in those undertakings which to a great extent depend upon lighting for their revenue. Already undertakings are feeling the effect of the half-watt lamp in the case of shops and public buildings, etc. Fortunately private houses, the mainstay of many undertakings, will be little affected in the meantime.

I throw out a suggestion, a crude one, as a result of the above position. Where a shop or public building has the whole of its lighting changed over to half-watt lamps, the ordinary tariffs should be increased by some percentage, say, for argument, 40 per cent. If such a consumer is using high-candle-power units, then his tariff would have to be doubled to bring in the same revenue. The above suggestion would, therefore, concede him 60 per cent. of the advantage, the supply undertaking retaining 40 per cent. If only 75 per cent. of the candle-power installed was with half-watt lamps, then the increase in the tariff would be 30 per cent., and on the same basis 50 per cent., and 25 per cent. would increase the tariff 20 per cent. and 10 per cent. respectively. There would, of course, be some difficulty in checking the above, and when you come to private houses it would be much greater. Perhaps, however, by the time the private-house problem has to be met there will be other solutions of the difficulty. The proposal, I know, is a crude one, and has objections. I simply throw it out in the hope that it may lead to further consideration and discussion of the problem and, perhaps, some solution.

P. J. Pringle.

Ballarat, Victoria, *December 9th*, 1915.

[We may point out that in this country the supply authority is forbidden by law to place any restriction on the type of consuming device adopted by its customers. We have grave doubt as to the practicability of the proposal contained in Mr. Pringle's last paragraph.—Eds. Elec. Rev.]

["Crane" is reminded that letters unaccompanied by the name and address of the writer are not accepted for publication.—Eds. Elec. Rev.]

Russian Chamber of Commerce in London.—The Foreign Office announces that the organisation styled "The Russian Chamber of Commerce in London" has not obtained the recognition or approval of either His Majesty's Government or the Imperial Russian Government.

THE PREDETERMINATION OF THE PERFORMANCE OF DYNAMO-ELECTRIC MACHINERY.

Prof. Miles Walker's paper was discussed by the Manchester Local Section of the Institution of Electrical Engineers on January 11th.

Mr. L. A. H. Carr said regarding leakage that the author's method seemed rather complicated. The speaker had found it possible in practice to calculate leakage by means of a formula containing only two terms, the first being proportional to the core lengths (a different constant being used accordingly as the rotor slots were more or less than the stator slots) and the second giving the end leakage. This method worked well in practice, and the determination of the two constants for any given line of motors was fairly simple. The core loss curves in the paper called for some criticism. Some years ago he had carried out a series of experiments on core losses, and it was found that for a given periodicity and flux density the core loss in a D.C. machine was about double that in an A.C. machine. Regarding the "tailing-off" at the upper end of the curves, he had observed this effect in asynchronous machines with cylindrical rotors. It did not occur, however, in D.C. machines, even with extremely high apparent tooth densities, the curves taking in fact an increased upward tendency. The equation for watts dissipated from a cylindrical surface seemed much too high for an induction motor, but gave good results for D.C. machines with relatively large air spaces between the salient poles. He gave figures to disprove the possibility of getting enough air through a narrow induction-motor air-gap in order to dissipate the quantity of heat mentioned.

Mr. Julius Frith said the current loading was surely quite as important as the flux loading, also the ratio of flux loading to current loading. The method of taking the maximum induction in the air-space and multiplying it by the maximum possible area of the air-space in order to get a fictitious large flux was not inviting. In reference to Mr. Field's work, a Manchester paper (*Journal*, I.E.E., Vol. 37, page 101), gave very good curves showing the increased ohmic resistance due to the current being forced outwards in the slot conductors. The four curves showing iron losses at different frequencies could, with sufficient accuracy, be combined into one curve by plotting watts per cubic centimetre against the product of induction and frequency.

Mr. Juhlin from personal experience testified to the ease with which a designer could lay out machines and get a clear grasp of the factors involved, using the method outlined by Prof. Walker; after using it for some time, it was exceedingly quick. Prof. Walker had stated that it was hardly worth while to calculate the iron losses accurately; it seemed, however, that without some fairly accurate idea of the iron losses it was impossible to deal with one of the main headings, namely, temperature rise, and, in his opinion, it was desirable to allocate the loss to different parts of the magnetic circuit. The curves in the paper appeared to give a result which was altogether too low. The losses in a finished machine did not by any means lie in the lamination, as pointed out by the author. A great part of these losses would be found in the iron structure supporting the laminations and also in the copper, especially in direct-current machines at high densities. The loss was probably much higher in D.C. machines than would be calculated using the author's curves. It would also seem necessary to discriminate between the losses in induction motors and turbo-alternators, and the field for investigation in this work was very great indeed. The eddy-current losses increased very rapidly with the working of the iron. For example, in turbo-alternators there was a big mass of unworked iron, whereas in induction motors with a large number of slots the worked surface was considerable, and the losses were consequently high. The same remarks applied to direct-current machines.

Mr. R. E. Grime said that a special sheet for each type of machine would be preferable; three such sheets would fulfil most purposes. The author had given prime importance to what might be described as "frame constants," *i.e.*, the idealised total magnetic flux ϕ crossing the air-gap $A_g B$, and the total ampere-turns $I_a Z_a$; the speaker entered a plea for the utility of *specific* magnetic and electrical loadings, especially in preliminary calculations. The specific magnetic loading was the average air-gap induction round the whole machine; denoting this by B_{av} it equalled $2 P \phi / 2 \pi r l$. The specific electric loading equalled ($I_a Z_a$/circumference), and was often denoted by q. These two quantities had the great advantage that for a given type of machine they remained sufficiently constant over a wide range of frame sizes. After some experience with these constants a designer could usually estimate what values to aim at, and make the constants the basis of the first tentative design. The output coefficient given by the $D^2 l$ formula on design sheets always appeared rather a blind way of estimating what use was being made of available space and material. This coefficient was inversely proportional to the product $B_{av} \times q$. For example, in a continuous-current machine, after allowing for internal resistance drop the $D^2 l$ formula might be written $KW/R\ P.M. = D^2 l \times B_{av} \times q \times \pi^2/6 \times 10^{12}$. This expression, which was quite familiar, merely brought out the fact that whereas the ordinary output coefficient was often used to indicate that it was possible to put a given output into certain dimensions, if this coefficient was replaced by the two quantities B_{av} and q, the designer would see at once how it was possible to get it into those dimensions. It was obvious that the air-gap induction B might be used instead of the average value at the discretion of the designer, as the author's field-form coefficient K_f was simply the ratio of these

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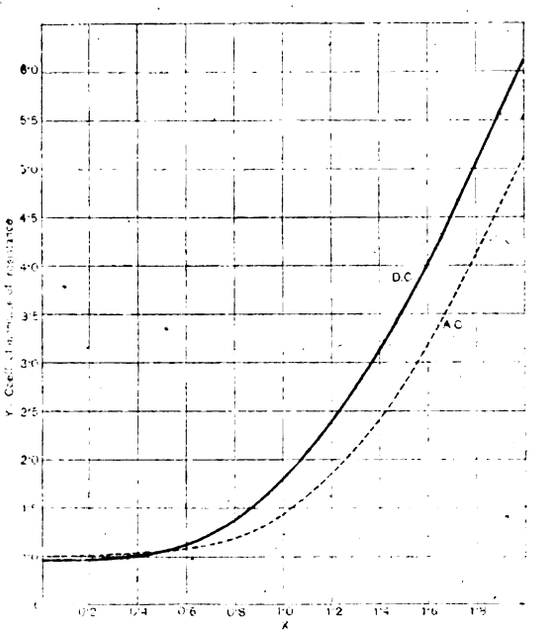
two quantities, *i.e.*, $B_{av} = K_f B$. The product $q\Delta$ of specific electric loading by current density in armature copper often gave a very close idea of the temperature rise of standard machines; it was something more than an empirical rule, as it was proportional to the copper loss per cm. of air-gap area, and also in the case of a barrel winding, per cm.^{2} of end-connection cooling surface. Thus for a given continuous-current frame of practically constant flux a curve could be plotted showing the relation between the permissible value of the product $q\Delta$ and the peripheral speed, and over quite a wide range of frame sizes this curve remained practically the same. In a line of standard machines of one type, therefore, such a curve, when once determined, gave instantly a fairly close indication of the current density to be employed in connection with any proposed value of the specific current loading. The observed total iron loss was usually considerably higher than that indicated by the curves. In induction motors and alternators the losses generally increased approximately as the square of the total flux, while in D.C. machines the index was usually 2·5 to 2·8, or even higher, at a very high tooth induction. The difficulties in the way of forming a reliable estimate of the extra losses were so great, especially in view of the large difference produced by small shop variations, that the allowance for them must remain mainly empirical. The stray losses, which were dependent upon the load, were mainly accounted for by (*a*) eddy-current losses in the conductors embedded in the slots, and (*b*) additional iron loss due to distortion of field-form by armature reaction. In the armature conductors of D.C. machines, owing to the almost rectangular shape of the current wave form, the effective increase in resistance was considerably greater than when the same conductor carried a sinusoidal alternating current. The curve A.C. in the accompanying figure gave the mean coefficient of increase of resistance for the top and bottom conductors of an ordinary barrel winding carrying a sinusoidal current; the curve D.C. showed the corresponding effect in a normal D.C. winding.



EQUIVALENT INCREASE OF RESISTANCE OF EMBEDDED COPPER OF STANDARD TWO-LAYER WINDING.

y = coefficient of increase of resistance (mean of top and bottom conductors).
x = 0·14 × depth of conductor in cm.
× √frequency × width of conductors, total / width of slot.
for copper at 60° C.

For simplicity the curves showed only the mean increase in top and bottom conductors, assuming these to be identical in size. The stray iron losses on load were not so amenable to calculation, owing to the awkward shape of the field-form. It was possible, however, by ignoring the field-form altogether, and simply considering the maximum induction under the trailing-pole tips (of a generator) to arrive quickly at a result which was, at least, of the right order of magnitude.

MR. R. TOWNSEND said that after 10 years' experience of Prof. Walker's method he preferred it to the method generally adopted. The constant K_e might seem rather complicated, but after a little use it was quite simple, and once obtained for a given frame it was practically constant irrespective of the number of slots per pole. The great advantage of using the constant was that it conveyed so much meaning in one figure and showed at a glance whether the best results were being obtained from any particular design of frame. The adoption of one calculation sheet for all machines was not desirable. For example, if a designer had been working on alternator designs for some time and suddenly turned to D.C. machines, it was quite easy to overlook the fact that in one case a certain portion of the tooth depth had to be added to the armature diameter, and in the other a certain portion had to be subtracted. A separate type of design sheet would certainly tend to prevent mistakes of this kind; in fact, sheets having a different colour would be preferable.

MR. W. E. M. AYRES said he had found it very useful, in the calculation of the magnetising current for induction motors, to plot curves for the magnetising current in terms of the air-gap plotted against flux densities for different parts of the magnetic circuit. Regarding the curves for iron losses which, presumably, were for A.C. machinery, he had not found the actual losses tapering off so much at high densities. The use of the same curves for losses in teeth and core was frequently insufficiently accurate owing to the fact that the core was usually substantial unworked iron, while round the slot was considerably worked iron. The estimation of the heating of induction motors was a very complicated matter. Cases had been observed where a reduction of rotor losses had resulted in cooler stator iron, although the stator iron losses had increased. The heating of the stator could be considerably modified by taking the heat away from the end connections in an efficient manner. Taking the ampere wires per unit length of periphery as the current loading, and air-gap flux density per unit area as the magnetic loading for any machine, the product of these values multiplied by $D^2 l$ was a measure of the output, and a glance at such figures was sufficient to indicate to an experienced person how the machine was loaded.

PROF. MILES WALKER, in a brief reply, said that he did not agree with Mr. Carr's suggestion regarding the correct method of calculating the leakage of induction motors. The calculation should be made as simple as possible, but the designer should have before him the principal factors which determined the amount of leakage. The iron loss curves, which had been subjected to considerable criticism, were intended to represent the legitimate iron losses. Reasons were given in the paper why some of the so-called iron losses were actually higher in practice, but the author did not consider it right to accept these additional losses as something inevitable and put them into the curves for general application. The correct procedure was to give curves for the legitimate iron losses, and if there was a legitimate loss, say due to eddy currents in conductors occurring when the teeth became saturated, a separate small formula should be employed to take care of it. He was quite sure that the legitimate iron losses would follow a curve as given in the paper. The author agreed that the teeth and core losses should be separated and the individual curves plotted. The importance of the iron losses was enormously great, and the temperature rise of a machine could not be estimated without a fair knowledge of these losses. For some reasons it was probably better to adopt separate design sheets, but it was well to have one general method of design.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Glass Wool.

Amongst the new industries that have been established within our borders as a result of the war, is the manufacture of glass wool. This useful substance is now made in London with British labour by the BRITISH GLASS WOOL CO., 134A, Holloway Road, London, N.; moreover, it is not made under foreign patents, but by an electrical method invented and developed by the firm, and the product is so fine, soft and brilliant that it can hardly be distinguished in appearance from silk—it is difficult to realise that it consists of glass. Makers of cookers, electric furnaces, portable accumulators and similar articles will no doubt be interested in the material, and we should think that many other classes of manufacturer would find it useful.

Salt-Water Leakage in Surface Condensers.

When salt water is used for circulating purposes in connection with surface condensers, there is always the possibility of contaminating the condensate because of leakage of the condenser tubes or packing. This leakage is usually detected by chemical tests of the condensate. The following electrical method of determining leakage has as its basis the measurement of the potential drop in a circuit. Referring to the illustration, an ordinary spark plug is screwed into the condensate pipe as near

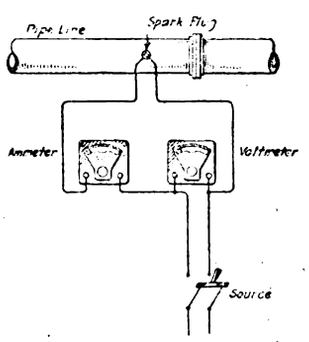


FIG. 1.—CIRCUITS TO MEASURE POTENTIAL DROP ACROSS GAP OF SPARK PLUG.

the base or hot-well of the condenser as possible. Across the two leads to this spark plug a voltmeter is connected, and an ammeter is placed in the circuit as shown. Assuming no leakage, pure water will flow across the gap of the spark plug and offer a high resistance to the flow of the current. This condition results in a

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high potential drop across the gap. As leakage occurs the resistance decreases, and the drop becomes less also, affecting the flow of current.

By a little experimentation the resistance of various states of the water from pure to rank contamination may be computed by Ohm's law and the results recorded. In actual operation the oiler may read the instruments and record the data on his log sheets. When these are turned in, it requires but a few minutes' work to determine the condition of the condenser as regards leakage.—*Electrical World.*

An X-Ray Portable Power Plant.

It is probably safe to say that at no time since its first application to medical science has the X-ray played so important a part as it is doing at the present time in connection with the work of saving the lives of wounded soldiers, who, but for the prompt diagnosis it permits, would succumb to their wounds. Not only are all the military hospitals equipped with such apparatus, but a large number of travelling hospitals in the form of specially-designed motor vehicles are also being used near the field of battle by the Medical Service of the Army. One of the needs that the war early brought about in connection with the use of the X-ray was that of a portable power plant which could be quickly installed either in a motor vehicle or in hospitals not

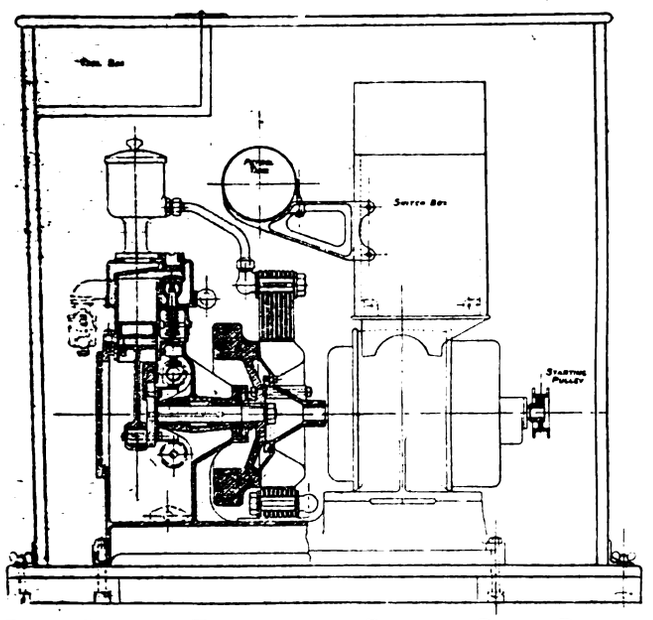

Fig. 2.—Sectional View of Austin Portable Power Plant.

provided with a source of electrical energy, and we are this week able to illustrate the compact little set which the Austin Motor Co., Ltd., of Northfield, Birmingham, specially designed for this work, and of which they have supplied a large number to the Director-General of Army Medical Service.

The set, which is exceedingly compact, occupying a space of only 3 ft. by 2 ft. by 3 ft., comprises a single-cylinder petrol engine

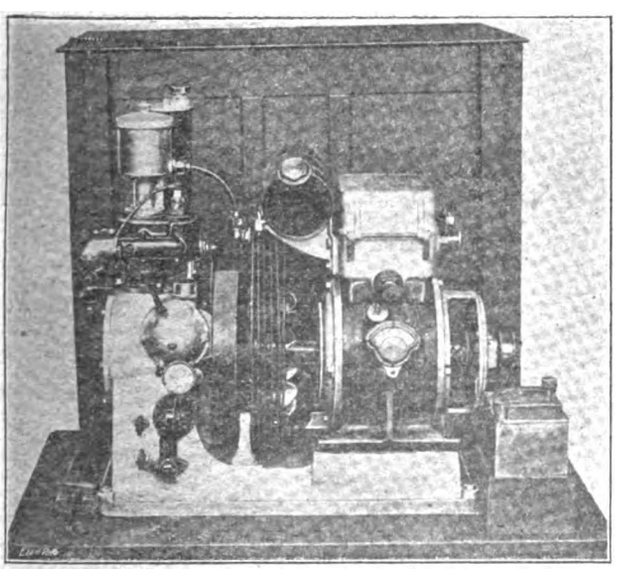

Fig. 3.—Austin X-Ray Portable Power Plant.

developing 1½ H.P. at a speed of 1,300 R.P.M. radiator, silencer, petrol tank, dynamo and switchbox, the whole, for portable purposes, being enclosed in a wooden box provided with carrying handles and also with a receptacle for the necessary tools.

So far as the engine, which has a bore and stroke of 2½ × 3 in., is concerned, this calls for no special description beyond that its crank case, which is of aluminium, is formed in one with the dynamo bed-plate so constituting a rigid bed. The ignition is by high-tension magneto, and the lubrication by pump circulation; the cylinder is provided with a water-jacket, the water, which is circulated by a pump, being carried in a small tank above the engine; for cooling purposes an ingenious form of radiator is employed; this consisting of six sections or disks embracing a rotary fan fixed to the flywheel. The petrol tank, which is centrally located above the radiator, has a capacity of one gallon, which is stated to be sufficient for a continuous run of about seven hours.

The dynamo or generator is of the reverse compound-wound type, having an output of 10 amperes at 70 volts, and is directly driven by the engine. The latter is put in operation by means of a pulley on the rear end of the dynamo spindle, the necessary initial impetus being given by a strap working on the pulley. The engine is fitted with a centrifugal governor which acts on the throttle valve in the carburettor; by means of a knurled nut and an adjustable spring the engine speed can be varied between wide limits.

The switchgear, which is entirely enclosed in an aluminium case mounted above the dynamo, is of the rotary type and furnished with outside operating handles; it is arranged to give any of the following combinations:—(1) off position; (2) battery to X-ray coil; (3) battery charging, and dynamo and battery in parallel to X-ray coil; (4) dynamo and X-ray coil only; (5) battery and dynamo in series to X-ray coil. The voltages to the coil are approximately:—No. 2 position, 36 volts; No. 3 position, 36-45 volts; No. 4 position, 75 volts; and No. 5 position, 110 volts.

Simplex Reflectors.

Messrs. Simplex Conduits, Ltd., of Garrison Lane, Birmingham, have introduced a new reflector, known as the "Anti-Zeppelin," made in enamelled steel, with a special diffusing reflecting surface inside. These are made in two types, "Extensive" and "Intensive," which terms define the light distribution, and are designed for both half-watt and ordinary metal filament lamps. The half-

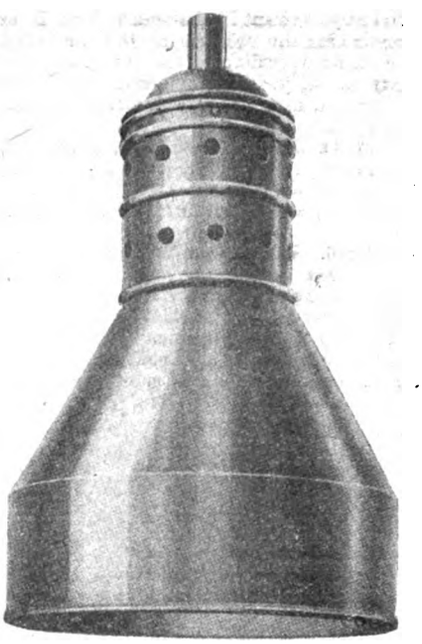

Fig. 4.—Anti-Zeppelin "Intensive" Reflector.

watt reflector is fitted with a tube, screwed ⅜ in. brass, of suitable length for 100-150-200-watt lamps. Upon removing this tube, the reflector is suitable for a Goliath holder for 300-watt lamps.

For ordinary metal filament lamps, the reflector is made with a 1¼ in. hole for attaching to the shade carrier holder; a special watertight holder can be supplied for outdoor use of these reflectors.

These "Anti-Zeppelin" reflectors are described in list No. 614, which also illustrates Simplex lanterns for half-watt lamps up to 1,500-watt size.

The "Overseas" Rectifier.

The Overseas Engineering Co., Ltd., of 75, Curtain Road, E.C., have introduced a patent electrolytic rectifier, principally for charging accumulators, for medical and X-ray work, electro-plating and running small motors. These are standardised for use up to 150 volts, above which pressure an auto-transformer is employed.

The rectifiers are constructed in four sizes for from 2 to 10 amps., the two smaller sizes consisting of a single earthenware cell, with a central anode in solution, while the two larger sizes are four cell rectifiers designed for continuous work and of heavier make.

The A.C. mains are connected direct with terminals on the apparatus, and the charging rate is regulated by means of carbon-

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filament lamps mounted on the rectifier itself for the 2 amp. size, and on a separate base for larger sizes; no charging board, resist-

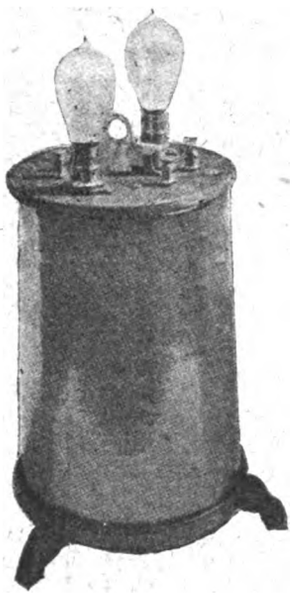

Fig. 5.—Small Electrolytic Rectifier.

ances or measuring instruments are necessary so that the cost of the installation is low.

Fig. 5 shows a small rectifier of this type.

Electrically-Operated Air-Regulating Device for Diesel Engines.

A substantial improvement in the operation of Diesel engines is obtained by regulating the pressure of the air which blows the fuel into the cylinder according to the amount of fuel blown in, the latter varying with the load. Such regulation is usually carried out by hand, demanding considerable attention on the part of the engine driver.

Messrs. Mirrlees, Bickerton & Day, Ltd., of Hazel Grove, Stockport, have, however, now introduced an automatic apparatus to obtain the desired result, which is made for either mechanical or electrical control, a description of the latter type being as follows:—

Referring to fig. 6. In this the current from the dynamo is passed round the coil (*a*) in such a way that this controls the finger (*b*) exactly as the finger of an ammeter is controlled by the current flowing through the ammeter. The finger, however, instead of pointing to ampere readings, is arranged to move round the scale of a pressure gauge, and point to that blast pressure which is best for the engine for the amount of power being gene-

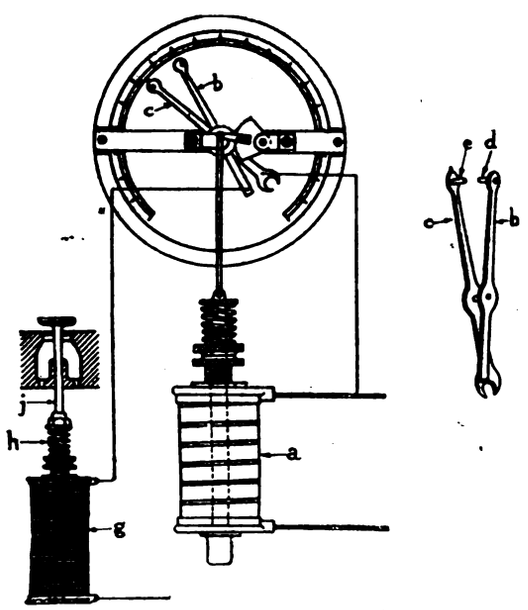

Fig. 6.—Air-Regulating Device for Diesel Engines.

rated at the moment. The pressure gauge shown is connected up with the blast pipe, consequently its finger (*c*) points to the blast pressure. Both fingers are provided with contact pieces (*d*) and (*e*) shown in detail in the small figure. The two fingers are insulated from each other, but are connected up with an electricity supply. The amount of current used is very small, therefore the fingers can if necessary be connected to a battery. The supply is also connected with the solenoid (*g*) in which the plunger (*h*) works. This plunger is connected with the stem of the air compressor throttle valve (*j*). Normally this throttle valve would be wide open and admit a full supply of air to the air compressor, in which case the pressure in the blast receiver would with any load on the engine rise rapidly, as the air compressors are always made with a substantial margin of capacity.

Supposing now that the engine is at work and that the pressure in the air receiver is lower than that indicated by the finger (*b*) as being the proper pressure for the load, the air compressor would pump at its full capacity into the receiver and rapidly increase the pressure, so causing the finger (*c*) to catch up to the finger (*b*) and make contact between the contact points (*d*) and (*e*). As soon as this occurs, current will flow through the solenoid (*g*) and the plunger will be drawn downwards into the solenoid, thus closing the throttle valve, and this valve will be held closed whilst the two fingers remain in contact. As soon as the pressure drops a little and the gauge finger (*c*) falls away from contact with the finger (*b*), then the circuit will be broken and the throttle valve will re-open. In this manner the pressure in the air receiver will be automatically regulated in accordance with the load on the engine.

The apparatus results in smoother running of the engine, less attendance, and in case of alternators run in parallel, both putting them into parallel and running them are facilitated.

Messrs. Mirrlees, Bickerton & Day have also recently introduced a crosshead type of Diesel engine (which was referred to in our issue of January 28th, page 116).

This construction is more costly than the trunk piston construction, but for large engines it has particular advantages in that piston troubles are reduced and trouble with connecting rod top-end bearings is decreased; cylinder wear is also lessened and lubrication improved.

The engine height is increased, but owing to the necessity with the trunk type of allowing headroom for withdrawing both piston and connecting rod clear of the cylinder, while with the crosshead type only the piston needs to be lifted clear, the height of the engine room will not necessarily be increased.

LEGAL.

Batteries from Holland.

Before the Recorder (Sir Forrest Fulton, K.C.) and a jury, in the Lord Mayor's Court, on January 27th, Mr. Isidore Grunhaus, fancy goods importer, of 142 and 145, Houndsditch, E.C., sought to recover the sum of £36 13s. 6d., the price paid for goods which were defective, and loss of profit on their sale, from Mr. A Franco, importer, of 10, Clothier Street, Houndsditch, E C.

Mr. E. Zeitlyn was counsel for the plaintiff, while the defendant was represented by Mr. C. J. Conway.

It was stated that in January of last year the defendant, who then had business in Holland, called on the plaintiff and asked him to store a number of dry batteries used in flash lamps. The defendant said that if the plaintiff could find a customer for the batteries he would sell them at 4½d. each. Some days later the plaintiff received an offer for the goods, and he wrote to the defendant at the Victoria Hotel, Amsterdam, offering to purchase them at 4s. a dozen, less 2½ per cent. discount. The defendant telegraphed back refusing to accept anything under 4s. 3d. per dozen. Finally the plaintiff agreed to purchase the batteries at 4¼d. each. He took over 4,800 batteries, received a three months' guarantee with them, and a discount of 3½ per cent. The price paid for the batteries was £81 16s. 3d. The plaintiff sold the batteries to Messrs. Rowarth Bros., of Norwich, who returned no less than 1,964 on the ground that they were defective. The plaintiff immediately informed the defendant that a large number of the batteries were "dead," and asked for others to be sent in their place. After some correspondence, defendant asked for the batteries to be returned to a firm in Amsterdam. The plaintiff, however, refused to send them back as requested, pointing out that he had dealt with the defendant, and did not know any other person in the matter.

In his evidence, the Plaintiff stated that he purchased the batteries at 4¼d. each, and sold them at 4½d. each. The Witness said he did not have much confidence in the defendant, as he had only sprung up since the war started. He told the defendant that it was usual to have a three months' guarantee with such goods. That was the custom of the trade, although some manufacturers gave a six months' guarantee

Counsel for the defence said he would not dispute that some of the batteries were defective, r that there was a guarantee given.

In cross-examination, the Plaintiff said that he was told by the defendant that more batteries were being sent over to replace the defective ones, but the ship in which they were consigned was sunk by the Germans. A second ship containing batteries was captured by the enemy. It was untrue that at the outset the defendant told him that the batteries were made by the Fabrik Metrom, of Amsterdam.

The Defendant, who said he was a Dutchman, and formerly traded in Belgium, said that at the outset he told the plaintiff that the goods were made by a manufacturer in Holland, who would guarantee every battery. At a later date, when he actually sold the goods, he told the plaintiff who the manufacturers were.

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The Recorder said that in the receipt which the defendant gave he signed his own name to the guarantee, and the name of the manufacturer did not appear.

The Jury returned a verdict for the plaintiff for the amount claimed, and judgment was entered accordingly, with costs.

Bergtheil & Young, Ltd., *v.* Lindley.

In the King's Bench Division, on January 27th, before Mr. Justice Atkin and a special jury, an action was brought by the plaintiffs against Mr. R. H. N. Lindley, of the firm of C. Lindley & Co., Ltd., tool makers, &c., Englefield Road, London, E., to recover damages from the defendant for an alleged slander which he was said to have uttered to a representative of the plaintiff firm at his business premises. The defendant denied that he uttered the words complained of, and he said if they were uttered they were spoken on a privileged occasion and without malice and *bonâ fide*.

Mr. Neilson appeared for the plaintiffs, and Mr. Dale represented the defendant.

Mr. Neilson said that the plaintiffs were electrical engineers in a large way of business. The alleged slander was a very serious one, as it was spoken of the plaintiffs in regard to their trade and business. The plaintiffs were an English company carrying on business here; they had large works at Parson's Green and Stoke Newington, and the slander they complained of was to the effect that they were a German firm. The plaintiffs employed many hands, and had had a deal of Government work, and it was a matter of great importance to them to have it made generally known that they were not a German firm. The plaintiffs had a Mr. Stent in their employ, and he had occasion to go to the defendant's premises about some lathe-chucks, and it was then that the defendant uttered the words complained of. The suggestion made now by defendant was that the words he uttered were in relation to his inquiries concerning the plaintiffs and their goods. The plaintiffs' complaint was that defendant said, with reference to their name:—"They are a German firm, and we will do no business with them whatever. They are a German firm, and it is a German name." It was asserted that the words were spoken on a privileged occasion, but it was not a plea of privilege to which he (Counsel) was accustomed. The jury would appreciate the extent of the harm that might be produced upon the plaintiffs' business by such a statement as this; its effects would be incalculable, and the plaintiffs desired that the true facts should be known. His clients were not out for money, and if Mr. Dale was ready to apologise now on behalf of the defendant, his clients would be satisfied. The plaintiffs employed about 1,000 hands. The company was a limited company registered under the Joint Stock Companies' Act in 1904. There were two directors only. Mr. Arthur Bergtheil and Mr. Edward Bergtheil, and all the people connected with the company, were English. The father of Mr. Arthur and Mr. Edward Bergtheil died in 1901, at the age of 82. He had lived in England since 1866. He came from Bavaria as a boy, and his sons, Edward and Arthur the present directors, were born at Paddington. The father, Mr. Bergtheil, was for some years a member of the Legislative Assembly of Natal, which involved his naturalisation. The plaintiff company was, therefore, an English company, and the slander was a very serious one. The name of the plaintiff company had now been altered to Berkeley & Young, with the consent of the Board of Trade.

At the close of Mr. Neilson's opening statement, Mr. Justice Atkin observed that it seemed to him that the object of the plaintiff's action was achieved, as it merely desired to give publicity to the true facts concerning the plaintiffs. Under these circumstances it seemed to him that something might reasonably be done to settle the matter. He would see counsel on both sides in private consultation if it was so desired.

After a consultation in Mr. Justice Atkin's room, it was announced that the case had been settled, and that the record in the action would be withdrawn.

Mr. Dale, addressing the Court, said that he wished to say on behalf of the defendant, Mr. Lindley, that he personally considered that he was justified in defending the action. There was no ground, the defendant thought, for the action to be brought at all, as he (Mr. Lindley) never uttered the words that were complained of, and he was only inquiring at the time as to the nationality of the plaintiff firm and their goods. If, however, by a certain construction the words that he uttered could be regarded as damaging to the plaintiffs, he was willing to say that he was sorry. He was ready to say that he was satisfied with the explanation given by the plaintiffs as to their nationality, and he did not suggest that they were anything other than a reputable English firm.

Mr. Justice Atkin said the settlement was satisfactory. It seemed to him that observations by Mr. Lindley in regard to the plaintiff company might have been misunderstood.

The record in the case was accordingly withdrawn.

Munitions Court Cases.

At a sitting of the Munitions Tribunal at Dundee on Friday, Frank Atkinson, electrician, asked a clearance certificate to enable him to leave an Arbroath controlled firm and accept service on urgent Government work. He stated that his work could be done by an older man, and he complained that his wages, £2 15s., were not sufficient in view of the amount of overtime he worked. In the event of breakdowns he was expected to work to any hour. He further stated that as the works were electrically driven they required great attention and he could not get time to make repairs. The Chairman said the certificate would be refused, and if Atkinson thought his wages were inadequate he could appeal to the Board of Trade.

At the Blackburn Munitions Tribunal on January 26th a Corporation employé—a cable jointer—asked for release from his work in order that he might join the Forces. He said he either wanted to enlist or to be given more work to do on munitions. A Corporation official said they would do their best to meet the applicant in this, and the man thereupon said he was satisfied.

At Oldham last week an electrical instrument maker employed at Hollinwood, complained that his release certificate had been unreasonably withheld by his employers. His case was that he was employed on the erection of house service meters, and not being on Government work, not having an official badge, and not being, as he alleged, in receipt of trade union rate of wages, he had applied for work which would place him directly on Government business, and would bring him in the trade union rate of pay. His earnings with the firm were 33s. per week and 3s. war bonus, and at his new place he was to get 39s. and 4s. war bonus. A representative of the firm said it was difficult to say exactly whether the man was on war work or not. Before a badge could be given to a man he must be substantially employed on war work, and, in his opinion, the applicant had been on war work during the past six weeks. He had been engaged on meters for munition works, power stations, or on meters for submarines. Mr. W. Sellars (chairman) said that whilst meters for submarines undoubtedly were war work, he was not satisfied that the making of meters for ordinary works and power stations could be considered war work. The firm's representative said the firm had undertaken to let any man not engaged on war work go into the Army. There was a suspicion that there was more behind the application than had come out. The applicant had a friend who had worked for the Hollinwood firm, and as he had not had good health, the firm offered to release him so that he could recuperate. He had since got a job in the south, and the firm there had written to the applicant and other workers at Hollinwood offering them jobs. The speaker added that there was an increase of 2s. due to the applicant, but he said he would rather go to the place where his friend was, as his health was not so good. The Chairman said that was an after consideration entirely. The application was refused.

Southampton Corporation *v.* Duguid.

At the Southampton County Court, the plaintiffs sued defendant for the cost, under a hire-purchase agreement, of electric fittings (£7 14s.) in the house occupied by him. From the evidence, it appeared that the house was previously occupied by a town councillor, and defendant agreed to take over the installation, it being promised that supply should be immediately connected if defendant paid £1 2s. 1d. then due. The next quarterly account for the installation was received, and he then said that he had only agreed to pay one sum of £1 2s. 1d. Defendant said he did not know when signing the agreement that he was making himself responsible for more than one single payment of £1 2s. 1d., and he paid that because he wanted to get into the house. He did not read the agreement, and there was no writing in the body of the agreement at the time. Later he heard from a Corporation canvasser that the amount of the alleged debt had been written off. The Judge, according to the *Hampshire Independent*, held that there was no agreement on the part of the defendant to pay the money.

An Irish Arbitration.

In this arbitration, to which we referred in our last issue, Mr. A. E. Porte has now given his award. According to *Freeman's Journal*. Mr. Brunker's claim was for £373, the balance of the contract and for extra work done.

The Marquess of Sligo made three counter-claims. He claimed a sum of £109 for alterations as to prices and deductions made by Mr. R. E. Mellon, the architect, from the contractor's accounts. A sum of £36 was allowed for this by the arbitrator. He claimed a further sum of £157 paid to Messrs. Edmundson's, Ltd., for completing work alleged to have been left undone by Mr. Brunker. The arbitrator allowed £62 5s. 3d. for this claim. The claim of the Marquess of Sligo for a penalty of £10 per week for delay was wholly disallowed. The Marquess of Sligo is to pay his own costs and the arbitrator's fees and expenses, and to pay five-ninths of Mr. Brunker's costs.

A 1,000-KW., 1,000,000-Volt Transformer.—According to the *Electrical World*, C. H. Thordarson, of Chicago, erected in the Exposition Grounds, San Francisco, a 1,000-kw., 1,000,000-volt transformer for 60-cycle operation. The windings were submerged in a 225-barrel concrete tank of oil, and the transformer complete weighed 30,000 lb. The low-tension 2,200-volt coils, of which there were 122, were connected in pairs across the 2,200-volt supply mains, with their midpoints grounded to the transformer frame. The 1,000,000-volt winding consisted of 190 coils wound with flat aluminium conductors insulated with paper. Some 90 miles of aluminium conductor and 270 miles of paper ribbon were used in the construction of the high-tension winding. Mr. Thordarson estimated the cost of the transformer at $30,000, including special winding machinery.

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WAR ITEMS.

The Question of Electrical Concessions in Russia.—According to a report published in the principal German commercial newspaper, no companies in Russia at present are in a more difficult situation than those which are engaged in the supply of energy for lighting and power purposes, including tramways. The annually increasing profits of these companies, which are mostly equipped with foreign capital, are said to have aroused, in the case of the State and the municipal councils, the desire to take advantage of the existing conjuncture of war by expropriating these profitable undertakings at as little cost as possible. We can understand an object of this kind when aimed at ventures in which German interests are chiefly concerned, but as a large amount of Belgian and French capital is also invested in these classes of undertakings in Russia, we assume that the Teutonic statement of the case, although it does not specifically mention any nations other than Russia and Switzerland, applies solely to companies in which German capital has exercised control in the past. At any rate, a dispute is reported to have arisen between the Government and the local authorities as to the future ownership of the supply works and tramways. At present two official projects are in opposition to each other. The first has been prepared by the Minister for Home Affairs, who proposes the compulsory transfer to the cities and towns of electrical undertakings which are of public interest. On the other hand, the Minister of Commerce is credited with a scheme for conferring upon the State a monopoly for granting concessions for these undertakings, and stipulating also that the owners of existing concessions must apply to the State for a concession to continue their business. The latter project is declared to have evoked great opposition in technical circles, and the Society of Engineers and Electro-technics, of Petrograd, has raised a protest against it. The scheme, which would deprive certain towns of large receipts, also contemplates the imposition of conditions which are much more unfavourable than those hitherto fixed in the case of concessions, and which would tend to check applications for such privileges. On one point only are the State and the local authorities said to be in agreement, namely, that the compensation to be paid to present holders of concessions shall be as little as possible; and both schemes proceed from the idea that a kind of expropriation has become necessary in the public interests. It is contended that the working of concessions is only right according to form, but that in fact it is the usurpation of a right devolving upon the general community, and the immediate and forcible rupture of the concessions would only represent the establishment of normal legal conditions. On this basis the companies would only be compensated for the fixed and movable assets in the shape of stations, cables, etc., but would receive nothing for the loss due to the stoppage of the concessions. It is stated that this principle has already found expression in practice in the case of the Kieff Tramway Co., whose works and rolling stock have been municipalised against the company's wish; and whilst the company claimed £2,100,000 by way of compensation, the City Council, excluding any indemnity for the concession, is only willing to pay £750,000. The report also refers to the well-known case of the Moscow Supply Co.—the branch of the Petrograd Electric Lighting Co. of 1886—although in this instance the Moscow City Council some time ago offered to pay a moderate compensation for the unexpired term of the concession. More recently, however, the Town Council has sought to secure a reduction in the charges for supply from the State sequestrator, and the German suggestion from this fact is that the nearer the business of a supply undertaking is brought to the state of ruin the better will be the prospects of the Russians acquiring it at a "slaughter price."

Trade After the War.—Opinion is becoming more divided as to whether, at the conclusion of the war, Germany will be ready immediately to enter upon a trade war. Mr. T. Russell, speaking at the Rotary Club, Edinburgh, on the probable condition of trade after the war, said (according to the "Financial Times"):—"At the close of the war, Germany would not be ready to compete. Germany was short of materials. Before she could dump goods she must obtain the material to make them with—and means to pay for them. Many of her factories were closed already. Competition after the war would come from America long before it came from Germany."

Enemy Shareholdings in Australia.—Reuter's representative at Melbourne reports that the Federal Executive has approved regulations for the wiping out of enemy and naturalised shareholders in public companies and making the transfer of their shares to the Public Trustee until a year after the war obligatory. Before April 15th enemy shareholders may apply to the Attorney-General, after transfer, to have their shares sold, and they will receive the proceeds. The regulations provide for the payment of dividends on enemy shares to the Public Trustee after allowing reasonable living expenses.

Swedish Export Prohibitions.—An order has just been issued by the Swedish Government prohibiting the exportation from the country of insulating composition containing asbestos and manufactures of such composition.

Enemy Firms in India.—In the House of Lords last week, according to the "Daily Telegraph," Lord Sydenham asked the Under-Secretary of State for India whether effective steps had been taken to put a stop to enemy trading in India, and gave an instance of such alleged trading at Bombay. Lord Islington, in reply, said the orders dealing with this matter laid down broadly that all hostile firms in India should cease to trade except under licence by the Government of India. The House might rest assured that the Government of India would actively co-operate with the Home Government in carrying out the intention of preventing these enemy firms from remaining permanently amongst us.

Prohibited Exports.—The exportation of pocket-lamp cases and cases fitted with bulbs, but not containing batteries, to all foreign countries in Europe, and on the Mediterranean and Black Seas, other than France, Russia (except through Baltic ports), Italy, Spain, and Portugal, is prohibited.

BUSINESS NOTES.

Book Notices.—*Aeroplanes and Airships.*—By W. E. Dommett. London: Whittaker & Co. Price 1s. net.—Like the book on "Submarine Vessels," by the same author, this is a popular and elementary book for the edification of the general reader, but being the work of an author who knows his subject, is not so "popular" as to be without interest to an engineer. It deals with the principal features of aircraft of all kinds in an entertaining and instructive manner, and is quite suitable for those who, not having time to study the subject fully, yet desire to have sound general ideas upon it, and to be in a position to understand the nature and bearing of new developments. The only feature of the work to which we take serious exception is the author's literary style, which in many places is really shocking. What, for instance, is an "increasing fitment," and how is it "practised"? We learn that "smokeless powder is used which makes it very difficult for the location of an artillery battery," and the aerial bombardment of German submarines in Ghent Harbour is mentioned as an operation frequently performed. There is a canal there, but does the author really mean Ghent? If the author would have his proofs read by a competent friend, the pleasure of reading his book would be very greatly enhanced.

Excess Profits Duty and Excess Mineral Rights Duty. By R. M. Montgomery and W. Allen. London: Butterworth & Co. Price 7s. 6d. net.—In this book the authors give an explanation of the Finance (No. 2) Act, 1915, which imposed the new War Tax known as the "Excess Profits Duty." The chief provisions of the Act are explained in due order, and instructions are given as to finding whether the profits of any business are liable to the duty, and the amount of the latter. The Act is also analysed and discussed in detail, and, finally, the complete Act is printed without notes, for convenience of reference. The book should be found very useful by those in charge of the accounts of firms which come within its scope.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXV, No. 1. January, 1916. New York: The Institute. Price $1.

"Technical Paper of the Bureau of Mines," No. 123. "Notes on the Use of Low-Grade Fuel in Europe." Washington: Government Printing Office.

"A Meteorological Treatise on Circulation and Radiation in the Atmospheres of the Earth and the Sun." By F. A. Bigelow. London: Chapman & Hall. Price 21s. net.

"*Journal* of the Institution of Electrical Engineers." Vol. LIV. No. 255. February 1st, 1916. London: E. & F. N. Spon, Ltd. Price 3s. 6d.—This issue contains the following papers:—"Predetermination of the Performance of Dynamo-Electric Machinery," by Prof. Miles Walker; "Proposed Standard Numerals for the Scales of Measuring Instruments," by Mr. A. P. Trotter; "Hydro-electric Power in New Zealand," by W. Wilson.

"Experimental Wireless Stations." By P. E. Edelman. Minneapolis, Minn, U.S.A.: P. E. Edelmann. Price $1.50.

The Import Trade of India.—The Board of Trade *Journal* publishes the following figures taken from a report of the Director of Statistics to the Indian Government:—

12 months ended July 31st,	1913. Rupees.	1914. Rupees.	1915. Rupees.
Railway plant and rolling stock	76,214,500	112,766,200	76,445,400
Metals—Iron and steel, and manufactures thereof ...	138,263,000	156,234,500	77,992,900
Machinery of all kinds, including belting for machinery	69,810,300	82,839,200	54,833,200
Cutlery, hardware, implements (except machine tools), and instruments ...	59,594,700	62,957,500	35,054,500
Metals, other than iron and steel, and manufactures thereof	45,627,000	65,181,500	25,630,500

Rupee at par = 1s. 4d.

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Catalogues and Lists.—GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, London, E.C.—Leaflet announcing altered prices of ignition dry batteries (Hellesen) consequent upon the new import duty on "motor accessories," and the decision of the Customs authorities that these batteries come under that heading. New pamphlet (R 1,951) of eight pages, giving illustrations and prices of Robertson carbon-filament lamps for various classes of illumination, flame or candle lamps, tubular lamps, heating lamps and battery lamps. A number of views are given of the Osram-Robertson lamp works and the glass works at Lemington-on-Tyne.

MESSRS. SIMPLEX CONDUITS, LTD, Garrison Lane, Birmingham.—Illustrated circular (No. 416) giving particulars and prices of Anti-Zeppelin reflectors for half-watt and metal-filament lamps, also Simplex lanterns for half-watt lighting in shops, factories, &c.

MESSRS. MIRRLEES, BICKERTON & DAY, LTD., Hazel Grove, near Stockport.—12-page pamphlet containing a full and illustrated description of Mirrlees-Diesel engines of their new "Crosshead" type. Also a list describing their electrically-operated air regulating device for Diesel engine compressors.

BRITISH THOMSON-HOUSTON CO, LTD., Rugby.—12-page illustrated price list (No. 5,100 A) describing their starting resistances for D.C. motors.

MESSRS. A. D. RILEY & CO, Ltd., of Wellington, N.Z., have sent us a pamphlet containing a reprint of a description of the municipal sewerage system of Petone, N.Z., for which they were the contractors, with Mr. Wilson Ormrod, A.M.I.E.E., as their engineer.

THE EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD., of Ponder's End, have prepared for advertising purposes what they term "Current Economy Correspondence Cards." The firm's trade customers will be able to obtain quantities printed with their own name and address so that the reply half with the order reaches them.

The Growth of Mazda.—Production has been so greatly increased in the lamp works at Rugby that new plant has trespassed on the normal storage space, leaving insufficient room to accommodate the stock. The B.T.H. Co. has, therefore, taken over the Rugby skating rink to provide more storage capacity. The annexe itself is already crowded, and a second floor has to be built immediately to facilitate working in the building and add to its capacity. At the same time the existing medley of lighting devices will be replaced by high-efficiency units on the well-known B.T.H. principle. The Mazda lamps are taken by an electric automobile to the new store, which is situated very near the railway station, thus ensuring rapid dispatch.

Board of Trade Exhibition.—The Board of Trade Exhibition in London opens on February 21st, and will continue until March 3rd. At Stand No. A 16, MESSRS. WARD & GOLDSTONE, notwithstanding that they are full up with work and are under Government control, will be, by special permission, exhibiting a large variety of their manufactures, principally of goods which, previous to the war, were made almost entirely in Germany. The exhibit will include a large range of electric pocket lamps, torches, refills for same, hand lamps, electro-medical apparatus, &c., also electric appliances for the car and garage.

Liquidations.—AUTOMATIC ELECTRIC BLOCK SIGNALLING CO, LTD.—A meeting of creditors is called for February 9th, at 10, Victoria Street, S.W., to hear an account of the winding up from the liquidator, Mr. A. Colls.

SHEFFIELD ELECTRICAL ENGINEERING CO., LTD.—A meeting is called for February 29th, at Ashton-under-Lyne, to hear an account of the winding up from the liquidator, Mr. H. Cawood.

Trade Announcements.—The business of VENNERS SIGNS, LTD., is being continued at 6, Old Queen Street, Westminster, S.W., under Mr. Battson.

THE EBURY ELECTRICAL ENGINEERING CO., of 80, Ebury Mews, Victoria, London, S.W., have been appointed British agents for the Dyneto electric lighting and engine starting sets for motor cars.

MR. E. J. JARVIS, electrician, of 48, Mutley Plain, Plymouth, announces that he is retiring from business.

THE PALMER ELECTRICAL CO., who represent the Nya Fjerenade Elektriska, of Sweden, state that they hold a stock of electrical supplies, motors, &c., at their new address at 52, High Street, London, W.C.

Prices Advance.—THE JACKSON ELECTRIC STOVE CO., LTD., announce a further increase of 10 per cent. in all their prices consequent upon the continued increase in prices of raw material and labour.

Bankruptcy Proceedings.—G. E. BONNER, electrical engineer, Palmer's Green, Middlesex.—First meeting, February 11th, at 14, Bedford Row, W.C.; public examination, February 21st, at the Court House, Edmonton.

For Sale.—The Corporation of Nuneaton has for disposal one 170-KW. Willans-Siemens direct-coupled D.C. generator, 350 amperes, 460 to 500 volts. The Tramways and Electric Lighting Committee of Swansea has for disposal the following electrical plant:—One 100-H.P. Willans & Robinson engine direct coupled to a 75-KW. Siemens-Schuckert 440/460-volt shunt-wound D.C. generator, and one 300-H.P. McLaren marine type engine, direct coupled to a 225-KW. Siemens-Schuckert 440/550-volt D.C. compound-wound generator, complete with a Yates & Thoms jet condensing plant. See our advertisement pages to-day.

An Inquiry from Canada.—H.M. Trade Commissioner in Canada reports that a manufacturers' agent in Montreal wishes to get into touch with United Kingdom manufacturers of electrical goods, and he desires to receive catalogues, price lists, &c. (Reference No. 16.) Apply to the Board of Trade Commercial Intelligence Branch, London.

LIGHTING AND POWER NOTES.

Accrington.—PROPOSED EXTENSIONS.—It is anticipated that owing to the rapidly increasing demand, extensions to the electricity works, involving an outlay of £25,000, will need to be undertaken by the Electricity Committee in the near future. A special meeting of the Committee is being called to consider the matter.

Australia.—MELBOURNE WIRING SCHEMES.—Although the City Council rejected the proposal to install electricity in city buildings under which the Council would be reimbursed in 30 monthly payments by the owners, the Electricity Committee has had under consideration and has recommended another scheme based on the hire-purchase system. The Committee is of opinion that unless some scheme is devised for assisting owners to wire the comparatively old premises in the city, the supply of current to these will always be very limited notwithstanding the low rates of charge for electricity for lighting, which are the lowest in Australia. After investigation and examination of similar schemes in other parts of the world, the Committee considers that it is desirable for the Council to introduce a hire-purchase scheme for the wiring of houses in the city, viz., at the signing of the agreement 10 per cent. of the estimated or ascertained cost of the installation to be paid, and the balance of cost in equal quarterly instalments plus interest at the rate of 6 per cent. on the amount outstanding. On the assumption that each year 500 installations of the average size are wired, the annual outlay on the part of the Council would be about £3,500. The Committee also considered a scheme providing for the hiring out of electric motors, electric irons, heating, cooking, and other electricity consuming devices. The Sydney City Council electric supply department have to-day on hire to consumers 2,546 electric motors, aggregating 12,160 H.P., at a capital cost of £60,000; the Committee considers that increased revenue from the sale of current in this direction, under Melbourne conditions, would produce about £50,000 per annum. So far as electric cooking is concerned, the Committee is disposed to wait until a supply of reliable and reasonably priced cooking apparatus is available on the market before extending the scheme in this direction, realising that in order to foster a demand for electricity for cooking, it would be necessary to arrange for the hiring out of cookers to the consumers. As the Council's statuary powers are restricted to the supply of electricity, it will be necessary to apply to Parliament for additional powers to cover the propositions recommended in the report.—*Australian Mining Standard.*

In connection with the West Australian power plant now being erected at Perth, the Federal Council of the Electrical Association of Australia has made representations to the Premier of West Australia on the desirability of maintaining a 50-cycle frequency throughout Australia, but it is said that the 40-cycle scheme is too far advanced to revert to the generally accepted Australian standard—*Commonwealth Engineer.*

The Long Reach Electric Lighting Co. (Queensland) has been formed to utilise the pressure from the local artesian bore to generate electricity for lighting the town, and has applied to the Council for its consent to an Order in Council being granted for this purpose.

The Hamilton (Queensland) Council has decided to instruct an electrical engineer to prepare plans for lighting the town with electricity.

The Kilroy Shire Council (Queensland) is also applying to the Government for a loan for the purpose of an electric light installation.—*Tenders.*

Birkenhead.—REVISED PRICES.—The T.C. has revised charged for current as under:—In the borough, ordinary lighting, 4d. per unit, plus 10 per cent.; ordinary power and heating, first 1,500 units per quarter, 1½d. per unit, plus 10 per cent.; beyond, 1d., plus 10 per cent. Prepayment meters, increase from 4½d. to 5d. Outside the borough, ordinary lighting, 5d., plus 10 per cent.; ordinary power and heating, 2d., plus 10 per cent.; prepayment meters, increase from 5½d. to 6d.

Bolton.—The L. & Y. Railway has agreed to bear the cost of new mains in Rake Lane to serve the company's new electric power station at Clifton Junction.

Chelmsford.—PUBLIC LIGHTING.—The T.C. has so far failed to come to a definite arrangement with the Electric Supply Corporation, Ltd., as to payments for public lighting on account of the restricted use of lamps. The company offered a rebate of £700 per annum, but the Council wishes to pay only £330 per annum, or a *pro rata* amount for any shorter term whilst the lamps remain extinguished. The company declined to agree to this proposal, but intimated that if an arrangement was made as to a new contract when the present one expires next March, it would probably be prepared to agree to the Council's proposals regarding payment under the existing contract. The question has been referred to a Sub-Committee, which is to confer with the company regarding the suggested new contract.

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Canada.—The electors of the city of Edmonton have approved the agreement between the city and the Edmonton Power Co. for a supply of electricity to the city for a period of 30 years on a KW.-hour basis, the price varying from 1·3 cents down to ·85 cent per KW.-hour, depending on the quantity taken.

The Edmonton Power Co. controls the water rights of the Saskatchewan River at Rocky Rapids, but on account of bad regulation in this district, dams will have to be built further up the river, and one of these will be placed some 10 miles back from the power house. The scheme of development at this point, including adequate water storage, has been under consideration for about three years, and some 60 square miles of land have been surveyed, and will be cleared and prepared for an artificial lake to impound the necessary water. The scheme is estimated to cost $6,000,000, this including an electric railway from Edmonton to the power site; the work will take probably four or five years, but the company has offered to at once take over and operate the present steam plant and sell electricity at 1·3 cents per KW.-hour to the city, which is to be responsible for the capital charges. It is estimated that the present generating cost of power in Edmonton is approximately 2·75 cents per KW.-hour, exclusive of distribution charges.—*Canadian Electrical News.*

China.—A SHANGHAI REPORT.—Mr. A. H. Preece, of Messrs. Preece, Cardew, Snell & Rider, consulting engineers, has recently reported to the Shanghai Municipal Council on the progress of the electrical undertaking and future plant extensions required to keep pace with it. So rapid has been the increase in output, that Mr. Preece forecasts annual additions of 10 or 20 million units, the annual demands increasing every year by 4,000 or 5,000 KW. As regards lighting units only, Shanghai increased from 5·4 millions in 1912 to 14·7 in 1915; that is, it is well ahead of Birmingham, and equal to Manchester in 1911.

In the matter of power units, over 30 millions have been added in three years. The expansion of the undertaking is regarded as inevitable, and it is only necessary to decide on the most suitable plant. New power consumers will reach 4,850 KW. in 1916, and there is evidence that in 1917 a further 3,000 or 4,000 KW. will be required, this being distinct from domestic lighting, heating and power, which has averaged an addition of 2,000 KW. for five years. Summarising the position, future maximum loads are anticipated of 19,000 KW. in 1916, 23,000 KW. in 1917, 26,500 KW. in 1918, 30,000 KW. in 1919, and 33,000 KW. in 1920.

The present capacity of the Riverside and Fearon Road stations is 18,400 KW., which, allowing one 5,000-KW. set as spare, leaves the maximum safe output at 13,400 KW. Mr Preece concludes from the conditions that the maximum load must be supplied from the Riverside station in future, and that this justifies the provision of at least 20,000 KW. of new plant there, making a total capacity of 34,000 KW. of plant installed; to obtain the 20,000 KW. of new plant he advises the immediate installation of a 5,000-KW. turbine set, also that orders be placed for (*a*) one 10,000-KW. and one 5,000-KW. sets, or (*b*) two 10,000-KW. sets, or (*c*) one 10,000-KW. and one 7,500-KW. sets; a 10,000-KW. set is regarded as essential, and should be ordered at once.

Mr. Aldridge's estimate of March, 1915, for extensions amounted to Tls. 2,276,772, but including the cost of the 5,000-KW. set, the total will amount to Tls. 2,650,000, which will be spread over 1916, 1917 and 1918. By the latter year there will be some Tls. 10,000,000 invested in the undertaking, and Mr. Preece considers that there is little doubt that by then the output sold will have reached 100,000,000 units. He further estimates that as the average selling price will be about c.2·7, and the present price is c.3·28, there is every prospect of reduced prices to lighing consumers.

The report as reproduced in *Eastern Engineering*, concludes with a suggestion as to distributing a portion of the profits of the undertaking for the general benefit of all ratepayers. Owing to the community controlling the undertaking, fresh capital can be raised at 5½ per cent. or so, as against say 7½ per cent. if the undertaking were a private concern; in consequence, it is suggested that the community is entitled to charge interest at say 1 per cent. on the money found by it. The effect of this would have been to raise the interest charge in 1914 to Tls. 34,190 instead of a dole of Tls. 30,255, and in 1915 a similar amount instead of about Tls. 35,000. and he recommends its adoption.

It is reported that a British firm has arranged to install an electrical plant at Handaohedzu, on the Chinese Eastern Railway, 170 miles east of Harbin. The plant will provide for several thousand consumers and street lighting.

Continental.—ITALY.—Cabanzaro, with a good part of the province of Calabria II., are about to be supplied with electricity from a large hydroelectric plant, the plans of which have just been completed. The scheme contemplates the enlarging of the small existing plant at Mongiana and Sera S. Bruno to supply the whole of the province, the use of the waters of the Rivers Allaro and Vazzallaro, and the erection of four high-pressure lines. Signor Gino Canzio is responsible for the scheme.

The projected amalgamation of the Società Anonima Elettrica Veronese and the Società Canale Milani has been postponed owing to the opposition of the minority of the shareholders. The scheme is to be submitted to a competent court.

Dover.—NEW LOANS, &C.—The T.C. has decided to apply for a loan of £4,000 for cables necessary to carry out a special contract, for the same purpose the loaning authority has agreed to renew a loan of £157,519 for five or seven years, with option to repay at the end of five years at six months' notice. The Council has accepted tenders for large and small cable.

Exeter.—WORKHOUSE LIGHTING.—The B. of G. has adopted a report of the surveyor for dealing with the electric lighting of the workhouse, and has decided to advertise for tenders for Block 3 in the scheme.

Haslingden.—BULK SUPPLY.—Provisional arrangements have been made, with the consent of the Accrington Corporation, for obtaining an additional supply of electricity from Rawtenstall, to supplement that obtained from Accrington. Haslingden is under an agreement to take all the current it requires from Accrington, but as the latter is unable to give a regular supply at present, the two towns have mutually agreed on this course.

Herne Bay.—E.L. SCHEME.—The Gas and Electricity Co. has asked the U.D.C. to consent to a further extension of time for carrying out the E.L. scheme for the town, and the clerk to the Council has been deputed to discuss the matter with the directors, and report.

Hornsey.—PRICE INCREASE.—The B.C. has increased the price of electricity, from March 31st, by 10 per cent.

India.—The Council of Regency, Bahawalpur State, has decided to give the City of Bahawalpur a public supply of electricity for street lighting and private use. Acting on the advice of the electrical engineer to the Punjab Government, the contract for the generating plant has been placed with Messrs. Balmer, Lawrie & Co., of Calcutta.

Kingsbury.—At last week's meeting of the U.D.C., the Clerk said the North Metropolitan Electric Power Supply Co. had made the Council a small allowance in respect of unlighted lamps, but this had been considered insufficient. A similar point had also been raised by another municipal body, its contention being that it ought not to pay for what it had not received. The case was taken to the High Courts, but judgment had been reserved. Having regard to the fact that the decision would no doubt have a considerable bearing on the position of affairs at Kingsbury, the Clerk thought it would be far better to allow any further report upon the question to be held over. The Council agreed to this course.

Liverpool.—YEAR'S WORKING.—The total income of the City Council's electricity undertaking for the year ended December 31st last, amounted to £345,808, of which £216,733 was in respect of the sale of energy for lighting and power, £118,824 for tramway supply, and £1,592 for public street lighting. Meter rentals brought in another £4,622, while £2,169 is credited in respect of sales and repairs in connection with installations. Expenditure during the 12 months totalled £136 249. Of this sum £60,868 is entered as generation expenses; £10,525 for distribution; £38,439 for rents, rates and taxes, and £16,497 for management expenses. The balance (£209,558) has been carried to net revenue account, where £50 is added as interest. Against the total is debited £65,749 in respect of interest; £57,635 transferred to sinking fund; and £36,233 transferred to renewal fund leaving £50,000 to be given in aid of the general rate.

The electric supply estimates for the present year provide for an expenditure of £57,191 on the reserve and renewal account, as compared with an actual expenditure of £34,133 in 1915, and £81,516 in 1914. On revenue account an expenditure of £214,837 is provided for, against £171,165 and £145,648 in 1915 and 1914 respectively. It is estimated that expenditure on capital account will amount to £17,167, but in regard to £15,000 of this money the sanction of the Treasury has to be obtained. Last year the expenditure was £2,344, and in 1914, £26,974.

London.—SOUTHWARK.—The Electric Light Committee reports that it has found it necessary to again revise the scale of charges for lighting and power. It is anticipated that the alteration in the scale, together with the various revisions, will show an increased income of £5,796.

Manchester.—PLANT EXTENSIONS.—The L.G.B. has sanctioned the proposal to divert £83,000 of the sum authorised in respect of the Barton scheme for the purchase of machinery to be installed temporarily at the Stuart Street station, in order to relieve the congestion and heavy loads. When the Barton scheme is completed it is probable that this plant will be transferred to the new station.

The coal question is no longer a source of anxiety to the electricity department. Coal is being obtained from Northumberland, the extra price paid being balanced by the higher electricity rates and the augmented consumption of energy.

During December last there was an increase in consumption of nearly five million units of electricity as compared with December, 1914; the increase of the power load was 24 per cent.

New Zealand.—The Ohakune B.C. is considering the installation of an auxiliary generating set as a stand-by to its hydro-electric plant, which was described in our pages of December 17th, 1915.—*Tenders.*

The Riccarton B.C. has decided to borrow £3,300 for electrical reticulation and £200 for wiring private installations.

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New Zealand.—British *v.* American Tenders.—Tenders for the supply of transformers for the electricity department of the Auckland City Council were recently received by the Public Services Committee, and passed on to the electrical engineer, who was informed that the Committee was prepared to consider only British-made goods. The engineer favoured an American tender as it was strictly in accordance with the specification, was complete, and offered material of a high class and a reasonable time of delivery. He said he could only recommend acceptance of English goods if the firms gave a satisfactory promise of delivery at their own works in 12 weeks. If this were done he was prepared to recommend the acceptance of tenders from English firms.

The Committee left the matter in the hands of the Mayor to act after communication by cable with the English firms mentioned.

Ripponden.—The Ripponden Commercial Co., Ltd., is on the point of installing electrical driving, by which it is hoped to save the cost of from 50 to 60 tons coal weekly. One room is to be taken at a time, and each room will have its own motor.

Salford.—Proposed Loan.—The Electricity Committee has recommended that application be made to the L.G.B. for sanction to borrow £18,660 for extensions of plant at Frederick Road station.

The Committee has entered into a new agreement with the Lancashire Electric Power Co., for the supply of electricity in bulk for a period of two years.

The proposed increase of the charges for electricity is to be considered by the Council at its next meeting.

Shipley.—Price Increase, &c.—The U.D.C. has increased the charges for electricity for power purposes by 10 per cent., from April 1st. This does not apply to cases covered by special agreement.

The Electricity Committee has deferred consideration of an inquiry from Messrs. C. F. Taylor & Co. as to a supply of electricity to Lower Holme Mills, Baildon, until it has been ascertained whether the Baildon U.D.C. would consent to the Council supplying electricity in the Baildon area.

Plant Inauguration.—On Wednesday last a new three-phase turbine set, together with switchgear, boiler plant, &c., at the Council's generating station, was to be officially started up, the proceedings being followed by a dinner at the Institute, Saltaire.

Stoke-on-Trent.—New Plant.—The T.C. has decided to install transforming equipment for a sub-station at the California Works of Messrs. Kerr, Stuart & Co., Ltd., and sanction to the borrowing of £1,200 has been applied for for that purpose, and has been provisionally procured.

Sunderland.—E.L. Estimates.—The estimates of the Corporation electricity department show that the income for the year ending March 31st next, is estimated at £72,102, compared with last year's estimate of £72,361, and £73,517 the sum actually received. The sale of electricity is expected to realise £67,048, compared with last year's actual income of £65,526. A decrease is allowed for in private heating and lighting, the estimate being £16,092, while last year's actual figure was £17,764. Power is expected to give an increased receipt, the figure being £36,858, against £33,640 last year. The total working expenses are expected to be £37,818, against £34,271 estimated for last year, and £34,382 actually spent. There is a considerable increase allowed for in the cost of coal, owing to the war, the estimate being £16,148, compared with £12,479, the actual cost last year. The total expenses are put at £41,306, against £40,090 the actual expenditure last year. There will, it is expected, be carried to net revenue and appropriation account £30,796, against £33,426, the actual amount realised last year. This balance will be apportioned as follows:—Repayment of loans, £17,612; interest on loans, £10,099; interest on lands and redemption, £157; contributions to capital, £963; income-tax on profits, £968; leaving for the renewals fund £995, as compared with £4,653, the amount placed to the renewals fund 12 months ago.

Whitby.—The U.D.C. has concluded arrangements for extending the electricity mains in High Stakesby, contracts for current for a period of years having been entered into with the proprietors of St. Hilda's School, the Manor House and Sneaton Castle.

Wigan.—Proposed Extensions.—The General Purposes Committee has adopted a resolution recommending the T.C. to engage the services of an expert electrical engineer to report upon the Corporation electricity works and upon a proposed scheme involving an expenditure of about £30,000 on new plant. This scheme, which has been under the consideration of the E.L. Committee for several weeks past, is for the provision of an additional 3,000-kw. turbo-alternator, a surface condenser, two rotary converters, one additional water-tube boiler and certain accessories, and the estimated total cost is £30,450.

Whitstable.—The U.D.C., which has undertaken the the generation of electricity for public use for the Electricity Co. at the sewage pumping station, has informed the debenture-holders that the work will be discontinued unless certain payments due are paid by a certain date. Regarding the public lighting contract with the company, the latter has offered to accept 35s. per lamp for the period of the war, and counsel, whose opinion on the contract has already been sought, is to be consulted as to the offer.

TRAMWAY and RAILWAY NOTES.

Continental.—Italy.—The Società Tranvie e Imprese Elettriche is seeking a concession from the Provincial Deputation and the Ministry of Public Works for two lines of electric tramways running respectively from Castellanza, through Olgiate and Cassano to Gallarate and from Gallarate through Lenate and Pozzolo to Oleggio. The necessary surveys for these lines have already been made.

The Central Umbrian Railway, now being provisionally worked with steam traction, will be equipped with electric driving power next year. The current will be supplied to Papigno by the Società del Carburo di Calci. From Papigno three-phase current will be supplied to Marsciano transforming station for conversion to single-phase current. The electric traction will be effected by locomotives, driven by four single-phase motors geared to the axles, each motor of 90 H.P.

The new goods locomotives of the Società Elettrica Bresciana have been built in the works of Messrs. Carminati e Toselli, of Milan, and equipped by the firm of Galileo Ferraris. They are equipped with four coupled motors of 80 H.P. each.

An influential meeting of syndics and other representatives of cities and towns around the Lake of Garda met recently to consider a scheme of extension of the Mantua-Peschiera electric railway. After a long discussion, it was decided to memorialise the Government for the concessions for extensions from Verona and from Peschiera to Lazise and Riva, *via* Mori and Rovereto. The promoters of the scheme have in view the great concourse of tourists that will be attracted to the shores of this beautiful North Italian lake, where the success of Italian arms will have freed the remainder of the Trentino from Austrian overlordship, as well as the knitting of ties with the reconquered territory.

Dudley.—Tramway Accident.—A second death has occurred as a result of the tramway accident on January 16th, and the inquest formally opened by the Wolverhampton coroner, has been adjourned until February 14th.

Failsworth (Lancs.).—Inquest.—On Tuesday an inquest was held on Martha Wilkinson, who received fatal injuries in the tramway smash at Radcliffe recently. Harry Pusey, driver of the runaway Bury car, said that when he got half way down the hill on Radcliffe New Road, the car was travelling at about 12 miles per hour, or two miles under the limit allowed; he tried to pull up at the stopping place, but the car commenced to skid, and he attributed the accident to the skidding of the wheels, and to the rails being in a treacherous condition. The car had been all right previously. A passenger thought that just before the collision with a van the car would be travelling at 30 miles per hour. A verdict of "Accidental death" was returned, and the driver was exonerated from blame.

Ilford.—Year's Working.—The somewhat belated though instructive report of Mr. L. E. Harvey, the tramway manager, on the working of the Council's tramway undertaking for the year ended March 31st last, shows that there was a deficit of only £21, as compared with a loss of £3,567 on the previous year's operation. The total receipts, £31,981, were £6,188 more than in the previous year, due to the running on the lines leased from Barking and to a reduction in 'bus competition. The car mileage 877,813, shows an increase of 45,918, and the passengers carried numbered 9,203,077, as against 8,036,552 in 1914. We note that the Edison electric tower wagon has been continuously in work, with the most satisfactory results; it has saved time in getting to breakdowns and has been largely used for conveying stores, &c. Mr. Harvey adds his conviction that it would pay the department to invest in a 2-ton electric wagon for permanent way use in place of hiring horses as at present for hauling and cartage work. It is believed that the present year will show a profit on the working of the undertaking, for the receipts are considerably in advance of the previous year's takings.

Lancashire.—A correspondent, writing on the shortage of tramway conductors in South Lancashire, says that this is due mostly to them obtaining far better-paid work in the local collieries, and not, as is usually supposed, to extensive enlistment in the Army.

Liverpool.—Year's Working.—The accounts of the Tramway Department of the City Council for the 12 months ended December 31st last, provide for a contribution of £100,000 in aid of the rates. Income from all sources dering the period under review totalled £707,097, traffic revenue contributing £696,893. Expenditure during the period amounted to £483,405, of which £192,353 was in respect of traffic expenses; £86,350 for general expenses, £80,594 for general repairs and maintenance, and £124,106 for power expenses. This leaves a balance of £223,692, carried to net revenue account, where it is increased to £242,673 by the addition of interest and a sum transferred from the suspense account. From this total has to be taken £50,084 in respect of interest, £4,968 for rent of leased lines, £64,526 for sinking fund charges, and £23,193 to be carried to the reserve, renewal and depreciation account, leaving £100,000 for rate aid.

London.—The Metropolitan Electric Tramways Co. is applying for powers to postpone, until three years after the termination of the war, the liability of the Middlesex C.C. to proceed with any tramway and street widenings authorised by Parliament in 1911; also to postpone until the same period the time granted in 1913 for erecting railless traction vehicle equipment in Woodford and Tottenham, from Green Lanes to Ferry Lane.

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Manchester.—The trolley boys employed in the tramway department have been dissatisfied for some days past with their pay, and, following the short-lived strike reported in our last issue, brought about because they thought they were receiving less than the new trolley girls who have just been engaged, the boys have asked for an advance of wages of 2s. per week. The Tramways Committee has offered a war bonus of 1s. per week and overtime at the rate of time and a quarter, and at a meeting of the boys last week this offer was accepted. There was a fair minority against accepting the bonus, and these left the meeting and got some of the lads on the cars to cease work again. There was no interference with the car service, and the "strike" quickly fizzled out.

Plymouth.—Tramway Purchase.—The arbitration with regard to the taking over by the T.C. of the undertaking of the Devonport and District Tramways Co. has resulted in the price being fixed at £103,970. The company claimed £257,000, and the Corporation's assessment of the value was £93,000. A loan of £5,000 for the purchase of six new cars has been sanctioned for 15 years.

Rochdale.—In consequence of a shortage of steam at the electricity works, there was a failure of the electricity supply on January 26th, and the cars on all sections were stopped for about 20 minutes.

Sunderland.—Revenue Estimates.—The estimates for the year ending March 31st next of the Corporation tramway department show that the estimated total income is £77,687, of which £77,300 is put down as traffic revenue, compared with last year's estimate of £74,882, and an actual income of £75,615. The working expenses are estimated at £43,467, as against an estimate for 1914-15 of £42 246, and an actual expenditure of £41,549. The traffic expenses are estimated at £20,860, an increase of over £1,000 on last year's figure, largely owing to increases in wages; whilst the general expenses are put at £6,127, compared with £5,608 last year. The sum of £34,222 will be carried to net revenue account, which is increased by bank interest to a total of £34,485, compared with last year's actual amount of £34,331. The sum of £5,000 will be appropriated from the balance for the relief of rates, whilst the reserve and renewals fund will receive £9,261. Loan repayments will amount to £10,767; interest on loans, £6,27,7; income-tax on profits, £2,438; Wheatsheaf offices part repayment £400, and car covers £400.

Trafford Park.—Light Railway Inquiry.—On Thursday and Friday last week an inquiry, authorised by the Light Railway Commissioners, was held in Manchester, touching the application of Mr. Marshall Stevens and others—persons concerned with the ownership of land in Trafford Park—for sanction to construct three light railways in and adjoining the Park. The railways proposed were approximately 2 furlongs, 4 furlongs, and 7 furlongs in length, and, on behalf of the applicants, it was stated that they were necessary for the conveyance of the increasing number of workmen who were employed in the Park, and also for goods traffic. At various points tramway rails had been down for years, but no cars had run over them. The application was opposed by the whole of the railway companies, the Manchester Ship Canal, Lancs. County Council, the Stretford District Council, Manchester Corporation, and a number of other public bodies, who urged that the proposed railways were not in the public interest, and alleged that it was the intention of the promoters to give preference to commercial undertakings in Trafford Park over those outside. In the result the application was refused.

TELEGRAPH and TELEPHONE NOTES.

Australia.—Justifying the new telephone charges of 1d. per call for subscribers and 2d. per call on slot machines, the Postmaster-General recently stated that in other countries the rates were much higher, except in Sweden, Switzerland, and Denmark, where labour was cheap. In Australia the average wages paid to the telephone employés, including administration and supervision, were 13·87d. per hour, compared with 9·09d. in America and 6·25d. in England. The cost of the mechanical section in Australia was 21·519d., in England 10·071d., and in the United States 16·20d. per hour. Linemen in Australia received 17·348d., in England 10·071d., and in America 15d. to 17d. per hour.

The Postal Service showed a deficit for the year ended June 30th last of £629,722, compared with a deficit of £501,457 in the previous year; the telegraphs alone made a loss of £106,461 compared with £151,446, and the telephones a loss of £364,109 compared with £290,424.

As the result of a request made by the Professional Officers' Association in Sydney, that the Postmaster-General should give preference to Australians in cases where they were qualified for higher positions in the service, the Postmaster-General has directed that all applicants for an electrical engineership at Adelaide, now vacant, must undergo an examination. Similar examinations will take place in future in the case of other senior positions as they become vacant. This, Mr. Webster thinks, will afford Australians the opportunity they have been contending for.—*The Age.*

Hull.—The accounts of the Corporation Telephone Committee for 1914-15 show income £138,675; working expenses, £95,102; works protection and war bonus, £226; marriage dowries and pensions, and one year's contribution to staff fund, £5,629, a total of £100,957, to which there was added for interest and sinking fund charges, &c., £32,328, a gross total of £133,285, leaving a net balance of £5,390. The loan repayment charges, amounting to £10,689, were for one year in the case of the original undertaking, and as regarded the ex-National undertaking, from the date of borrowing—May 6th, 1914—in compliance with the requirements of the Local Government Board. After paying the expenses caused by the removal of officers from Hull, consequent upon the transfer, and meeting the cost of replacement of switchboard cables, there remains a credit balance of £11,684 in the reserve fund. The capital account shows a net expenditure of £198,183, which included the purchase of the ex-National undertaking, and an amount of £3,664 capital expenditure since January 1st, 1912. The total capital outlay was £313,112.

In submitting a report on the undertaking the engineer (Mr. T. Holme) stated that the accounts in connection with the plant acquired from the Post Office covered a period of 3¼ years. The gross profit amounted to £37,717. He estimated £3,600 as the loss per annum on the Post Office system before the transfer. The main items which turned this loss into a profit on the amalgamation of the two systems were: Salaries of Post Office staff not replaced, £2,500 per annum; profit on Wincolmlee system, £2,500 per annum; loss on 25s. tariff, now abolished, £2,000 per annum. The effect of the war would be to keep the income down and increase the expenditure. But for the war, the increase of income on the amalgamated system would have exceeded £1,000 per annum. The total length of single wire on the system was 43,254 miles. The estimate for 1916-17 returned the profit at £1,030.

Mongolian Telegraphs.—A Russo-Chino-Mongolian telegraphic conference has decided that the telegraphic lines from Kalghan to Urga and Kiakhta, crossing the territory of autonomous outer Mongolia, are to pass into the possession of the Mongolian Government, in conformity with a triple agreement signed in June, 1915.

Torpedo Controlled by Wireless.—A Reuter telegram from Washington, U.S.A., states that wireless control of a coast defence torpedo by an aeroplane has been definitely accomplished, and the Navy Department has asked Congress to appropriate nearly a million dollars to acquire the rights. Aeroplane control makes it possible for the operator to guide the torpedo through the water from any height, air bubbles from the compressed air motor of the torpedo giving him a certain guide to steer it against a ship's hull. No details are available, and the method by which the controlling waves are enabled to actuate the steering gear of the torpedo, in spite of the shielding effect of the shell of the latter, and of the sea-water, is not known.

United States.—The Marconi Wireless Telegraph Co. of America has brought an action against the Detroit and Cleveland Navigation Co. at Buffalo, N.Y., for using infringing apparatus on its steamships.

The antenna of the radio-station of the Atlantic Communication Co., at Sayville, L.I., was brought down by the weight of sleet on December 29th. Repairs were made at once.

The Marconi Wireless Telegraph Co. of America has placed a contract for the erection of a new station building at Cape May, N.J. A tower 140 ft. high will also be erected.

The United States battleship *Wyoming* reports that while she was near Cape Henry, Va., on January 10th, radio-telegraph messages were exchanged with the *San Diego* at Graymas, Mexico, a distance of 2,500 miles.

Recently the Marconi Wireless Telegraph Co. of America brought an action against the American-Hawaiian Steamship Co. for infringement of its "tuning patent," by the use of certain wireless telegraph apparatus manufactured by the Kilbourne & Clark Manufacturing Co., of Seattle, Wash., which had been installed on its steamship *Floridian*. Judge Veeder, on January 8th, granted a preliminary injunction against the further use of the apparatus on the steamship.

Judge Mayer dismissed, on January 7th, the wireless patent infringement suit brought by the receivers of the National Electric Signaling Co., of Pittsburg, Pa., against the Atlantic Communication Co., which operated the Sayville wireless station. It was complained that the defendant had infringed the claims of patents granted to Reginald A. Fessenden, but Judge Mayer held that the claims were invalid.

The Marconi Wireless Telegraph Co. of America has closed a contract with the Inland Navigation Co., New York, for the installation of wireless apparatus on 36 freight barges, which are soon to ply the waters of the Mississippi. The contract provides for 2-kw. Marconi sets, giving a communication range of 400 miles or more. Marconi operators will be supplied and service with land stations provided as in ocean navigation.—*Telegraph and Telephone Age.*

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CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—April 15th. P.M.G. Common-battery multiple switchboard, or automatic or semi-automatic switchboard, and associated apparatus. See "Official Notices" December 31st.

Brisbane.—April 26th. Deputy P.M.G. Five sections of trunk line switchboard for Toowoomba Exchange. (Schedule No. 342.)

Melbourne.—March 22nd. Thermo-electric pyrometers, for the Victorian Government Railway Commissioners.*

April 12th. Electrically operated runway hoist for the Jolimont car shops. Particulars at the contractors' room, Spencer Street.

Sydney.—February 28th. Municipal Council. Tenders for induction regulators. Specifications (11s. 6d.) from the Electric Light Department, Town Hall, Sydney.

April 10th. Municipal Council. Supply, laying and maintenance for six months of six 11,000-volt submarine cables, each 400 yards long, across Darling Harbour.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-kw. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.

Belfast.—February 16th. Corporation. Tramway stores, including cable, lamp and electrical accessories. See "Official Notices" to-day.

Birmingham.—February 8th. Twelve months' supply of electrical stores, for the Birmingham, Tame and Rea District Drainage Board. Forms of tender from the Board's offices, Tyburn, Birmingham.

Exeter.—B. of G. Electric light installation for Block 3 at the workhouse. Particulars from the Surveyor.

Halifax.—February 14th. Corporation. Twelve months' supply of electric lighting fittings and accessories, cables, telephone wire, meters, &c. See "Official Notices" January 21st.

Leigh (Lancs.).—February 18th. Electricity Committee. 2,000-kw. turbo-alternator, 6 600 volts; surface condenser, set of pumps, 1,000-kw. rotary or motor-converter, with switchgear. See "Official Notices" January 28th.

London.—Islington.—February 17th. B. of G. Alteration to wiring, provision of switchboards, motor starters, &c., provision of motors, and purchase of old plant. See "Official Notices" January 28th.

Hammersmith.—February 16th. Corporation. Twelve months' supply of stores, including wires, cable joint boxes, fuse boxes, insulating material and electric light sundries, for the Electricity Department. See "Official Notices" to-day.

Battersea.—February 21st. B.C. Engine-room stores, oils, electricity meters, service joint-boxes, ironmongery, tools, troughing, conduits, insulators, coal, &c., for the Electricity Department. See "Official Notices" to-day.

Manchester.—February 15th. Corporation. General stores, including cables, telephones, electrical accessories, &c., for the Tramways Department. See "Official Notices" January 28th.

New Zealand.—Dunedin.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.

Raetihi.—March 14th. Town Board. 40-h.p. hydro-electric generating set, switchboard, &c. Plans and particulars from Messrs. H. W. Climie & Son, Raetihi.*

Wellington.—March 8th. Public Works Office. One 3,000-kw. generator and one 4,300-h.p. water turbine, at Lyttelton, for the Lake Coleridge electric power scheme. Specifications, &c., may be consulted by British firms at the office of the High Commissioner in London for New Zealand, at 13, Victoria Street, S.W.

Pembroke (Dublin).—February 7th. U.D.C. Twelve months' supply of electrical goods. Specifications from the Town Hall, Ball's Bridge, Co. Dublin.

Portsmouth.—February 15th. Corporation. Six months' supply of tramway stores, including insulating materials, lamps, motor windings. See "Official Notices" to-day.

Southampton.—February 19th. Corporation. Twelve months' supply of general stores, electric lamps, &c., for the Tramways Department. Specifications from the Manager, Tramway Offices, 161, Above Bar Street.

Spain.—Tenders have been invited by the municipal authorities of Anzuola (Province of Guipuzcoa) for the concession for the electric lighting of the town.

Todmorden.—February 12th. Electricity Committee. One Lancashire boiler, superheaters, mechanical stokers, pipework, centrifugal pump; also brickwork for Lancashire boiler. See "Official Notices" to-day.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Australia.—The following tenders have been accepted:—

P.M.G.'s Department, West Australia.

7 miles 763 yards of lead-covered conductor cable, 150 pairs, £1,018 per mile; 4 miles 1,602 yards ditto, 100 pairs, £748 per mile.—Western Electric Co. (Aust.), Ltd.

P.M.G.'s Department, N.S.W.

3½ miles of lead-covered conductor cable, 15 pairs, £101 per mile; 9½ miles ditto, 25 pairs, £182 per mile; 9½ miles ditto, 85 pairs, £165 per mile; 33⅔ miles ditto, 50 pairs, £228 per mile; 9½ miles ditto, 75 pairs, £293 per mile.—W. T. Henley's Telegraph Works Co., Ltd.

14½ miles of lead-covered conductor cable, 150 pairs, £494 per mile; 1½ miles ditto, 200 pairs, £634 per mile; 5 miles ditto, 250 pairs, £778 per mile; 11½ miles ditto, 800 pairs, £920 per mile.—Western Electric Co. (Aust.), Ltd.

4 miles of lead-covered conductor cable, 400 pairs, £1,185 per mile.—British Insulated & Helsby Cables, Ltd.—*Tenders.*

Barking.—The U.D.C. has accepted the tender of Mr. S. E. Moss, of Southend-on-Sea, for extensions at the electricity works, at £1,200.

Bristol.—The Corporation Docks Committee has accepted the tender of Messrs. W. T. Henley's Telegraph Works Co., Ltd., for 250 yards of 7/18 paper-insulated lead-covered cable.

Derby.—The T.C. has accepted the tender of the British Electric Transformer Co., Ltd., for a transformer, at £110.

Glasgow.—The Electricity Committee recommends acceptance of the following tenders:—

British Westinghouse Co., Ltd.—One 6,000-kw. turbo-alternator and condensing plant, at £25,622, for the Port Dundas station.

Willans & Robinson, Ltd.—One 6,000-kw. turbo-alternator and condensing plant (with Dick, Kerr alternator), at £25,480, for St. Andrew's Cross station.

The above sets are to be completed by September of the present year.

The Tramways Committee has recommended acceptance of the following offers:—

V.I.R. cable.—Liverpool Electric Cable Co.; Pirelli, Ltd.

Commutators.—British Westinghouse Co.

Ilford.—The following offers of coal have been accepted by the Electricity Committee:—

E. Foster & Co.—100 tons Glyncoed through and through, at 24s. 9d. per ton; 100 tons Glyncoed small, at 20s. 10d. per ton; about 150 tons Measham slack, at 18s. 6d. per ton.

Cleeves & Co.—200 tons Notts large hard, at 26s. 9d. per ton.

E. Foster & Co.—Three trucks per week of West Cannock 2-in. nutty slack, at 20s. 10d. per ton, over a period of 12 months.

The Committee has also accepted the tender of the Albion Clay Co. for cable ducts, at 2s. 4½d. per yard.

London.—L.C.C.—The Education Committee has considered a claim from Messrs. Lund Bros. & Co., the contractors for the electric lighting installation at Ocean Street School, Stepney, in respect of the rise in the prices of materials between the time of the acceptance of their tender and the execution of the work. The contract was accepted in December, 1913, and the first portion completed in 1915; the second portion has only recently been commenced, owing to the building trade strike in 1914. The Committee is of opinion that an allowance of £39 should be made in settlement of the claim; and also that the request of Messrs. Defries and Goldman, contractors for installing electric light at Star Street School (Fulham), Victoria School (Hammersmith), Senior Street School (Paddington), and Woolmore Street School (Poplar), for permission to assign their contracts to the Alpha Manufacturing Co., be complied with.

West Bromwich.—The Electricity Committee recommends the acceptance of the tender of Messrs. J. Dallow & Sons, at £8 850, for the erection of the engine-room walls and foundations and brickwork for steel chimney, in connection with the plant extensions at the electricity works; also the tender of the New Conveyor Co. for certain extensions to the coal conveyor.

Windsor.—Messrs. Chamberlain & Hookham, Ltd., have received the contract for the supply of electricity meters for the coming year.

Whitby.—The contract for laying cable and installing the electric light (approximately 65 lights) at Sneaton Castle, for Col. J. W. Richardson, has been secured by Mr. Isaac Stephenson, of Whitby.

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FORTHCOMING EVENTS.

Greenock Electrical Society.—Friday, February 4th. At 7.45 p.m. At the Temperance Institute, 19, West Stewart Street. Paper on "Colliery Electrical Installations," by Mr. R. Gordon Campbell.

Saturday, February 12th.—Visit to blast furnaces at the Govan iron works of Messrs. Wm. Dixon, Ltd.

London Association of Foremen Engineers.—Saturday, February 5th. At 8 p.m. At Cannon Street Hotel, E.C. Lecture on "Superheated Steam," by Mr. T. Sugden.

Society of Engineers.—Monday, February 7th. At 5.30 p.m. At Caxton Hall, Westminster, S.W. Presidential address by Mr. P. Griffiths. Presentation of premiums.

Institution of Civil Engineers.—Tuesday, February 8th. At 5.30 p.m. At Great George Street, S.W. Paper on "Notes on the Working of a Rack Railway," by Mr. W. T. Lucy.

Liverpool Engineering Society.—Wednesday, February 9th. At the Royal Institution, Colquitt Street. Paper on "The Education of a Marine Engineer," by Mr. J. E. Jeffery.

Association of Engineers-in-Charge.—Wednesday, February 9th. At 7.30 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Multiple-Effect System of Refrigeration," by Mr. W. Stokes.

Royal Society of Arts.—Wednesday, February 9th. At 4.30 p.m. At John Street, Adelphi, W.C. "The Organisation of Scientific Research," by Prof. J. A. Fleming, F.R.S.

Institution of Electrical Engineers.—Thursday, February 10th. At 8 p.m. At Victoria Embankment, W.C. Paper on "The Testing of Underground Cables with Continuous Current," by Mr. O. L. Record.

(Western Local Section).—Monday, February 7th. At 5.30 p.m. At the South Wales Institute of Engineers, Park Place, Cardiff. Paper on "The Testing of Underground Cables with Continuous Current," by Mr. O. L. Record.

(Manchester Local Section).—Tuesday, February 8th. At 7.30 p.m. At the Engineers' Club, 17, Albert Square. Paper on "The Testing of Underground Cables with Continuous Current," by Mr. O. L. Record.

(Scottish Local Section).—Tuesday, February 8th. At 7 p.m. At Prince's Street Station Hotel, Edinburgh. Paper on "The Principles of Modern Printing Telegraphy," by Mr. H. H. Harrison.

(Yorkshire Local Section).—Wednesday, February 9th. At 7 p.m. At the Philosophical Hall, Leeds. Paper on "The Testing of Underground Cables with Continuous Current," by Mr. O. L. Record.

Manchester Association of Engineers.—Saturday, February 12th. At the Grand Hotel, Aytoun Street. Paper on "Oil Engines," by Mr. G. E. Windeler.

North of England Institute of Mining and Mechanical Engineers.—Saturday, February 12th. At 2 p.m. At Neville Hall, Newcastle-on-Tyne. General meeting.

THE B.E.A.M.A. ANNUAL MEETING.

The annual general meeting of the B.E.A.M.A. was held at the Connaught Rooms on Thursday, January 20th. Mr. F. R. Davenport (Willans & Robinson, Ltd.), chairman of the Council, presided, and we learn that there was a good attendance of members.

In submitting the annual report and balance-sheet, the chairman said that notwithstanding the handicaps under which members were suffering due to shortage of labour, difficulties in obtaining materials, Government control, &c., they had, compared with some other trades, no reason to be dissatisfied with the situation.

Public attention was at the present time being largely directed to the question of the probable situation after the war, and several associations purporting to look after that matter and working more or less on parallel lines had sprung up. The B.E.A.M.A. had been invited to join some of these associations, but up to the present had not done so, though they had given considerable time to the exchange of views and the holding of conferences, and were still directing their attention to the efforts made towards creating some central and representative body which would embrace the common interests of all British traders. Suggestions had been made by the B.E.A.M.A. to the Colonial Office that money raised within the Empire should be expended on British goods, and whilst the Secretary of State for the Colonies was unable to give any definite assurance, there appeared now to be a far more favourable atmosphere surrounding the whole question of Colonial and Allied trade.

The Association had been in conference with the Advisory Committee of the Commercial Intelligence Department of the Board of Trade, to whom memoranda had been submitted, many of the recommendations put forward being, the Chairman understood, embodied in the report made by this Committee. That looked as if things were tending in the right direction. They had been in conference with the Government Research Committee, which was appointed by the Board of Education to inquire into the broad question of scientific and industrial research and for the granting of sums of money in aid of research. Although he had nothing to say at the moment as to probable results, their Committee was a strong one, and there was every sign that good results would flow from the effort. With a view to organising and extending the export work of members, additions had been made to the export staff, and Overseas Committees had been appointed in India, Australia and South Africa. Others, it was hoped, would be shortly appointed. The *Beama Journal*, which had a wide overseas circulation, was used by members as a publicity missionary for export trade, and, with the object of discussing ways and means of bringing about co-operative effort, both in the home and export sides of the industry, which were, of course, very intimately interlinked, recently a series of informal evening gatherings had been held. As the report told them, home conditions of contract and standardisation still remained amongst their fundamental activities, and they had been actively engaged in these directions. He thought they might say, without any undue pride, that their position as an Association, both nationally as well as in relation to their own trade circles, had been strengthened without in any sense alienating, as far as he was aware, customers' minds and their general opinion of the B.E.A.M.A.

In the discussion which followed, Mr. Lundberg (A. P. Lundberg & Sons), Mr. Longbottom (Electromotors, Ltd.), and Mr. Berry (Berry, Skinner & Co.) referred to the unsatisfactory position in regard to patents. Practically all members were now controlled firms, and their patents were naturally in a state of suspension, although patent fees had to be paid. This meant that the useful life of the patent would be shortened by the duration of the war. It was considered that notwithstanding the unsympathetic attitude of the Board of Trade the matter should be persevered with.

The report was adopted.

Messrs. Callender's Cable and Construction Co., Ltd., were elected members of the Council.

NOTES.

Two Interesting Problems.—The Christmas number of the *Wireless World* contained the following solutions to the cube problem (which we reproduced in our last issue), by a correspondent, Mr. W. B. Ferguson :—

If the cube be imagined to be pulled apart from points *e* and *c*, fig. 1, all confusion at once vanishes, as the cube assumes the shape shown in fig. 3, from which it is obvious at a glance that we have three in parallel, (W-X) in series with six in parallel (X-Y) in series with three in parallel (Y-Z); therefore the resistance from *e* to *c* is one-third plus one-sixth plus one-third. Answer: Five-sixths of an ohm.

Alternative Problem (sides made of 1-ohm sheets).—In fig. 1 the current entering at *e* divides equally between top, front, and left side (*a b f e*; *e f g h*; *e a d h*), each of 1-ohm resistance, therefore one-third of an ohm total. The current leaves by three sheets—bottom, back, and right side (*c d h g*; *c d a b*; *c b f g*), each of an ohm resistance, therefore one-third of

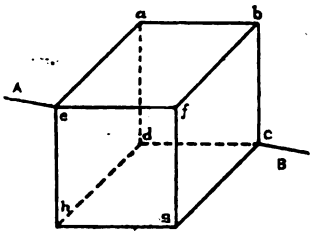

FIG. 1.

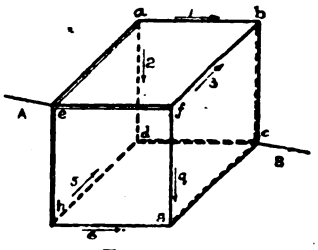

FIG. 2.

an ohm total. The first set of sheets joins direct with the second lot of sheets along the line *a*, *b*, *f*, *g*, *h*, *d*, *a*; therefore we have one-third of an ohm in series with one-third of an ohm. Total, two-thirds of an ohm.

We have received from Mr. W. N. Y. King, A.C.G.I., solutions on similar lines, leading to the same conclusions.

With regard to the second part of the cube problem, although both solvers arrive at the same result, we are unable to agree that the solution is correct. In point of fact, on consideration of the conditions—a cube constructed of sheet metal, with current led in and out by diagonally opposite *corners*—we have come to the conclusion that the problem is one of considerable difficulty. The solvers appear to assume that the resistance of one side is one ohm, no matter in what direction the current passes through it, but this

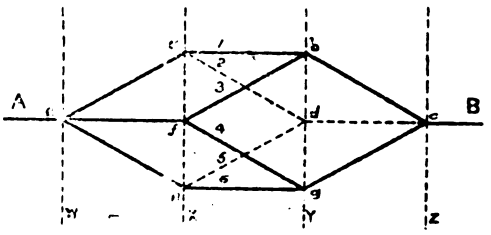

FIG. 3.

is clearly an inadmissible assumption. It must, of course, be taken that the sides are in contact along every edge; and the resistance of each side from edge to edge is 1 ohm—if it is taken diagonally it becomes indeterminate.

As the solution to the second problem (the two steel rods) will be published by our contemporary this week, we shall not be guilty of discourtesy if we include it here:—Gently apply one end of bar A to the middle of bar B, and separate the bars again. If there is magnetic attraction between them, as indicated by "stickiness," A is the magnet; if no attraction is felt, obviously A is not magnetised, and, therefore, B is the magnet. A symmetrically magnetised bar, having two poles only, has no external magnetic field at its median plane. Mr. King solved this problem correctly.

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"Jitney" Competition in America.—Full reference has recently been made in our "City Notes" to the serious effect of unlicensed jitney 'bus competition upon the traffic of the British Columbia Electric Railway Co., Ltd., a competition which may have far-reaching results, including the closing of some of the tramway sections. We now read in the British Consular Report for the district of Portland, Oregon, U.S.A., that this kind of service has also been making its influence severely felt in other places as well, and has got to be reckoned with in the future. The writer of the report says that in the last six months of 1914 the street car service of most of the United States, but especially on the Pacific Coast, was hard hit. "In Portland the company that has control of the street railways and supplies most of the electric current for household and commercial purposes, mostly consists of Eastern States capital, and is not so much affected by loss in passengers on the cars, as that is only part of the revenue, but companies which have no other earning power are very much affected. A few months ago a number of automobiles of different makes, sizes and conditions started to compete for the passenger service on the streets where cars run. It was vulgarly termed the 'Jitney' service, after a name given to the 5 cent. (2½d.) coin used, and grew with leaps and bounds, as many people who used automobiles to get to work, and for occasional business journeys during the day, would put up a sign for passengers on their way to work and in the evening home. Some women who own automobiles, and have no house or family, have gone into the business, which the city authorities are now endeavouring to regulate, as the loss in revenue to the city is quite great, and some of the 'Jitney' drivers are incompetent and wild. The new system is a great comfort to many people, because, as soon as a car, say, carrying five persons, is filled, they take short cuts through the residential district, not being interfered with by the car tracks and heavy wagons on the main streets, and a man reaches his office or home in half the time he would on a street car, and, if convenient to the others in the car, can on wet days be put off at his office or house. One result of the 'Jitney' outbreak has been the faster running of the street cars, which formerly were very trying to a nervous man who was in a hurry. Many people interested in this new business say that the big heavy automobiles with a large carrying capacity will soon die out from the expense of fuel and upkeep, while the cheap car, built for economy and carrying from four to seven passengers, will make a living for their drivers and expenses. The cost of taxicabs here is very great. Many of the 'Jitneys,' neat looking cars, can be hired for a trip to the station for about a quarter what the taxicabs charge, and for less than half by the hour for an afternoon's trip, so it is to be hoped that the regulations on them will not be too severe. One regulation suggested that all licensed 'Jitneys' must have the name of their route painted on them, must keep on a fixed route, must not run on a street where a street car runs, not get off the route laid down, and all be at work from 5 to 10 a.m., and from 4 to 11 p.m., notwithstanding weather or sickness of owner, who is generally driver. Investors in such undertakings as street railroads must look forward to the changes in methods of transportation, and are likely to suffer, as their predecessors the horse-tram, 'bus and cab companies did."

Institution and Lecture Notes.—Illuminating Engineering Society, U.S.A.—This Society holds its mid-winter convention in New York, on February 10th and 11th. The programme of papers includes the following:—Relation of Lighting to Architectural Interiors; Candle-Power Measurements of Series Gas-Filled Incandescent Lamps; Theatre Lighting; Illuminating Engineering Photographs; The Lighting of Important General Offices in New York City; An Interlaboratory Photometric Comparison of Glass Screens and of Tungsten Lamps, involving Colour Differences; The Box Photometer; and a Lecture on the Lighting of the Panama Pacific Industrial Exposition.

Wolverhampton and District Engineering Society.—On Friday last, Mr. C. Jones, chief electrical engineer to the Cannock Chase Collieries, gave an interesting lecture to the Society on the application of electricity to the working of collieries.

Nottingham Society of Engineers.—At a joint meeting of the Society with the Association of Mining Electrical Engineers, Mr. R. A. Sheldon read a paper on the use of electricity in conveying coal from the working face to the pit-head.

Leeds Association of Engineers.—At a meeting on Thursday last week, Mr. G. Wilkinson, electrical engineer to the Corporation of Harrogate, read a paper on the use of electricity as a means of conserving our coal measures; he pointed out that the enormous drain upon the Empire in men, money, and materials, occasioned by the war, had emphasised the need for thrift and economy in all directions. One of this country's chief assets was coal, and economy in its use and consumption was very needful. About one-tenth of all the coal raised in these islands was burned in private fires. A great saving could be effected at once by abandoning the wasteful open fire in favour of other more economical forms of heating, such as hot-water radiators. On banishment of the open fire, the supplemental heating of the living rooms would take the form of electric fires or gas stoves, thus effecting great economy both in fuel and in labour.

Belfast Association of Engineers.—On January 21st an address was delivered by Mr. W. Pleasance, on "Three-Phase Current for Power Purposes." The lecturer dwelt on the advantages of the three-phase system as compared with direct current for power and lighting, and a discussion followed. According to the *Belfast News-Letter*, the Chairman, Mr. J. W. Kempster, said that, broadly speaking, they ought never to put in a D.C. machine if they could put in three-phase plant; but they must give due weight to the purpose in view, and not install three-phase merely for the sake of three-phase. Individual driving in an engineering works he said, was undoubtedly the most economical in the end. The introduction of electrical driving was one of the ways in which they would have to make good the wastage of capital caused by the war; properly applied, it enabled them to get the utmost possible out of the man and the machine, and greatly increased the productivity of their factories and workshops.

Decimal Coinage.—In our contemporary *Nature* for January 20th, a writer using the initials "G. H. B.", who is clearly an ardent supporter of the metric system, takes us to task because, in our recent article on "Decimal Coinage and the Metric System," we "associated these undoubted claims for standardisation of units with the advocacy of a change of monetary system which nobody understands, and which does not appear calculated to advance the cause of international uniformity." He goes on to say that the result of our inquiries of business firms was "a very thorough discussion of the advantages of the metric system, and the absence of any substantial evidence regarding the monetary question," and afterwards demonstrates that the decimal system of weights and measures in international use is based on a distinctive and unique nomenclature for tens, hundreds, thousands, and corresponding submultiples of the fundamental unit, whereas most systems of coinage are centesimal, and chaotic at that.

Our critic, who has evidently only glanced at parts of the article in question, omits to mention that we explicity stated in several places that we regarded the adoption of the metric system in this country as of the first moment, and that the adoption of decimal coinage was an independent question of secondary importance, its chief recommendation being economy of clerical labour. Apparently "G. H. B." bases his sweeping statement to the effect that "nobody understands" the system upon his own lack of comprehension of it, which is a somewhat shaky foundation; but we did not advocate decimal coinage with a view to international uniformity in this respect, an ideal which is obviously unattainable. The writer goes on to dilate upon the disadvantages of such uniformity of coinage, thus unconsciously supporting our proposal that we should *not* adopt the franc or anything of equivalent value, but should base our system upon the pound sterling and its decimal submultiples, the florin being about twice the value of the mark, and two and a-half times the value of the franc, lira, &c. He further supports our contention that the exchange value of an English sovereign is known all over the world, and states that our manufacturers can at present give their quotations in decimals of a pound—yet he does not seem to understand that the system we propose achieves precisely that very end, without the necessity of reducing shillings and pence to decimals of a pound!

Instead of realising that the present is an ideal time for introducing a change in coinage, when our normal standards of value have gone overboard, and the slight change of 4 per cent. in the value of *copper coins only* would be unfelt, "G. H. B." thinks "it is quite clear that any such change would lead to a state of chaos in our international trade"—although he has himself stated that the value of the sovereign is known all over the world, and our proposal is to convert our coinage to sovereigns and decimals of a sovereign, which, he says, can easily be done! If "G. H. B.'s" arguments are to have any weight, they should be less at war with one another; a writer who puts forward statements on the "it-is-quite-clear" basis, when his own arguments demolish one another, and exhibit a confusion of thought deplorable in one who assumes the office of a critic, can hardly hope to secure the approval of anyone but his adversaries.

Fatalities.—An inquest was held at Leigh, on Thursday last week, on Richard Tinaley, aged 45, an electrician employed at the Bickershaw Collieries of Messrs. Ackers, Whitley & Co., who met with a fatal accident at the pit on the previous day. He had been engaged in repairing some wire in the 7-ft. shaft, about 10 yards below the surface, and, according to the evidence of Henry Collier, assistant electrician, the job had been finished. They told the banksman they had done with the cage. A few minutes later it was lowered, and Collier heard a crash. The cage was stopped and brought to the surface. The body was subsequently recovered from the sump-hole in a mutilated condition. A verdict of "Accidental death" was returned.

The Burnley Coroner held an inquest, on January 24th, concerning the fate of Alfred Dixon, of Manchester, foreman electrician for the L. & Y. Railway Co., who was knocked down by a train near Gannow Junction. Deceased was repairing some of the wires close to Gannow Junction when the fatality happened. He had been employed by the Railway Co. for 21 years on this class of work. The jury returned a verdict of "Accidental death."

Municipal Employés and Compulsory Service.—At the meeting of the Birmingham City Council on Tuesday last, the General Purposes Committee recommended that the privileges granted to the officers and servants of the Corporation who had joined the naval and military services should be extended to those men who were taken by compulsion for service. An amendment was moved by Alderman Davis that the report be referred back for further consideration. He submitted that the Corporation would not be keeping faith with those men who had voluntarily enlisted if equal advantages were given to those who were conscripted. This was the feeling of the majority of the Council, and the amendment was carried.

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Appointments Vacant.—Junior engineers-in-charge (42s.), and switchmen (35s.) for the Newport Corporation Electricity Department. See our advertisement pages to-day.

Electrical Rain-Making.—The Committee appointed by the N.S.W. Premier to inquire into Mr. Balsillie's proposals for causing rain by electricity has now reported. The essential features of the proposal were the use of an electrically charged, metal-coated captive balloon, the suspending of a Rontgen-ray tube from it, and the combination of the electrically-charged body and the Rontgen-rays. The Committee reports that after experiments it was not satisfactorily established that Mr. Balsillie had succeeded in making any definite advance towards attaining practical results, but recommends further investigation of the subject, with a view to the carrying out of open-air experiments in New South Wales.—*Sydney Evening News.*

Volunteer Notes.—Engineering Institutions' Volunteer Engineer Corps.—Orders for week commencing February 7th, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commandant.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Sunday, February 6th.—Trench Work Train, 9.33 a.m. Cannon Street.

Monday, February 7th.—Sections 1 and 2, Technical; Sections 3 and 4, Lashings and Trestle Bridging, Signalling Class and Recruits.

Tuesday, February 8th.—School of Arms, 6 to 7 p.m.

Thursday, February 10th.—Shooting for Sections 1 and 2 and Signalling Class.

Friday, February 11th.—Sections 3 and 4, Technical; Sections 1 and 2, Lashings and Trestle Bridging; Signalling Class and Recruits.

Saturday, February 12th.—Uniform Parade, 2.45 p.m.

Sunday, February 13th.—Signalling Section. For particulars see Notice Board.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Regiment (Volunteers).—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, February 3rd, 1916:—

Week-end Parades.—Saturday—The Battalion, less Platoons Nos. 8, 11, North London and Blackheath, will parade at Wembley Park at 3.15 p.m. "Derby" recruits are invited to attend.

Sunday.—(The first Sunday in the month).—Field Operations. The Battalion will parade at 9.30 a.m., at King's Cross Station, G.N.R., and proceed to Hatfield Park. Members are requested to purchase their tickets before the hour appointed for parade, and to provide themselves with White hat-bands. Lunch will not be provided by the Corps, but the Quartermaster will make arrangements to provide light liquid refreshments. The 3rd Battalion Herts. V.T.C. have kindly arranged to provide Tea, at a very small cost, after the Operations.

The Battalion will return to town at 5.22 p.m.

Musketry.—The Inter-Platoon Competition will be continued at the Acton Range on Saturday next, the 5th inst., in accordance with the orders published on Monday last. The competing platoons Nos. 8, 11, North London and Blackheath, to parade punctually at 1.30 p.m. in uniform with bayonets.

A. G. Joiner, *Major and Adjutant*, O.B.C.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The Preston Corporation has appointed Mr. H. Alston, of Blackburn, to the position of chief traffic clerk in the tramways department.

Mr. F. Mawdesley, assistant engineer at the Plumstead electricity works of the Woolwich Borough Council, has been promoted acting charge engineer at £110 per annum.

Mr. J. Dugdale, the Oldham Corporation tramways manager, who, as recently reported, met with an accident at Rotherham, has now returned to Oldham.

General.—The Curtis Manufacturing Co., Paddington, inform us that their principal, Mr. F. C. Curtis, after putting in seven months' signal work with the Royal Naval Division, R.E., in the trenches at Gallipoli, is now at —— in charge of the motor cycle maintenance for the Division. The company's business is being carried on as usual in his absence.

The *London Gazette* Territorial Force cancellation notice which, in our last issue, was bungled by the printer when making corrections, should have read as follows:—"Captain (temporary Major) Arthur E. Levin; Second-Lieutenant (temporary Captain) George L. L. Russell; Lieutenant (temporary Captain) Hugh C. C. Tufnel; Second-Lieutenant (temporary Lieutenant) Frederick H. Bowers."

The marriage has taken place at Luton of Mr. Wm. Thos. Godden, chief electrician at the Royal Naval Hospital at Chatham, and Miss Alice Molland.

The marriage took place on January 22nd, at St. Botolph's Church, Bishopsgate, E.C., of Sapper Bertram Goddard, electrical engineer, of the London *Electrical Engineers*, and Miss Gladys Raison, of Woodford.

From the *London Gazette*:—"Territorial Force: Royal Engineers. *Tyne Electrical Engineers.* To be Second-Lieutenants on probation:—W. W. Wilson; Private J. B. Murray, from the Artist Rifles O.T.C."

Mr. L. W. Phillips, A.M.I.E.E., late of the technical staff of the Edison & Swan Laboratory, Ponder's End, has been appointed manager of the advertising and publicity department of the Electrical Supplies Co., of Tottenham Court Road, London, W.

On Saturday, March 4th, a wedding will take place, very quietly, at Herne Hill, between Henry Cobden Turner, of the British Westinghouse Co., Ltd., Trafford Park, son of Mr. Wilberforce Turner, of Westbrook, Eccles, and of Bare, Morecambe, Lancs., and Elizabeth Anderson (Bessie), daughter of Mr. William Noble, assistant engineer-in-chief of the G.P.O., of Roselea, Burbage Road, Herne Hill, S.E.

Councillor Jas. O'Neill has been re-elected chairman and Councillor McGuinness has been elected vice-chairman of the Dublin Corporation Electricity Committee.

Roll of Honour.—The February number of the *Journal* of the Institution of Electrical Engineers contains a list of awards to members and students for service in the field as follows:—

Lieutenant-Colonel J. C. Chambers, member, and Brigadier-General A. M. Stuart, member, have been made Companions of the Bath.

Major F. J. Chapple, assoc. member, Major S. H. Cowan, assoc. member, Captain A. E. Davidson, assoc. member, and Captain H. M. Leaf, member, have each received the D.S.O.

Lieutenant-Commander E. G. Robinson, assoc. member, was awarded the V.C. last August for conspicuous bravery in Gallipoli.

The Military Cross has been conferred upon:—Second-Lieutenant C. H. Goulden, assoc. member; Lieutenant H. R. L. Groom, graduate; Lieutenant H. J. Gwyther, student; Captain H. P. T. Lefroy, assoc. member; Lieutenant I. W. Massie, assoc. member; Lieutenant A. Podmore, assoc. member; Second-Lieutenant O. W. Sherwell, student; Lieutenant A. R. Tabor, student; and Second-Lieutenant G. W. Williamson, assoc. member.

The Distinguished Service Cross was won by Lieutenant E. G. Boissier, assoc. member.

The D.C.M. has been awarded to Private A. M. Doig, assoc. member; Private P. J. Wood, student; and Corporal C. W. Saunders, graduate.

Sapper J. H. Murray, assoc. member, has received the Distinguished Service Medal.

Seventeen gentlemen in the different classes of membership have been mentioned in dispatches.

The *Journal* contains a further list of members on military service, with particulars of promotions, transfers, &c.

Second Corporal H. E. Govett, of the 67th Field Company, Royal Engineers, reported killed in action in Gallipoli, was for several years engaged with the British Thomson-Houston Co., Ltd., at Rugby, and when he enlisted was on the staff of the testing department.

Corporal Horace Powell, of the 9th Battalion King's Royal Rifles, who was, before the war, on the Rugby staff of the British Thomson-Houston Co., Ltd., is reported missing.

Rifleman T. A. Taylor, of the 21st London Regiment, and late of the staff of Messrs. Siemens Bros., of Charlton, S.E., has been mentioned in dispatches for gallant conduct at Loos.

Private A. V. Pipe, of the 1/20th London (Woolwich and Blackheath) Regiment, who was with Messrs. S. W. Gibson and Co., electrical engineers, of High Street, Dartford, is officially notified to have been killed in action on May 26th last. For many months he had been posted as "wounded and missing."

Private Hugh Kaudy, of the 11th Battalion Manchester Regiment, who has died from dysentery contracted at Gallipoli, was employed prior to the war by the Lancashire Dynamo Co., Ltd., Trafford Park.

Private J. E. Peppin, of the 7th Lancashire Fusiliers, who, prior to the war, was employed at the British Westinghouse Works, Trafford Park, has been killed in action.

On Monday, the Deputy Lord Mayor of Manchester presented Private J. O'Connor, of the 8th Manchesters, formerly employed in the tramways department, with the D.C.M., which he has won for conspicuous gallantry under heavy fire.

Obituary.—Mr. H. M. O'Kelly.—"Nature" states that the death is announced, at the age of 69 years, of Mr. H. M. O'Kelly, formerly superintendent of Government telegraphs in India. He joined the Indian Telegraph Department in 1866, was appointed superintendent in 1886, and retired in 1898.

Colonel Robert Hamilton Vetch.—The *Morning Post*, in announcing the death of Colonel Robert Hamilton Vetch, late of the Royal Engineers, at the age of 75, states that an interesting incident in his life occurred in 1869, when he was sent by the Government in the *Great Eastern* to report on the laying of the French Atlantic cable from Brest to St. Pierre and thence to Duxbury, Mass.

Will.—The late Mr. G. A. Scott, a director of the North of Scotland Electric Light and Power Co., Ltd., left £14,533.

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NEW COMPANIES REGISTERED.

W. J. Burroughes and Sons, Ltd. (142,842).—This company was registered on January 26th, with a capital of £5,000 in £1 shares, to take over the business of a heating and lighting engineer carried on by W. J. Burroughes, at 143 and 144, Holborn, E.C., as W. J. Burroughes and Sons, to carry on the business of heating, ventilating, and electrical engineers, plumbers, manufacturers of and dealers in appliances, etc. The subscribers (with one share each) are: W. J. Burroughes, 143 and 144, Holborn, E.C., engineer; and S. H. Burroughes, 143 and 144, Holborn, E.C., engineer. Private company. The number of directors is not to be less than two or more than five; the first are W. J. Burroughes (permanent governing director, special qualification, 1,000 shares) and S. H. Burroughes. Qualification of directors, 400 shares. Remuneration of governing director, £500 per annum. Registered office: 143 and 144, Holborn, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Torpoint Electric Supply Co., Ltd.—Particulars of £1,500 debentures created January 4th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £220. Property charged: The company's property, present and future, including uncalled capital. No trustees.

Costa Rica Electric Light and Traction Co., Ltd. (56,447).—Capital, £130,000 in £1 shares. Return dated January 5th, 1916. All shares taken up; £7 paid; £129,993 considered as paid. Mortgages and charges: £286,850.

CITY NOTES.

London and Suburban Traction Co., Ltd.—The directors have declared a dividend at the rate of 5 per cent. per annum on the cum. pref. shares for the past half-year.

Blackpool and Fleetwood Tramroad Co., Ltd.—A final dividend of 4½ per cent. per annum, making 6½ per cent. for the year, is recommended, placing £615 to depreciation reserve, £5,499 to general reserve, writing down investments £995, carrying forward £4,250.

Traction and Power Securities Co., Ltd.—The directors recommend a dividend of 4s. 6d. per share, free of income-tax, on the ordinary shares for the year.

India.—The United Provinces Electric Supply Co., Ltd., is the name of a new undertaking which has lately been formed in Calcutta with a capital of 1,550,000 rupees.

South London Electric Supply Corporation, Ltd.—The directors have declared, subject to final audit, a dividend on the ordinary shares at the rate of 5 per cent. per annum for the year 1915, with a carry-forward of £2,900. Last year the dividend was at the same rate.

Yorkshire Electric Power Co.—Dividend on the ordinary shares, 1 per cent. for 1915.

National Gas Engine Co., Ltd.—Dividend on the ordinary shares, 7½ per cent. for 1915.

Winnipeg Electric Railway Co.—Dividend, 2 per cent. for the quarter ended December, 1915.

City of Buenos Aires Tramways Co. (1904), Ltd.—Balance dividend of 1s. 3d., making 5 per cent. for the year.

Metropolitan Railway Co.—The directors announce a dividend upon the ordinary stock for the past half-year at the rate of £1 per cent. per annum, making 1 per cent. for the year.

STOCKS AND SHARES.

Tuesday Evening.

The latest departure—it will no longer be latest at the end of this week—is the removal of minimum prices from several scores of stocks in the Colonial market which, since the opening of the Stock Exchange, have been protected in this manner by the Treasury regulations. Its effect upon the other parts of the Stock Exchange is marked by dulness in most gilt-edged securities, in consequence of the widening of the area of choice thrown open to the investor.

Home Railway gilt-edged stocks are still hedged round by the minimum prices, as are also a few Government stocks; and strong criticism is launched against the Treasury for not carrying out their plan at one fell swoop. Retention of minimum prices in the cases quoted simply serves to accentuate the confusion and uncertainty that were bound to arise; and if the Treasury had done away with the minima at one operation, it would have been better for investment all round.

The first of the electricity supply companies' dividends are now announced. The Westminster Co. is paying at the rate of 9 per cent., which gives 7 per cent. for the year—a reduction of 2 per cent. as compared with this time in 1915. The St. James' and Pall Mall has brought its year's dividend up to 8 per cent.—a reduction in this case also of 2 per cent. The other West End companies are expected to follow suit, and for some such falling away as this the market has been prepared by intelligent anticipation.

Prices have not moved at all. If dealers are asked how it happens that the quotations keep so comparatively steady, the answer always is that it was thoroughly well recognised that reductions of this sort could hardly be avoided. At the same time, the effect has been to make the shares a little more difficult to sell than they were previously; and probably, by the time that all the companies have announced their dividends, the changes in prices caused by the declarations will be practically nil. On the other hand, it is hardly likely that people will be eager to buy the shares, having regard to the lowered rate of return and the competition which it meets from Government borrowings.

Home Railway dividends are also beginning to make their appearance, and that of the Metropolitan was one of the first to be posted. The company is paying at the rate of 1 per cent., making 1 per cent. for the year, which is ¼ per cent. less than that for the corresponding twelvemonth. The price of the stock gave way, and Districts dropped in sympathy. Metropolitan Surplus Lands receives 2¼ per cent., the same as usual. Underground Electrics, however, have kept firm, notwithstanding depression in the prices of the Home Railway market as a whole, and the company's 6 per cent. income bonds maintain a very steady position about 83½.

The London & South-Western started its extended electrified train system on Monday, and, as it happened, could scarcely have chosen a more inauspicious day, having regard to the darkened conditions under which trains had to run in the evening in consequence of the Zeppelin visit to the provinces. The only people who failed to see a rather humorous side to the business were the travellers using the line during the affected hours. One of the most inexplicable developments to the ordinary layman was the stoppage of the lifts at some of the stations on the City & South London, but this was not the only thing which gave rise to some wonderment on that evening.

Brazil Tractions have gone back to 51½, although as this is ex dividend, the actual fall is trifling. The company is doing well, and for the eleven months to the end of last November the published earnings show an increase over those of 1914 of two million milreis. Even with the exchange as low as 11½d., it is thought that the company will be able to maintain 4 per cent. dividend, at any rate, which would give a return of 7¾ per cent. on money invested at the present price.

The Canadian and American power companies are mostly doing well, good November statements being issued, *e.g.*, by Shawinigan Water & Power, Mississippi River Power, and Pennsylvania Water & Power companies. There is not much business passing in these; but when the Americans have bought their own railway stocks up to comparatively small-yielding levels, the prosperity of the States will undoubtedly bring industrials to the fore and may easily cause active demand for this class of investment.

Americans during the last few days, however, have been on the dull side—partly because of labour troubles, partly because of President Wilson's brave words to Germany. Not that anybody on this side pays much heed to the latter, but the Americans themselves have stopped buying shares for a time, probably because the prices which most of the active securities have attained are already high enough. American Marconis have gone back with the rest of the list, reacting to 16s., while Canadians are also a dullish spot at 6s. 3d.

Anglo-American Telegraph preferred has risen a point. Eastern Extensions are ⅛ up, and so are Globe ordinary. The debenture stocks in this section are lower: this is due to the removal of the minimum prices, as mentioned in the first paragraph. With Colonial Government stocks reduced to figures at which they pay 5¼–5½ per cent. on the money, industrial securities have had to come down in sympathy. In favour of the latter, it may be pointed out that in most cases they are irredeemable, whereas the others are terminable at fixed dates. This will give the first-mentioned class a decided advantage in the days when money becomes cheap and investment stocks start to rise once more. For the time being, however, it is bound to weigh heavily upon fixed-interest stocks, particularly of the kind to which industrial debentures belong.

The Mexican position is no better, so the prices for Mexican utilities are again easier. With President Wilson's mind concentrated upon the European War, it is thought that he will have no time to carry out any constructive policy of amending Mexican conditions. Therefore all of the stock and shares connected with the country are weak, and in too many cases unsaleable.

British Westinghouse preference have gone back 1s. 3d. to 43s. upon more cautious views prevailing as to what the next dividend is likely to be. Henleys rose 5s. to 13¼, and Telegraph Constructions are £1 up at 36, this market as a whole being a strong one. Iron and Steel shares throughout are firmly held.

The armament section is in more favour. Rubber shares gave way with the price of the raw product, the latter dropping below 3s. and causing some of the recent optimists to take sudden fright, and to sell their shares. At the same time, the decline in rubber brought about a cessation of the buying, with the result that business fell away to a fourth or fifth of what it was ten days ago. The check will do no harm, if it helps to nip in the bud the gambling spirit that was on the increase day by day; and the proprietors of shares in good-class rubber companies need feel no anxiety on the score of their concerns doing excellently well though rubber may drop to half-a-crown per lb.

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SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Feb. 1, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.				
Brompton Ordinary	10	7½	—	£5 18 4
do. 7 per cent. Pref.	7	7	—	5 0 0
Charing Cross Ordinary	5	3½	—	7 2 10
do. do. 4½ Pref.	4½	3½	—	6 0 0
do. do. City Pref.	4½	3	—	7 10 0
do. 4 Deb.	4	75	—	5 6 8
Chelsea	5	4	—	6 5 0
do. 4½ Deb.	4½	87	—	5 3 6
City of London	9	12½	—	7 7 3
do. do. 6 per cent. Pref.	6	11	—	5 9 1
do. do. 5 Deb.	5	98	—	5 2 0
do. do. 4½ Deb.	4½	85	—	5 6 0
County of London	7	10	—	7 0 0
do. do. 6 per cent. Pref.	6	10½	—	5 17 3
do. do. 1st Deb.	4½	85	—	5 5 0
do. do. 2nd Deb.	4½	88	—	5 8 0
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	1⅜	—	8 8 4
do. do. 6 per cent. Pref.	6	4½	—	7 1 2
do. do. 4 Deb.	4	75	—	5 4 0
Metropolitan	8½	2½	—	7 15 7
do. 4½ per cent. Pref.	4½	3	—	7 10 0
do. 4½ Deb.	4½	85	—	5 6 0
do. 3½ Deb.	3½	70	—	5 0 0
St. James' and Pall Mall	10	6	—	8 6 8
do. do. do. 7 per cent. Pref.	7	6	—	5 16 8
do. do. do. 3½ Deb.	3½	70	—	5 0 0
South London	5	2⅜	—	7 5 6
South Metropolitan Pref.	7	1 7/8	—	6 14 0
Westminster Ordinary	9	6	—	7 10 0
do. 4½ Pref.	4½	4	—	5 12 6
Telegraphs and Telephones.				
Anglo-Am. Tel. Pref.	6	100½	+1	5 19 0
do. Def.	33/6	21½	—	7 14 8
Chile Telephone	8	6¾	—	6 10 8
Cuba Sub. Ord.	5	7⅜	—	6 9 0
do. Pref.	10	14½	—	6 18 0
Eastern Extension	7	12½ xd	+ ⅛	*6 5 0
do. 4 Deb.	4	75	—4	5 6 8
Eastern Tel. Ord.	7	127½ xd	—	*6 5 0
do. 3½ Pref.	3½	64⅛	—	5 8 6
do. 4 Deb.	4	75	—4	5 6 8
Globe Tel. and T. Ord.	6	10½	+ ⅛	*6 10 6
do. Pref.	6	10⅜	—	5 17 1
Gt. Northern Tel.	22	33⅜	—	6 10 4
Indo-European	13	49	—	6 15 4
Marconi	5	1 1/16	—	5 3 1
New York Tel. 4½	4½	100⅜	—	4 9 1
Oriental Telephone Ord.	10	1⅜	—	5 6 8
do. Pref.	6	⅞	—	6 17 2
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	1	5⅞	—	*7 19 0
do. Pref.	5	4⅞	—	5 8 1
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	12⅜	—	*6 4 6
do. 4 Deb.	4	77 xd	—2	5 4 0
Home Rails.				
Central London, Ord. Assented	4	69	—1	5 16 0
Metropolitan	1⅜	24⅜	— ⅜	5 2 0
do. District	Nil	15	— ½	Nil
Underground Electric Ordinary	Nil	1 1/16	— 1/16	Nil
do. do. "A"	Nil	6/6	—	Nil
do. do. Income	6	88½	+ ½	*8 4 0
Foreign Trams, &c.				
Adelaide Sup. 6 per cent. Pref.	6	6	—	6 0 0
do. 5 Deb.	5	95	—	5 5 0
Anglo-Arg. Trams, First Pref.	5½	4⅛	—	6 13 6
do. 2nd Pref.	5½	3⅝	—	8 3 0
do. 4 Deb.	4	71	—	5 12 8
do. 4½ Deb.	4½	77	—	5 17 0
do. 5 Deb.	5	80	— ½	6 5 0
Brazil Tractions	4	61½ xd	— ½	7 15 4
Bombay Electric Pref.	6	10 xd	—	6 0 0
do. 4½ Deb.	4½	85	—	5 8 0
British Columbia Elec. Rly. Pfce.	5	58	—1	8 9 6
do. do. Preferred	—	38	—2	Nil
do. do. Deferred	—	34	—1	Nil
do. do. Deb.	4½	64	—	6 12 10
Mexico Trams	Nil	39	—	Nil
do. 5 per cent. Bonds	—	45	—1	Nil
do. 6 per cent. Bonds	—	88	—1	Nil
Mexican Light Common	Nil	29	—	Nil
do. Pref.	Nil	28	—	Nil
do. 1st Bonds	—	45	—2	—
Manufacturing Companies.				
Babcock & Wilcox	14	21 1/16	—	5 4 1
British Aluminium Ord.	5	22/6	—	4 9 0
do. Pref.	6	18/-	—	6 13 4
British Insulated Ord.	15	10½	—	7 2 10
do. Pref.	6	5⅝	—	5 11 7
British Westinghouse Pref.	7½	48/	—1/3	6 19 4
do. 4 Deb.	4	69	—	5 14 10
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	11½	—	6 13 4
do. 5 Pref.	5	4½	—	5 17 8
do. 4½ Deb.	4½	90	—	5 0 0
Castner-Kellner	20	8½	—	6 8 0
Edison & Swan, £3 pd.	Nil	7/6	—	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	60	—	6 13 4
do. do. 5% Deb.	5	60	—	8 6 8
Electric Construction	6	15/-	—	8 0 0
do. do. Pref.	7	1	—	7 0 0
Gen. Elec. Pref.	6	9½	—	6 3 1
Henley	20	13½	+ ½	*8 6 2
do. 4½ Pref.	4½	4½	—	5 6 0
do. 4½ Deb.	4½	92	—	4 17 9
India-Rubber	10	9½	—	*12 19 0
Telegraph Con.	20	36	+1	*7 12 6

*Allowance made for dividends being paid free of income-tax.

Electric Industrial Vehicles in the U.S.—According to some information just to hand, there are at present no fewer than 24 concerns in the United States building electrical motor vehicles of the industrial type. The number of different models constructed is 53, ranging in capacity from 7 cwt. to 9 tons.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, February 2nd.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	..	..
a " Nitric	"	..	..
a " Oxalic	per lb.	1/4	..
a " Sulphuric	per cwt.	..	..
a Ammoniac Sal	"	..	..
a Ammonia, Muriate (large crystal)	per ton	£54	£4 inc.
a Bleaching powder	"	..	..
a Bisulphide of Carbon	"	£33	..
a Borax	"	£25	..
a Copper Sulphate	"	£15	..
a Lead, Nitrate	"	..	..
a " White Sugar	"	..	..
a " Peroxide	"	..	..
a Methylated Spirit	per gal.	..	..
a Potassium, Bichromate, in casks	per lb.	..	..
a Potash, Caustic (88/90 %)	per ton	..	..
a " Chlorate	per lb.	1/8	..
a " Perchlorate	"	1/6	..
a Potassium, Cyanide (98/100 %) (for mining purposes only)	"	Nom.	..
a Shellac	per cwt.	75/-	..
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	"	£11 10	..
a " Recovered	"	..	..
a " Lump	"	£9	10/- inc.
a Soda, Caustic (white 70/73 %)	"	..	..
a " Chlorate	per lb.	1/4½	..
a " Crystals	per ton	60/-	..
a Sodium Bichromate, casks	per lb.	8½d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	..	..
b " Wire, in ton lots (1 to 14 S.W.G.)	"	..	..
b " Sheet, in ton lots	"	..	..
g Babbitt's metal ingots	"	..	..
c Brass (rolled metal 3" to 12" basis)	per lb.	1/2⅜ to 1/2⅞	½d. inc.
c " Tubes (solid drawn)	"	1/3½ to 1/4	½d. inc.
c " Wire, basis	"	1/2½ to 1/3½	½d./⅝d. inc.
c Copper Tubes (solid drawn)	"	1/4½ to 1/5	1d. inc.
g " Bars (best selected)	per ton	£131	£6 inc.
g " Sheet	"	£131	£6 inc.
g " Rod	"	£131	£6 inc.
d " (Electrolytic) Bars	"	£128	£6 inc.
d " " Sheets	"	£141	£6 inc.
d " " Rods	"	£130	£6 inc.
d " " H.C. Wire	per lb.	1/3½	1d. inc.
f Ebonite Rod	"	3/-	..
f " Sheet	"	2/6	..
a German Silver Wire	"	2/2	4d. inc.
h Gutta-percha, fine	"	6/10	..
h India-rubber, Para fine	"	3/2	4½d. dec.
l Iron Pig (Cleveland warrants)	per ton	65/9	5/9 inc.
l " Wire, galv. No. 8, P.O. qual.	"	£30	..
g Lead, English Pig	"	£32 5	25/- inc.
g Mercury	per bot.	£16 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e " " " medium	"	8/6 to 6/-	..
e " " " large	"	7/6 to 14/- & up.	..
e Nickel, sheet, wire, &c.	"	Nom.	..
p Phosphor Bronze, plain castings	"	..	..
p " " rolled bars & rods	"	..	..
p " " rolled strip & sheet	"	..	..
e Platinum	per oz.	..	..
d Silicium Bronze Wire	per lb.	1/6	3d. inc.
r Steel, Magnet, in bars	per ton	£85	..
g Tin, Block (English)	"	£181 10	£4 10 to £5 10 inc.
n " Wire, Nos. 1 to 18	per lb.	2/9	1d. inc.
p White Anti-friction Metals	per ton	..	..
k Zinc, Sh't (Vieille Montagne brd.)	"	Nom.	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

Callender's Hospital Fund.—On Monday last, at the Belvedere Works of Callender's Cable and Construction Co., Ltd., the thirteenth annual report of Callender's Hospital and Distress Fund was unanimously approved. Despite the war and all its disturbing influences the work of the Fund was well sustained during 1915. A large number of members had joined the Colours and naturally subscriptions showed a decrease. The highest sum on record has been, on this occasion, voted to the hospitals. The penny weekly subscriptions amounted to £270 against £281 in the previous year. The Committee resolved not to appeal to the donors this year owing to the war demanding so many calls. The awards to hospitals and other institutions were £285. The report gave particulars of the number of hospital letters issued, and the number of special home-nursing letters granted, and stated that a large number of applicants were supplied with surgical appliances, spectacles, convalescent home letters, and financial assistance.

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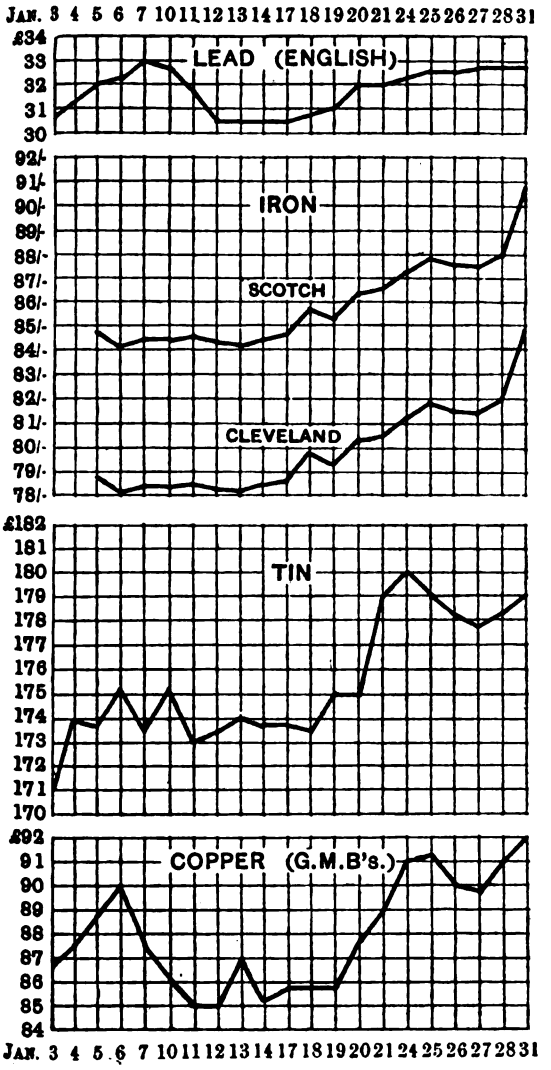
METAL MARKET.

Fluctuations in January.



Turbine Development in the U.S.—Our contemporary *Power*, in its review of the year, refers to the increasing size of American steam turbine units. Several machines of 30,000 KW. capacity are in service, as is also the 35,000-KW. unit of the Philadelphia Electric Co.; a 40,000 K.V.A. machine has been ordered by the Duquesne Light Co., of Pittsburg; the Detroit Edison Co. is contemplating 45,000 KW. units at a new station to be added to the Delray group; and rumour has it that a 50,000-KW. unit is soon to be built. In connection with large turbine units a two-stage condenser has been proposed, in which part of the steam is to be condensed in the first stage at a vacuum of, say, 29 in., the balance of the steam passing through the final stage of the turbine to the second stage of the condenser under a vacuum of 29½ in. An appreciable gain is expected over the standard condenser, and extremely high vacuums are possible without undue increase in area of the final stages of the turbine.

Australian Patents Board.—The Commonwealth Minister for Public Instruction recently caused the appointment of a Patents Investigation Board, to enable persons who had made inventions likely to be of use to the public, to have the merit of such inventions demonstrated or investigated without cost to themselves. If, after investigation, it is shown that an invention possesses novelty and merit, and is likely to be of assistance to industry, the general Board will consider it, and, if favourable, will recommend the Government to assist the inventor in developing and perfecting it, and experimenting with it.—*Sydney Morning Herald.*

An Inquiry from Lyons.—H.M. Consul at Lyons reports that a dealer in accessories of all kinds for electric lighting, who has considerable orders which cannot be satisfied owing to shortage of local supplies, desires to get into communication with United Kingdom manufacturers of such accessories. (Reference No. 22.) Apply to the Board of Trade Commercial Intelligence Branch, London.

MUNICIPAL ELECTRICITY SUPPLY AT JOHANNESBURG.

By R. TURNBULL MAWDESLEY.

(*Continued from page* 101.)

Boiler Plant.—The boiler house, which runs parallel with the engine-room, at present contains 16 boilers in all, 14 being of the standard land type and one of the standard marine type, by Messrs. Babcock and Wilcox, all with integral superheaters; and one "Bettington" atomised-fuel boiler, with superheater and economiser. The steaming capacities of the boilers are approximately as follows:—

3	B. & W. Land type, each of	500 H.P.,	7,000 lb. per hour.
7	" " "	750 H.P.,	11,000 " "
4	" " "	1,000 H.P.,	17,000 " "

The B. & W. marine type boiler has a capacity of 34,000 lb. per hour, and has a stack with the Prat induced-draught system, and an economiser placed above the boiler. All the above boilers have chain grates electrically driven.

The "Bettington" boiler, designed by the late Lieut. Claude Bettington, is not, so far as the writer is aware, very well known in Great Britain, and in view of this a brief description will not be without interest.

This boiler is capable of evaporating 34,000 lb. of water per hour, at 180 lb. pressure, with feed-water at 85° F., and of superheating the steam 150° F.

The broad principle consists in the use of a vertical "gas" (powdered coal) jet inlet, so constructed that an

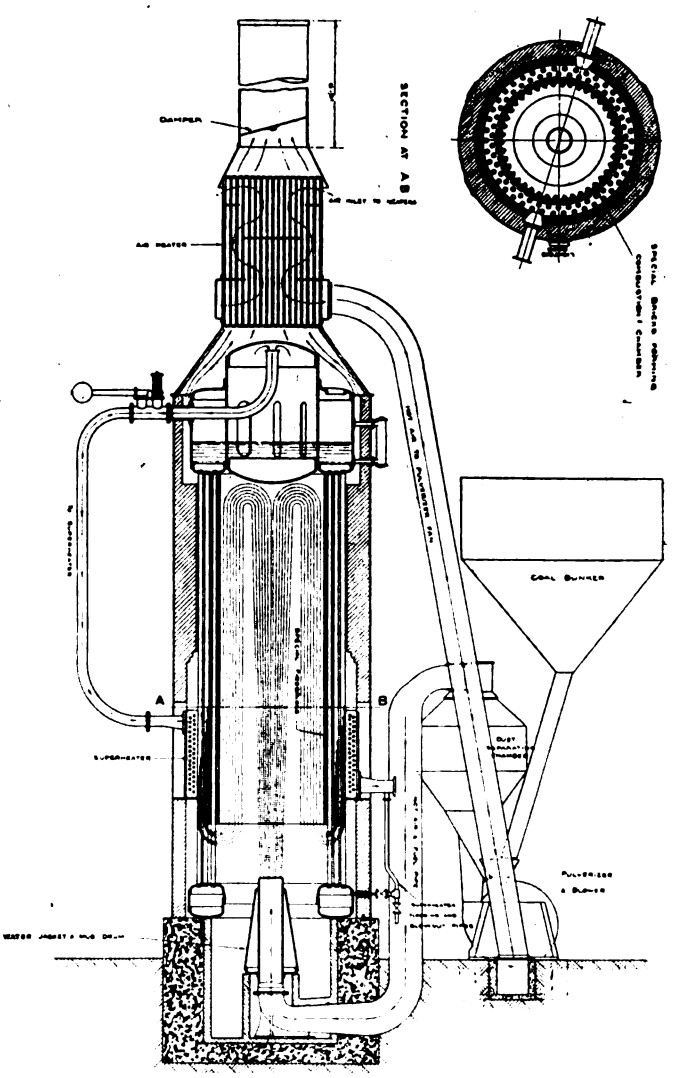


Fig. 8.—Sectional Elevation and Cross Section of Bettington Boiler, showing Path of Gases.

umbrella-shaped flame is produced within a closed ring of vertical water-tubes, which form the main heating surface of the steam-producing plant. Fig. 8 shows a sectional elevation and cross-section of the Bettington boiler.

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The coal is powdered by two pulverisers, situated directly in front of the boiler, one being driven by an A.C. motor and the other by a D.C. motor. These pulverisers also act as blowers—and it has been found that one pulveriser is quite sufficient to supply fuel up to the normal output of the boiler. The air supply to the pulveriser is pre-heated by the escaping flue-gases, and by this means

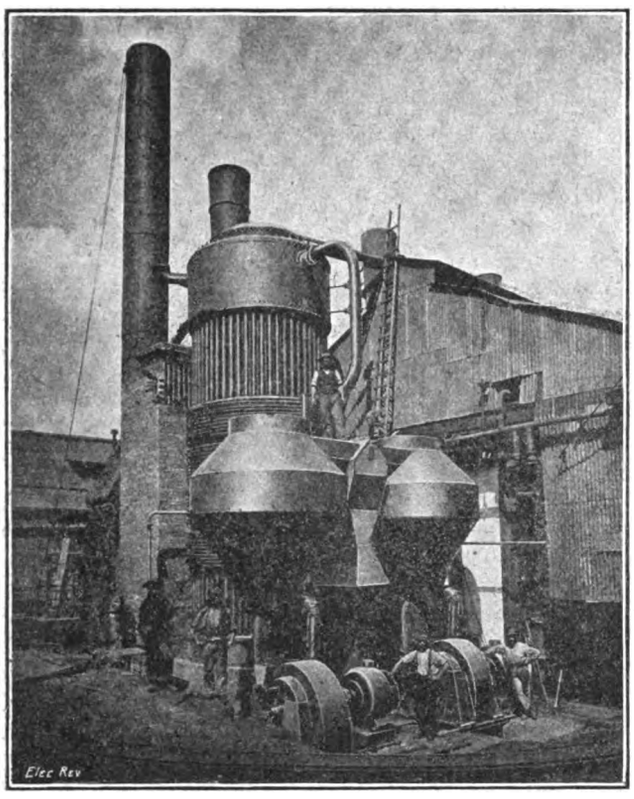

Fig. 9.—Bettington Boiler in Course of Erection.

coal of 15 per cent. moisture is handled satisfactorily. From the pulveriser the coal passes to a separator, the larger and heavier particles returning to the pulveriser and the finer fuel passing direct to the tuyere, which is surrounded by a water jacket, and forms a mud drum.

The tubes surrounding the combustion chamber are lined with refractory material to within a short distance of the bottom header. No fireclay is used in lining this chamber, the fire-bricks being merely stacked in position. The ash of the fuel in its passage through the zone of highest temperature is converted into liquid spray, which quickly fills up the interstices, and the surplus, in time, trickles down to the bottom edge, from which it drips, in small globules, to the ash-pit below. The result is that the furnace keeps itself quite clear of slag at all rates of combustion, and deposits slag in a manageable form—*i.e.*, in globules about $\frac{1}{2}$ in. in diameter, in the ash-pit.

The heating up and continuous ignition of the incoming stream of dust and air, is effected primarily by the enveloping sheath of the products of combustion—a mixture of gases (CO_2, H_2O, and N principally), at a temperature of about 3,000° F.

This "self-igniter" does not change in position more than 10 per cent., no matter how great a velocity is given to the incoming coarse "gas" (coal dust).

Ignition is independent of the incandescent brickwork, which is, in its turn, dependent upon its proximity to the place of combustion for incandescence. The returning gases always ensure incandescent brickwork round the tuyere, and, after a temporary stop, the fire may be re-started by turning on the fuel supply.

The boiler is fired up when cold by means of a Bunsen coal gas jet, which passes through the tuyere. (This gas supply comes from the neighbouring gasworks.) The pulveriser is run with the damper closed until a rich mixing is available, and then the full mixture is turned on. When this coarse "gas" is ignited, the Bunsen flame is turned off, and the fuel and air supply regulated.

It is possible to put this boiler on the range within 25 minutes of lighting up from dead cold—and this is a distinct advantage in a station of low load factor such as Johannesburg. As all the fuel is consumed in suspension, it follows that as soon as the fuel is shut off, the fire is extinguished like a gas jet, and there are practically no stand-by losses.

By means of a CO_2 recorder, or even by observing the colour of the flame, it is possible to regulate the proper supply of air and fuel to obtain absolutely smokeless combustion.

Anthracite coal, of course, is not suitable for burning in this boiler; when pulverised very finely, it burns fairly well, but not so well as coal having a higher percentage of volatile matter.

The boiler is equipped with a superheater, the tubes of which pass round the outside of the lower portion of the water tubes which form the combustion chamber.

The gases pass from the boiler into the feed section (which consists of two steel headers, stayed with expanded steel tubes, together with the necessary feed connections, and brick housing), and from there through the air heater away to the stack.

Fig. 9 shows the Bettington boiler in course of erection, the vertical water tubes and the superheater tubes being visible. The economiser is shown at the rear, and the motor-driven pulverisers and separators in the foreground. (Since the photograph was taken the existing boiler house has been extended to cover in the Bettington boiler.)

Notwithstanding the extra cost of pulverising, &c., it would seem that this boiler is not less efficient than the best known makes of water-tube boiler. It was supplied by Messrs. Fraser & Chalmers, Ltd., to whom the writer's thanks are due for the diagram in fig. 8, and for the figures of the steaming capacity.

Referring again to the Babcock boiler plant, not all

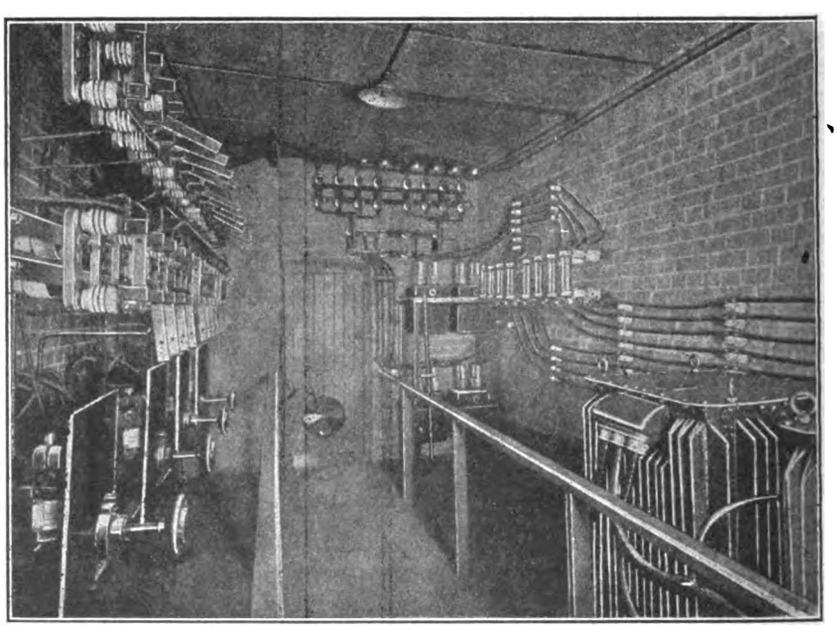

Fig. 10.—Doornfontein Transformer Station.

these boilers are furnished with economisers, only seven economisers in all being installed, apart from the two mentioned. These are of the well-known "Green" make, and each has motor-driven scrapers as usual.

All the make-up water for the boiler feed is derived from the town mains, and is treated by the addition of four gallons of "Noxall" fluid in 24 hours. There is a

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small de-oiling tank for electrically treating the condensate before it returns to the feed tanks. The feed pumps are all rotary pumps, partly turbine-driven and partly motor-driven.

An overhead coal bunker extends above the boilers for the whole length of the boiler house, with bucket elevator and conveyor, drawing coal from a sunk hopper, into which the coal is tipped from railway wagons.

An ash tunnel runs underneath the boiler house, along which small skips take the ashes to an end hopper, from which they are elevated to a silo, raised sufficiently above ground to enable carts to draw under. All ashes are removed from the site by the Sanitary Department of the Municipality. The coal and ash-handling plant and the bunkers were installed by Messrs. Reunert & Lenz, Ltd., of Johannesburg.

There are altogether eight stacks, five with the Prat induced-draught system, with two boilers to each stack. The marine type boiler has a stack to itself, as before

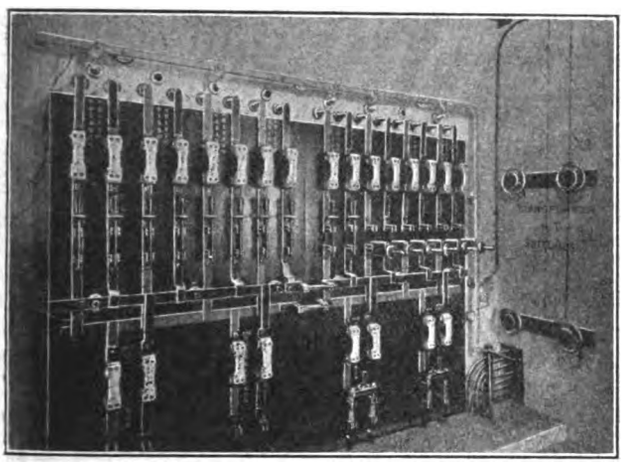

Fig. 11.—Link Chamber, Doornfontein Sub-Station.

explained. The Bettington boiler has its own stack with induced draught, and there is a further natural draught stack which accounts for three boilers.

It is, of necessity, a difficult matter to describe a boiler plant, which had originally no design—but which has been added to, from time to time, as the necessity arose. This, as previously pointed out, has been a difficulty with which the Department has had to deal from the beginning—and it is no small achievement to have carried out the work without serious interruption.

With reference to the outer area distribution, fig. 10 shows the subterranean transformer sub-station at Doornfontein. There are actually two chambers here, one containing the transformers and H.T. switchgear (fig. 10), and the other the low-tension distributing board (fig. 11). In fig. 11 the plus and minus signs painted on the bus-bar strips are misleading, the supply being, of course, alternating current, single-phase, at 200 volts.

Similar sub-stations and underground link chambers are in operation at Braamfontein and other important suburban centres, and it may be stated that some 60 townships, apart from the inner area, are at present supplied from the power station. New connections to the mains average about 100 per month.

(*To be continued.*)

Electrically-controlled Change-Speed Gear for Motor Vehicles.—We hear that considerable interest is just now being shown in motor manufacturing circles in a new electrically-controlled system of change speed gear for motor vehicles in which electro-magnetic clutches play an important part. The arrangement has been submitted to the most exhaustive tests, with the result that one of the largest motor manufacturing concerns in the country is reported to have decided to adopt it on all its new cars when once again it is in a position to revert to the manufacture of cars for the public, the factory being at present entirely engaged on Government work..

CONTROL EQUIPMENTS FOR MACHINE TOOLS.

It has long been recognised by manufacturers and users that to operate a machine tool at its highest efficiency there should be possible a wide variation in speed in each individual tool. When tools are driven from long lines of shafting, this is not economically possible, but when tools are individually driven by electric motors they may be operated at any speeds independent of any other tool in the works.

To obtain the maximum efficiency, therefore, it is not only necessary to adopt individual motor drive for the machine tool, but the control of the driving motor must be simple, free from complication, and enable the operator to obtain the maximum output with the minimum risk.

The motor control should be entirely automatic, requiring no attention from the operator beyond pressing the control button or throwing over the control arm and enabling him to devote his whole attention to the work in hand. The automatic control should ensure that the motor starts, reverses, or stops in the shortest safe time when required, and that it is protected against excessive overloads at all times.

The following control equipments have been developed to meet the above requirements; they are classified under four headings as follows:—

(*a*) Non-reversing control without dynamic braking.
(*b*) Reversing control without dynamic braking.
(*c*) Non-reversing control with dynamic braking.
(*d*) Reversing control with dynamic braking.

The apparatus comprising the complete equipment is determined to an extent by the conditions of service, but all equipments have a common feature in the accelerating unit, which is an automatic device giving full protection to the motor, and ensuring that the machine starts or stops in the shortest safe time.

All these equipments are for constant speed machines, but they can be used for variable speed machines in conjunction with a field rheostat and a relay.

Standard equipments are designed for capacities up to 10 H.P. and for voltages up to 550. Non-reversing control equipments without dynamic braking can also be supplied up to 15 H.P. at 200/250 volts, and up to 25 H.P. at 400/550 volts.

The operation of the equipment is as follows:—When the control switch is closed, current flows through the motor armature, which is then in series with the full starting resistance and the first coil of the series contactor or accelerator, and the motor starts up slowly.

As the speed increases, the current taken from the line decreases, and when it reaches the value for which the

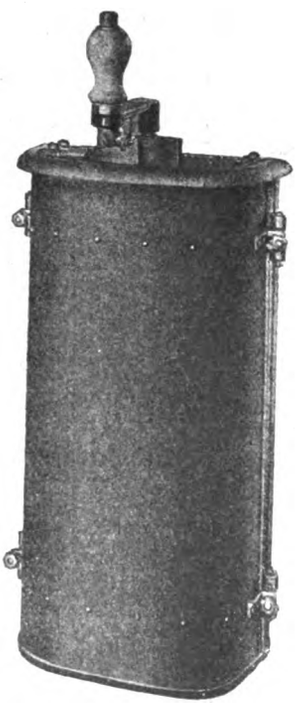

Fig. 1.—Controller for B.T.H. Machine Tool Control.

accelerator is set the first contactor closes and cuts out a section of the starting resistance. This results in a fresh current increment, and the operation is repeated by each contactor until the whole of the starting resistance is cut out and the motor is connected to the line.

The accelerator is designed so that each section of the resistance is cut out in the shortest safe time, while the motor current is kept within safe limits.

Each contactor switch is automatically locked open so long

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as the current flowing through its coil exceeds the value for which it is set. The motor is thus protected against excess current at each step of the accelerator.

On moving the control switch to the "off" position, the motor is disconnected from the line, and consequently comes to rest.

Where a quick stop is required, this is accomplished by means of a controller arranged for dynamic braking. When the handle of this controller is moved to the "braking" position the connections are changed, so that all the starting resistance is connected in series with the motor armature. The motor is then quickly brought to rest by dynamic braking, the contactor switches in this case acting as a retarding device and cutting out the resistance step by step as the speed of the motor decreases.

The accelerating unit consists of a number of series contactors, or electrically-operated switches, mounted on a slate

FIG. 2.—PUSH-BUTTON SWITCH FOR B.T.H. MACHINE TOOL CONTROL.

base, behind which the starting resistance is mounted, the whole unit being totally enclosed in an iron box suitable for attaching to a wall.

Each contactor when closed short-circuits a section of the starting resistance, so that when all the contactors are closed, the motor is connected direct to the line.

The special feature of these contactors is that they remain open if the current passing through the series-operating coil exceeds a predetermined value, and close immediately the current decreases to that value.

The first contactor coil is connected in series with the starting resistance, so that on closing the control switch the current passes through this contactor coil. As the motor accelerates the current decreases until it reaches the predetermined value at which the contactor is set to operate. The first contactor switch immediately closes and short-circuits the first section of the starting resistance, at the same time completing the circuit through the second contactor coil. This short-circuiting of the starting resistance causes an instantaneous current increase, which locks the second con-

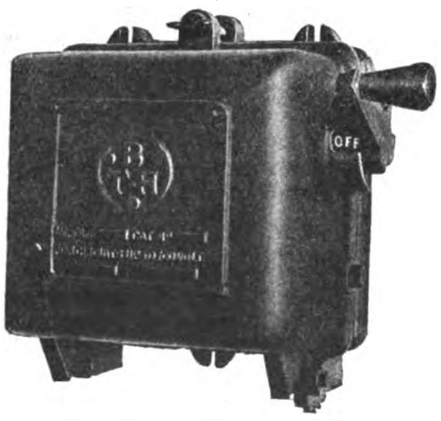

FIG. 3.—MAIN SWITCH FUSE FOR B.T.H. MACHINE TOOL CONTROL.

tactor in the open position until the current again decreases to the predetermined value due to the speeding up of the motor. Each section of the starting resistance is short-circuited in a similar manner.

The whole device is extremely simple, due to the fact that the coil used for closing the contactor is also used to hold it open until the current has decreased to a safe value. The coil, being a series coil, is wound with wire or strip of ample section so that it is not likely to be damaged by the instantaneous current rushes.

The controllers supplied for these equipments are three-way switches built in the form of drum type controllers, and are supplied for reversing or non-reversing.

The controllers supplied for non-reversing control equipments, as well as those for reversing control equipments, are fitted with crank handles which can be moved to any of three stops. In the case of the former for forward running or for braking positions, and in the case of reversing controllers with dynamic braking, these stops correspond to forward running, braking, and reverse running positions. For those without dynamic braking, the stops correspond to forward running, off and reverse running positions.

Controllers are fitted with magnetic blow-out coils, and are suitable for breaking the main current.

The main switch fuse is of the double-pole quick-break type, enclosed in a cast-iron case.

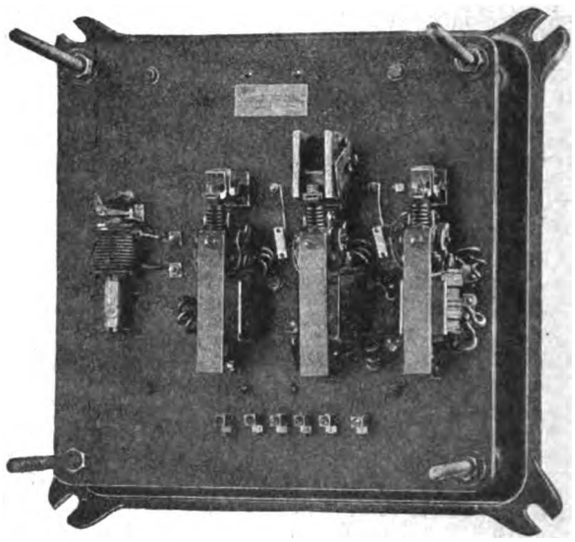

FIG. 4.—ACCELERATING UNIT FOR B.T.H. MACHINE TOOL CONTROL (cover removed).

Equipments without dynamic braking can be supplied with push-button control, in which case the connections are specially arranged, so that the result obtained on pressing any one button is maintained after releasing the button, and continues until a separate button is pressed.

The construction of this control switch is shown in the illustration. The contacts are mounted on a slate base and enclosed by a metal case, through which the push buttons project.

When variable speed control is required, the foregoing equipments must be supplemented by a hand-operated field rheostat and a field relay to prevent the motor being started with a weak field.

The relay supplied for this extra equipment permits the motor to be stopped and then started again without the risk of starting on a weak field and without the operator having to pay attention to the position of the rheostat handle. Thus, when the field rheostat has been set for a certain cutting speed, the motor will automatically run up to that cutting speed when restarted after a stoppage.

The control equipment described above is supplied by the British Thomson-Houston Co., Ltd., of Rugby, and is giving satisfactory service, not only in their own, but in many other works throughout the world.

THE DESIGN OF HIGH-PRESSURE DISTRIBUTION SYSTEMS.

MR. J. R. BEARD'S paper was discussed at a meeting of the YORKSHIRE LOCAL SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS, on January 12th, at Leeds.

The CHAIRMAN, Mr. H. H. WRIGHT, said that in many Yorkshire industrial districts the demand for power had grown at such a rate during the past few years that the station engineer had found some difficulty in keeping pace with it, the consequence being that many of the feeders were already overloaded; new feeders and transformer stations had had to be put down, and many questions had arisen similar to those dealt with in the paper. He thought the author erred on the side of safety in giving 22½ years as the period of depreciation for underground cables. The committee appointed by the INSTITUTION last year to investigate this question had come to the conclusion that a life of 30 years should be allowed for all classes of underground cables if laid with proper regard to the nature of the soil, and suggested 60 years as the life of conduits. In the lay-out of a distribution system it was not the first cost of switchgear that was so important as the fact that by the choice of suitable discriminating gear a saving of many times the cost of the gear might be made in mains, etc. The author made out a very strong case for core balancing and split-conductor systems of protection, but there were many existing systems to which they could not be applied.

Mr. J. E. STORR said he believed that distribution of power to the consumer's terminals for transformation on the site was undoubtedly the method by which they would have to

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transmit their larger loads in the future. He thought the general utility of the high-pressure transmission would be enhanced if the gear could be standardised on a pressure of 11,000 volts. The overhead system was undoubtedly the method by which the early development of an undertaking, which had a large area to cover, could be dealt with. He thought that pressures were bound to increase rather than remain stationary, but feared that the splitting-up of a 20,000-volt main to make it economical between sub-stations at such a high voltage would mean more than the number of switches allowed for intermediate sub-stations.

Mr. W. Lang thought that all practice showed that the survey of the route and the estimate of the probable demands that would be made for electrical power on that route were often very far short of what actually took place during a very short period. This had been instanced very especially during the war period; loads had come on to the mains that were never anticipated by the most sanguine of them. The value of the scrap copper of underground cables would, he thought, be more than that of the overhead lines.

Mr. A. R. Chaytor said he thought the best reason for the general neglect of the formula was given by fig. 4, which showed that for quite a considerable portion of the curve the annual cost was practically the same. It was hardly worth while, unless it was a very big undertaking, to work out the formula. He thought the scrap value after 17½ years of overhead lines would be nearer 10 per cent. than 20 per cent. With regard to underground mains and the 22½ years, he would give a 20 per cent. value and think the mains had 20 per cent. of their life left. It was usually forgotten that it was possible to take underground cables across fields for considerable distances; people compared the cost of overhead lines with underground cables to the disadvantage of the latter, from the fact that they were usually laid through the busy portions of towns and had to bear the cost of reinstatement of pavement.

Mr. J. Shepherd said he did not think the author gave full value to the overhead system; in England they did not use that system to anything like the extent that they did in other countries. At Zurich they had actually put up overhead lines for a distance of something like 80 miles. The same system was shortly to be introduced in Berlin. All the inner stations in Berlin were being shut down, and the entire power, which would certainly run to 500,000 kw., would be transmitted by the overhead system a matter of something like 90 or 100 miles. If they could do that abroad he thought the time would come when, in England, they would have to adopt the overhead system for higher voltages. The Treasury usually allowed 25 years for the life of a cable, but he did not see, if cables were laid solid where no surface water came into contact with the lead, why they should not last 100 years. A good deal had been said about the calculation of the economical area, but if the data were incorrect all the calculations would be inaccurate. In getting out this economical area he did not think the author had made any allowance for the capital value of the plant required to compensate for the losses in the cable.

Mr. Wilson Hartnell said that no engineer in his senses would put down an underground wire if he could put the wire above ground. In most of the British Colonies, wherever public opinion was not against it, all the wires were put above ground. The Yorkshire Power Co. was carrying its wires where it could, but what he thought was needed was some very drastic legislation to empower the company to carry the wires over any land, irrespective of what the owners of the property thought of the matter.

Mr. J. H. Shaw said he desired to say a good word for the "change-over tee" system. In the undertaking with which he was connected it had been in operation for 10 years, and he believed they had only had six faults on some 60 miles of extra-high-tension mains. The author discussed the diversity factor as helping the interconnected system; that might be all right for the North-East Coast, but in towns where the trades were similar and started more or less at the same time, and left off at the same time, there was no diversity factor.

The Author, in the course of his reply, said the 22½ years for cables was not intended to be taken as an actual figure; it simply worked out at that owing to his taking 2 per cent. He was very glad that his capital charges had been criticised as being on the high side. He still felt, however, that the figure was somewhere about what it should be, and it did not really conflict with the Local Government Board's revised figures so much as appeared. He agreed that the life of cables was probably very much more than 22½ years, and in the Newcastle district in very few cases had any serious depreciation of cables been found; many of them had been in since 1901, and some which were put in then were as sound to-day as ever. Core balancing was not mentioned in the paper, but his people had used quite a lot of so-called core-balancing protection on single-ended feeders and on rotary-converter transformers, where it was very useful in giving an instantaneous trip on faults. He rather doubted whether one could usefully standardise voltages at present; what should be standardised was the frequency. His firm were putting up large mileages of overhead lines at present; there was no doubt, however, that in the North-East Coast district, if one talked to the operation people they would ask for cables every time. There were many ways in which overhead lines could be damaged, quite apart from questions of design; for example, they could not do away with hay blowing off a hayrick. The overhead lines were found to be useful in the early stages of development. Recently his firm had connected up a very big amount of munition load, and, in all cases, it had been so easy to do it that the supply had been available months before the firms had been ready to take it, although, in many cases, they were seven or eight miles from the company's power stations. The split-conductor for use on existing cables by running them in duplicate had been developed, and was now in quite successful operation. He believed his firm found that 2½ switches per sub-station was quite a reasonable figure. In the majority of sub-stations they only required two. He could not agree that the old rule-of-thumb was all right, but it was rather a surprise to him, in going through these calculations, to find that the densities came down to about the old figure of 1,000 amps. per sq. in. They had taken underground cables in many instances across fields, and, as a rule, it was more difficult to arrange for overhead lines. In open agricultural country the cables would have to be laid deeper than they had to be in the roads. He believed in Berlin they were experimenting with something like 60,000-volt underground cables. When he said that there were twice as many faults in overhead lines as in cables, they must not conclude that there was a great number of faults on the former. It simply meant that there were very few faults in the cables, and the number of faults they got on the overhead lines was quite sufficient to annoy consumers and, hence, generally forbade their use. Inductance in feeders had the disadvantage of tending to limit the area of distribution, and it should be avoided. The Americans, who strongly recommended inductance in feeders, were the people who had done nothing to develop switch design for about ten years. They brought out, ten years ago, a switchgear which was better than they had in England, but he did not think that that position of affairs obtained now. Rotary condensers had been used in two cases in Durham, with very satisfactory results. He quite agreed that one could do too much calculation in designing actual extensions. He had allowed for the capital value of the plant to supply the losses. In America water-power transmission had forced them into the use of very high voltages, and his eyes had been very much opened by some figures he had seen in an American paper with regard to the number of breakdowns on overhead lines on a large system. The figures were half-a-dozen times as great as one would expect on an English system. One thing which explained the use of overload lines in America was that there they did no mind a temporary interruption so much as did English people. Electrical people in America had got a free field, and if consumers did not want their supply they need not have it. In England, however, circumstances were entirely opposite. Here electricity competed all the time against other forms of power and lighting. On the North-East Coast it was almost invariably possible to couple up consumers on the interconnected system without any consideration whatever for the effect it would have on the protective arrangements of the rest of the system. On the North-East Coast they had very varied industries, and the industries themselves had very variable loads, and it was not a question of starting up a big block of machinery at a certain time and shutting it down at another time. The cost of the protective devices, he thought, could be readily explained by the fact that they had, up to the present, been used on very large systems, and the corresponding switchgear had been developed to suit these systems, and that was very expensive. If there was a demand for, say, the split-conductor system on lighter forms of gear, it should be readily designed to suit requirements.

ELECTRICAL ENGINEERS AND THE MOTOR CAR TRADE.

A question of some importance to electrical engineers was discussed at the meeting of the Agents' Section, Ltd., and the Motor Trade Association, which has just been held at Leeds. It may be mentioned that the first-named body is the Agents' Branch of the Society of Motor Manufacturers and Traders, while the M.T.A., as it is usually known, is an association of motor traders whose object is that of preventing, as far as possible, other than recognised and legitimate motor traders from securing trade terms, and of preventing price-cutting in manufacturers' standard productions. The main point under discussion was whether electrical engineers were entitled to trade terms on motor goods.

The opening speaker was Mr. G. Hubert Woods, of the British Westinghouse Co., Ltd., who stated that, as regards his company, the matter of electricians was a difficult one. The difficulty arose from the fact that they had a large number of electrical customers all over the country who were entitled to trade terms on electrical parts. Therefore, if trade terms were given to a firm on a dynamo which was going to be put on the floor, the question was naturally asked why trade terms should not also be given on a dynamo which was going to be put on a motor car. It was difficult for a manufacturing company to say, "unless you are *selling* motor cars, we cannot give you trade terms." He thought electrical motors would be very prevalent in the future, and he considered the right thing for both bodies was to legislate

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for a condition of things which could be seen coming, before it came. It would not necessarily be assumed that because electrical firms were admitted to membership of the Motor Trade Association, they were entitled to the same terms as motor agents. Manufacturers could give them a discount of some sort or other, but continue to give to the members of the motor trade the same discount as at present. Mr. Woods concluded by stating that if it would help matters along, he would propose that a class for electrical engineers be formed by the Motor Trade Association, and that they be admitted under that category provided their applications were proposed by the local division of the Association.

Mr. A. Goodwin, of Messrs. C. A. Vandervell & Co., Ltd., said that he did not agree with Mr. Woods' remarks as to it being difficult to define the difference between trade in a dynamo that was to be fixed on a floor and one that was to be affixed to a car. In his opinion, the line of demarcation was one of definite character. When a firm received an application for trade terms from electrical people, there was generally something which cropped up in the correspondence, or on the notepaper of the firm applying for trade terms that would give some clue as to the class of business the firm in question were doing. As regards his company, if the notepaper did not give any indication, their travellers on the spot made certain inquiries. In the case of lamp bulbs, however, it was impossible to refuse to supply them at full trade terms to any electrical firm in the trade, and, therefore, in his opinion, Mr. Woods' suggestion that the manufacturers should give electrical firms one class of terms and the legitimate motor trader another was one that could scarcely be followed in practice, although very nice in theory. The point was to give the manufacturer some basis to work upon, but he did not think the organisation could move in the matter as to where the line of demarcation should be drawn.

Mr. A. Noel Mobbs, of the Pytchley Autocar Co., Ltd., of Northampton, expressed the opinion that electrical firms should not be included in the M.T.A. It was, however, going too far to say that nobody but motor firms legitimately in the motor trade should be supplied with accessories in the electrical line which were fixed on motor cars at any discount whatever. If a few lamp bulbs were sold by electrical firms and used on motor cars, surely they could stand that. He thought the Association should go for simplicity, and that it would be sufficient to say that electrical firms should have trade terms on proper electrical goods without bringing them into the Association. He would propose a resolution to that effect.

In closing the discussion, the Chairman, Mr. A. R. Atkey, of Nottingham, said that it was no use trying to close one's eyes to the fact that the *bona-fide* electrical engineer was not only entitled to trade terms on electrical goods, but was looming on the horizon as one of the most important factors in connection with the motor industry, and if a deaf ear were turned to their application to join the Association, the time might come when the Association might feel sorry, and electrical firms might decline to carry out the interests of the trade. The ideal of the Association was not to prevent anybody earning a legitimate livelihood, but to embrace in the ranks and cover by its influence all those who could help in the general advance of the movement. The question the meeting had to decide was as to whether they would admit electrical engineering firms to a section, or whether they would close the Association against them and leave them outside and uncontrolled.

Eventually the following resolution was adopted:—"That in the opinion of this meeting electrical engineers shall be entitled to trade terms on electrical goods, but shall not be entitled to membership of the Agents' Section, Ltd., or the Motor Trade Association, or to trade terms on motor cars or accessories other than electrical, and that price maintenance agreements must be obtained from them."

Commenting on the meeting, the *Motor Trader*, to whom we are indebted for our summary of the proceedings, concludes:—"On the whole, the resolution, though in the nature of a *via media*, provides an acceptable solution of the problem. Electrical engineers may have no more than an academical interest in the motor trade, but to suggest that the manufacturers of electrical goods should recognise the distinction between motor and non-motor goods in supplying them would be imposing an almost impossible obligation. It is desirable, however, that eligibility for trade terms on one class of motor goods should not carry with it a similar privilege in regard to all motor goods."

ELECTRIC GENERATING STATIONS IN CHINA.

By Prof. C. A. MIDDLETON SMITH, M.Sc., A.M.I.E.E.

(*Abstract of paper read before the* Hong-Kong Local Centre of the Institution of Electrical Engineers.)

China is a country which, for practical purposes, is entirely devoid of roads. It is quite probable that 90 per cent. of the inhabitants of China have never heard of a steam engine, or of a heat engine of any description. The number of Chinese who have any idea of what is meant by the words "electrical power station" cannot be one-tenth of one per cent. of the population. Possibly about 10 per cent. of the people have seen the ordinary electric lamp, and about one-tenth of that number have seen a gas lamp.

In the whole of China there are only three places in which modern industrialism is even attempted on any scale such as is common in towns of, say, 50,000 inhabitants in England. These places are Hong-Kong (a British colony), Shanghai (a foreign settlement), and Hankow. In these places the work of the electrical engineer is very much in evidence.

The Hong-Kong dockyards probably employ about 600 Europeans and about 7,000 Chinese workmen.

The three dockyards are well equipped with all modern machine tools, many of which are motor-driven. In the Taikoo Dockyard there is a large central power station containing 1,000-B.H.P. gas engines and continuous-current generators with a total capacity of 2,250 kw. Mond gas producers supply the fuel for the engines. In the Naval Dockyard there is a central station with steam and Diesel engines.

In the colony of Hong-Kong there are two public electricity supply companies. That which is on the island and supplies the city of Victoria has a station containing 2,000 kw. of Diesel engines and 600 kw. of steam engines, and a new steam turbine-driven station is being planned. The present price of electrical energy as supplied by this company is 6d. per unit for lighting and 1½d. and 1¼d. for power. There is also a separate generating station for supplying power to the tramways. This is steam-driven, and probably will disappear in time. The Hong-Kong University has its own central station, installed largely for educational work, with a total capacity of rather over 100 H.P. of gas, oil, and steam engines, a steam turbine, and a Pelton wheel.

In Kowloon, on the mainland portion of the colony of Hong-Kong, the China Light & Power Co. supply light and power. Their plant is rated at 516 kw., but 1,500 kw. is to be installed this year.

Near Hong-Kong there is the Canton Electric Supply Co. Canton is the most populous and progressive city in China. There are well over a million inhabitants. The Canton Supply Co. uses steam and Diesel engines—it was originally a steam-engine station—and its total capacity is 1,540 kw. The Chinese shopkeeper is willing to pay high prices for electric light, and uses it in a most lavish fashion.

The great centre of electrical development in China is Shanghai. The conditions are more favourable in Shanghai than in any other place in the Far East for such enterprise, but at the same time many opportunities have been seized there which might easily have been lost.

The Shanghai generating station compares most favourably with anything of its kind in Europe or America. It is, indeed, a model for the Far East, and British engineers should be very proud of the fact that it has been built up under the direct personal supervision of a Britisher.*

The station is steam-driven with two 5,000-kw. and two 2,000-kw. turbines. Quite recently the chief engineer has suggested extensions which amount to 20,000 kw. It is almost certain that this region will be the first part of China to develop works and factories on a large scale.

An English firm have installed 102 steam engines in China, with a total rating of 28,960 B.H.P. Most of these are used for electricity supply.

Another British firm have installed in North China at Soochow a 375-kw. 3-phase alternator, direct-coupled to a high-speed steam engine, complete with high-tension switchboard, etc. In Chang Chow there is a 150-kw. 3-phase alternator direct-coupled to a high-speed steam engine complete with water-tube boilers, high-tension switchboard, transformers, etc. In Tientsin there are two 75-kw. continuous-current generators coupled to high-speed steam engines, supplied for extension lighting of the Japanese settlement. Further contracts recently secured are for the lighting of two other large Chinese cities; the electrical plant consists of one 200-kw. and one 150-kw. 3-phase alternator. A large number of single-phase and 3-phase motors from 5 up to 100 H.P. have also been supplied for use in cotton mills and other factories. An outlet for electrical plant is found in up-country hospitals, missions, and private Chinese residences where small dynamos driven by oil engines are very much in favour. Many small steam engines and dynamos for lighting river steamers have been sent to South China, as well as small oil-driven sets for hotels and private houses.

A merchant firm state that they have supplied various electric lighting installations in South China, including a large number of small private plants from 1 kw. to 10 kw.; also one 12-kw. 100-volt continuous-current set direct-coupled to a vertical semi-Diesel engine at Tung Shan, Canton. A large European firm have supplied important plants in the South.

In the case of the new installations the general practice at present seems to show that the Chinese commence on a scale of rather under 100 kw. Take a small oil-engine installation of 50 kw. The capital cost of the engines, foundations, dynamos, and switchboard would be (roughly) $13,000 (£1,300). A rough building and land would probably bring it up to $15,000 (£1,500).

We find at the University that crude oil can be used as fuel to cost less than 2¼ cents (¼d.) per unit; lubricating oil, and

* A full description of this station appeared in the Elec. Rev. of November 5th, 12th and 19th, 1915.

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waste, etc., say ½ cent (¼d.) per unit. Wages for supervision, drivers, etc., $200 (£20) a month, say $2,400 (£240) per annum. The output of the station is reckoned at 50,000 units per annum. The total generating costs are about 11 cents. (2¼d.) per unit. As overhead mains may be used, the distribution costs are low. Experience has shown that the Chinese will pay 25 cents (6¼d.) a unit, and there is clearly a very good margin of profit.

There is practically no legislation in China concerning electric supply, and if progress continues as at present, there will be endless annoyance and confusion for engineers and customers in a few years.

After two years of study of the subject, the author has the impression that at present the demand for electrical apparatus in China is on a comparatively small scale. Shanghai is the one great exception.

There is a great desire among all classes of the Chinese to have electric light, and experience in and around Hong-Kong seems to prove that they are quite willing to pay for it at even extravagant prices.

The plants already installed are having an educational effect. In nearly all cases extensions are contemplated.

The Chinese are particularly anxious to make use of applied science. The simple statement that, of the 167 students in the Hong-Kong University, 92 have selected engineering as a profession, shows quite clearly the direction of the thoughts of the more progressive parents.

Up till the present there has been practically nothing in the nature of an educative campaign on behalf of electrical machinery in China. There are difficulties, financial and administrative, to be overcome before this market is greatly increased, but the greatest difficulty of all is to provide object lessons to the Chinese, and to supply information and unbiased advice. In the furtherance of that work the Engineering Department of the Hong-Kong University will be happy to do its utmost.

The large oil companies are busily extending their market all over China. Possibly the immediate developments inland will be brought about by the use of oil engines or water turbines. The use of coal inland is not probable in the immediate future. Even in South China it is necessary to use Japanese coal, and the price seems to be about $10 (£1) per ton. The fuel problem is one that will be solved easily, when the Chinese begin properly to develop their own natural resources. The electrical engineer has to compete only with such crude illuminants as the candle and oil lamp.

In the discussion that followed, Mr. E. T. Williams said that without co-operation Great Britain could not hope to reap the possibilities of electrical work in a vast country like China. If this prospective market was to be really exploited, what was wanted was co-operation embracing the selling of machinery, the undertaking of contracts, and the devising and financing of electrical schemes; in other words, they must employ in China methods adapted to the circumstances of the country. The electrical and engineering firms of Great Britain should combine their resources for China, and then, having studied the possibilities, should distribute throughout the country a properly organised business network, largely composed of educated Chinese engineers under European control. This organisation should conduct in China the business of the united British interests. In time it would become a self-supporting organisation, and would create a great demand for the electrical manufactures of Great Britain.

Mr. D. W. Munton said that, assuming that a Chinese came down from the interior to purchase machinery, he was generally discovered by the various compradores, into whose clutches he fell; not one, but several estimates were submitted, and disastrous competition followed, the result of which was that, in order to be in the running, the very minimum of machinery was offered, together with a vaguely worded tender. When the contract was finally awarded, the firm in question generally began to consider what items not absolutely indispensable could be cut out. Unfortunately, contractors of repute there had to compete with firms who sold anything from tintacks to aeroplanes; and some of these firms, having very little in the way of reputation to live up to, promised anything, and seldom fulfilled their promises.

Mr. W. L. Carter said that it was not true that industrially the country was unorganised. China was the cradle of trade unionism, and the guilds had held complete control for many centuries. It was due to the great efficiency of these guilds that this people had resisted the introduction of modern methods into their ancient industries. Before any large schemes could come to fruition the whole question of security for both foreign and native capital would have to be satisfactorily settled.

Prof. T. H. Matthewman held that if electricity was to appeal to the majority of China's millions, it would be from the standpoint of its economy as compared with existing illuminants. This was the vital point in a country such as China, where the scale of living was so low. He bore out what the author said about the importance of the engineering graduate as a factor in the development of the electrical industry in China. The American manufacturer had realised the importance of training such graduates, who came back to China to represent these firms and push American goods. If British manufacturers would offer similar conditions, it would be greatly to their advantage in the future.

Mr. G. E. Marley emphasised the great need in Hong-Kong and China generally for the unbiased consulting engineer.

Prof. Smith, in reply, agreed with Mr. Williams concerning co-operation, and mentioned that the British Electrical and Allied Manufacturers' Association had guaranteed the electrical equipment for the Hong-Kong University—a most excellent example of co-operation.

TRADE STATISTICS OF SPAIN.

The figures given below show the imports of electrical and similar goods into Spain during the year 1914, according to the official statistics recently issued. It will be observed that in both years German trade predominated in practically every branch. The growing share of the United States is also noteworthy. The figures for 1913 are given for purposes of comparison, and notes of increases and decreases (which are very considerable) have been added:—

	1913. Pesetas.	1914. Pesetas.	Inc. or dec. Pesetas.
Arc lamps.—			
From Germany	90,000	66,000	– 24,000
,, France	18,000	10,000	– 8,000
,, Great Britain ...	83,000	29,000	– 54,000
,, Other countries ...	11,000	10,000	– 1,000
Total	202,000	115,000	– 87,000
Dynamos, electric motors, induction coils, resistances, transformers, etc., up to 400 kg. weight.—			
From Germany	5,269,000	2,806,000	– 2,463,000
,, France	1,270,000	575,000	– 695,000
,, Great Britain ...	967,000	551,000	– 416,000
,, Switzerland	236,000	132,000	– 104,000
,, United States ...	736,000	666,000	– 70,000
,, Other countries ...	498,000	650,000	+ 152,000
Total	8,976,000	5,380,000	– 3,596,000
Ditto, weighing from 401 to 2,500 kg.—			
From Germany	3,395,000	1,597,000	– 1,798,000
,, France	786,000	333,000	– 453,000
,, Great Britain ...	866,000	399,000	– 467,000
,, Switzerland	463,000	82,000	– 381,000
,, United States ...	890,000	532,000	– 358,000
,, Other countries ...	508,000	412,000	– 96,000
Total	6,908,000	3,355,000	– 3,553,000
Ditto, weighing from 2,501 to 5,000 kg.—			
From Germany	749,000	387,000	– 362,000
,, Switzerland	217,000	89,000	– 128,000
,, Great Britain ...	215,000	63,000	– 152,000
,, United States ...	743,000	694,000	– 49,000
,, Other countries ...	327,000	336,000	+ 9,000
Total	2,251,000	1,569,000	– 682,000
Ditto, weighing more than 5,000 kg.—			
From Germany	5,634,000	2,564,000	– 3,070,000
,, France	713,000	489,000	– 224,000
,, Great Britain ...	266,000	571,000	+ 305,000
,, Switzerland	377,000	189,000	– 188,000
,, United States ...	3,045,000	2,025,000	– 1,020,000
,, Other countries ...	14,000	66,000	+ 52,000
Total	10,049,000	5,904,000	– 4,145,000
Accumulators and electric batteries.—			
From Germany	60,000	47,000	– 13,000
,, France	66,000	68,000	+ 2,000
,, Great Britain ...	104,000	17,000	– 87,000
,, United States ...	16,000	23,000	+ 7,000
,, Other countries ...	27,000	37,000	+ 10,000
Total	273,000	192,000	– 81,000
Cables and wires for electricity, with or without insulating material, of 1 cm. dia. or more.—			
From Germany	2,279,000	895,000	– 1,384,000
,, Great Britain ...	1,096,000	149,000	– 947,000
,, United States ...	51,000	137,000	+ 86,000
,, Other countries ...	311,000	532,000	+ 221,000
Total	3,737,000	1,713,000	– 2,024,000
Ditto, less than 1 cm. in dia.—			
From Germany	296,000	207,000	– 89,000
,, France	45,000	33,000	– 12,000
,, Great Britain ...	105,000	22,000	– 83,000
,, United States ...	9,000	23,000	+ 14,000
,, Other countries ...	30,000*	8,000	– 22,000
Total	485,000	293,000	– 192,000

* Switzerland 2,400.

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	1913. Pesetas.	1914. Pesetas.	Inc. or dec. Pesetas.
Carbons for arc lamps.—			
From Germany	102,000	63,000	− 39,000
,, France	11,000	13,000	+ 2,000
,, Great Britain ...	9,000	15,000	+ 6,000
,, Other countries ...	3,000	2,000	− 1,000
Total	125,000	93,000	− 32,000
Telegraph and telephone apparatus, electric meters and parts.—			
From Germany	2,390,000	1,641,000	− 749,000
,, Belgium	55,000	45,000	− 10,000
,, France	344,000	174,000	− 170,000
,, Great Britain ...	677,000	448,000	− 229,000
,, Sweden	90,000	261,000	+ 171,000
,, United States ...	26,000	11,000	− 15,000
,, Italy	83,000	3,000	− 80,000
,, Other countries ...	41,000	34,000	− 7,000
Total	3,706,000	2,617,000	− 1,089,000
Electrodes.—			
From Germany	14,000	15,000	+ 1,000
,, Italy	—	13,000	+ 13,000
,, Other countries ...	15,000	6,000	− 9,000
Total	29,000	34,000	+ 5,000
Incandescent electric lamps, mounted.—			
From Germany	4,667,000	2,105,000	− 2,562,000
,, France	347,000	48,000	− 299,000
,, Great Britain ...	63,000	47,000	− 16,000
,, Austria	158,000	215,000	+ 57,000
,, Other countries ...	85,000	742,000	+ 657,000
Total	5,320,000	3,157,000	− 2,163,000
Hydraulic motors.—			
From Germany	1,187,000	611,000	− 576,000
,, France	244,000	193,000	− 51,000
,, Great Britain ...	47,000	29,000	− 18,000
,, Switzerland	829,000	387,000	− 442,000
,, Other countries ...	5,000	50,000	+ 45,000
Total	2,312,000	1,270,000	− 1,042,000
Steam and gas engines (stationary) up to 10,000 kg. weight.—			
From Germany	555,000	298,000	− 257,000
,, Great Britain ...	784,000	490,000	+ 294,000
,, France	59,000	88,000	+ 29,000
,, Belgium	62,000	247,000	+ 185,000
,, Other countries ...	92,000	60,000*	− 32,000
Total	1,552,000	1,183,000	− 369,000
* Italy 39,000.			
Ditto, from 10,000 to 25,000 kg. weight.—			
From Germany	191,000	39,000	− 152,000
,, Great Britain ...	153,000	112,000	− 41,000
,, Belgium	71,000	59,000	− 12,000
,, Other countries ...	40,000	35,000	− 5,000
Total	455,000	245,000	− 210,000
Ditto, over 25,000 kg. weight.—			
From Germany	3,069,000	579,000	− 2,490,000
,, Belgium	140,000	88,000	− 52,000
,, Great Britain ...	123,000	404,000	+ 281,000
,, Other countries ...	43,000	163,000*	+ 120,000
Total	3,375,000	1,234,000	− 2,141,000
* France 163,000.			
Cylindrical steam boilers.—			
From Germany	119,000	55,000	− 64,000
,, Great Britain ...	356,000	151,000	− 205,000
,, France	111,000	37,000	− 74,000
,, Belgium	71,000	92,000	+ 21,000
,, Other countries ...	1,000	—	− 1,000
Total	658,000	335,000	− 323,000
Multitubular boilers.—			
From Great Britain ...	2,835,000	1,540,000	− 1,295,000
,, Germany	733,000	476,000	− 257,000
,, Belgium	328,000	196,000	− 132,000
,, France	621,000	346,000	− 275,000
,, Other countries ...	64,000	24,000	− 40,000
Total	4,581,000	2,582,000	− 1,999,000

NOTE.—25 Pesetas = £1.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

695. "Trolley system electric tramways." A. CAMERON. January 17th.

710. "Air inlet attachment for sparking plugs of internal combustion engines." J. KNIGHT. January 17th.

721. "Electro-magnetic shuttle throwing gear for weaving looms." BACHELET SHUTTLE & LOOM CO., AND W. ROUTLEDGE. January 17th.

723. "Electrically-operated portable vacuum cleaners." H. SCHOLEY. January 17th.

731. "Wireless telegraph transmitters." C. S. FRANKLIN & G. MARCONI. January 17th.

732. "Wireless telegraph transmitter." W. S. ENTWISTLE & G. MARCONI. January 17th.

775. "Electric resistances." W. F. JONES. January 18th.

801. "Shade-holders for gas or electric light fittings." R. W. MCLACHLAN. January 18th.

802. "Electric switches." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). January 18th.

812. "Combined trench signalling electric lamp and message block." J. W. MANDER. January 18th.

820. "Telegraphic transmission of pictures." T. T. BAKER & G. E. HEYL. January 18th.

821. "Dynamo-electric machines for the lighting and ignition of internal-combustion engines." G. H. WOODS. January 18th.

850. "Method of control by electro-pneumatic device for playing piano, etc., from the keyboard of a concertina." N. W. M. HOLT. January 19th.

869. "Electrical relay systems." SIEMENS & HALSKE, AKT. GES. January 19th.

876. "Telephone systems." L. C. BYGRAVE & RELAY AUTOMATIC TELEPHONE CO. January 19th.

894. "Current limiters or mercury meters." K. PETTERSEN. January 19th.

904. "Mica cutting machines in connection with direct-current generators." J. H. BERRY & D. A. TURNER. January 20th.

930. "Electric lamps." P. E. WESTON. January 20th.

948. "Electric switches." TESTORS FABRIKS-AKTIEBOLAG & J. F. TESTOR. January 20th.

951. "Electric indicators." P. M. LINCOLN. January 20th.

955. "Electrical condensers." H. R. VAN DEVENTER. January 20th.

967. "Electric lighting device." G. WEISSMANN. January 20th.

972. "Coin freed telephonic apparatus." F. M. BALDING, G. S. P. SCANTLEBURY, & J. E. SCANTLEBURY. January 20th.

999. "Sparking plugs and manufacture of same." T. CROSSEE & SONS AND W. J. SPICER. January 21st.

1,035. "Whistle and electric torch combined." P. B. ROTH. January 22nd.

1,037. "Mouthpiece for telephone instruments." J. KNIGHT. January 22nd.

1,038. "Electric lampholders, adaptors, etc." J. C. WHITE. January 22nd.

1,040. "Electrical machines for use alternatively as motors for starting engines and as generators driven by the engines." C. H. STEVENSON. January 22nd.

1,053. "Couplings for armoured cables and electric conductors for use under water." G. FIORENTINO & V. C. H. GIBSON. January 22nd.

1,063. "Electrolytic extraction of zinc." METALS EXTRACTION CORPORATION, H. F. K. PICARD & H. L. SULMAN. January 22nd.

PUBLISHED SPECIFICATIONS.

1914.

24,335. ELECTRIC ARC LAMPS. G. A. Hughes (trading as London Electric Firm). December 19th.

24,701. AUTOMATIC PHONOGRAPHIC RESPONDING AND RECEIVING DEVICES FOR USE WITH TELEPHONES. F. Seelau & A. M. Newman. December 28th. (December 30th, 1913.)

1915.

82. ELECTRIC CURRENT MODULATORS, MORE PARTICULARLY FOR MICROPHONES, ELECTRIC VIBRATORS, AND THE LIKE. F. Morano. January 2nd.

188. CORD GRIPPING MEANS SUITABLE FOR INCANDESCENT ELECTRIC LAMPHOLDERS. C. Pressland. (Cognate application No. 562/15.) January 5th.

190. ELECTRICAL COMBINED LIGHTING AND STARTING SYSTEMS FOR MOTOR VEHICLES AND OTHER PURPOSES. M. Wuillot. January 5th. (January 24th, 1914.)

398. WIRELESS TELEGRAPHY. Signal G.m.b.H. January 9th.

484. ELECTRIC TRANSFORMER AND CIRCUIT ARRANGEMENTS THEREFOR. G. J. Van Swaay & H. I. Keus. January 12th. (January 27th, 1914.)

580. MANUAL AND SEMI-AUTOMATIC TELEPHONE SYSTEMS. Relay Automatic Telephone Co. & W. Aitken. January 14th. (Cognate application, 869/15.)

1,802. PHASE ADVANCERS FOR DYNAMO-ELECTRIC MACHINES. G. Kapp. February 4th. (Cognate application No. 4,795/15.)

3,710. FRAMES OR RACKS FOR USE IN CHARGING SECONDARY ELECTRIC BATTERIES. J. G. Patterson. March 8th.

3,774. ELECTRIC SIGNALLING APPARATUS. E. Walker. March 9th.

4,564. ELECTRIC MOTORS. F. Hornby. March 24th.

5,594. FIELD, TELEPHONE, OR TELEGRAPH WIRE REEL. G. Dod. April 14th.

5,909. TELEPHONE CALL RECORDER. F. P. Reid. April 20th.

6,244. TELEPHONE TRANSMITTERS. M. S. Conner & A. R. Kahl. April 27th

15,081. JOINT FOR ELECTRIC LIGHT FITTINGS, PARTICULARLY APPLICABLE TO PORTABLE ELECTRIC LAMPS. H. J. C. Forrester (J. W. Dunham, U.S.A.). October 25th.

Manchuria.—According to *Eastern Engineering*, a company of Chinese and Russian capitalists has been organised under the name of "Energia" to undertake the construction of an electric street railway and power plant at Harbin. A joint stock company is proposed in which the municipality will take an interest if a proper franchise is granted.

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THE
ELECTRICAL REVIEW.

VOL. LXXVIII. FEBRUARY 11, 1916. No. 1,994.

ELECTRICAL REVIEW.

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NOTICE.

IN view of the recent Increase in the Postal Charges, our Subscription Rates for Great Britain and Canada will until further notice be increased to £1 1s. 8d. and £1 3s. 10d. respectively.

BRITISH INDUSTRY AFTER THE WAR.

WHAT is to be the outcome of the exhaustive investigation that has been made by a sub-committee of the Advisory Committee to the Board of Trade on Commercial Intelligence? We wish that we could expect more than we really do by way of immediate result. The findings of the sub-committee as adopted by the committee have been published—for our information. That is all that Mr. Runciman will or can say at the moment. The sub-committee was a small one (five members), and it only had to consider a few selected industries. These circumstances unfortunately open the way for delay, and that way the President and his Department elect to follow. Why? In the House of Commons a few weeks ago the President said that many of the recommendations were of wider scope than the group of industries investigated, and that "any decision thereon must involve considerations of policy affecting many other industries and interests." Mr. Runciman declined to take "responsibility for any of its conclusions," but he felt, nevertheless that, "pending the institution of wider inquiries," it was desirable "for the public to be made acquainted with the information so far obtained." How much better than a cold douche is this? Yet we cannot entirely blame the President for this attitude, for the committee itself says that "the conclusions at which we have arrived might be modified in some respects were the range of the inquiry to be extended." We find herein little encouragement to seriously accept Mr. Runciman's very confident declaration that when the war is over we shall have available means for effectively dealing with German industrial and trading competition, and preventing the enemy from ever again "lifting her head" commercially, but as the report is in many ways important we feel justified in devoting a good deal of space to the matter. We hope that the Government will hasten the holding of those "wider inquiries."

The sub-committee was appointed six months ago to report what steps should be taken to secure the position, after the war, of firms who have undertaken industries "in consequence of the Exchange meetings leading up to the British Industries Fair." This, in the opinion of the committee, restricted its inquiry to the following:—(1) Paper manufacture. (2) Printing trade. (3) Stationery trade. (4) Jewellers' and silversmiths' trade. (5) Cutlery. (6) Fancy leather. (7) Glassware. (8) China and earthenware. (9) Toys. (10) Electrical apparatus. (11) Brushes. (12) Hardware. And a subsequent one, introduced by the President himself (13) Magneto industry. As regards (12), as the Wholesale Hardware Club could not furnish evidence within the time allowed, that branch is not covered. If it had been we should have had the unlucky number, and the President's cold douche might have been a foregone conclusion instead of, as we regard it, an extremely unpleasant surprise. Many of the above classes of industry are really no concern of ours as an electrical trade

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journal, but we must indicate them so that nobody imagines that this is an electrical report pure and simple. We may desire to know what definition the committee would give for "electrical apparatus." In this connection we have to turn to the Cheapside Exchange meeting, where all sorts of "small stuff," of which we have imported large quantities from Germany, etc., was brought together, and to the British Industries Fair, at the Agricultural Hall, where, speaking from memory, we did not see much of an electrical character. But though this report is not one on electrical trade pure and simple, we may derive satisfaction from the circumstance that the committee availed itself somewhat generously of the information and counsel vouchsafed by the British Electrical and Allied Manufacturers' Association, and we find that in several places "electrical machinery" is referred to, which seems hardly to have been intended by the instruction to cover "electrical apparatus." We remember that the secretary of the B.E.A.M.A. not long ago told us, in pretty much the same words as Mr. Runciman used in his bravest speech in the House of Commons, that when the war was finished everything would be found in readiness. The B.E.A.M.A. certainly seems to have tried hard to impress a number of wholesome truths upon the minds of the committee; indeed, we believe it has succeeded, but then there is sometimes a difference between the minds of business men and those of our politicians. Something must now be done to prevent the Association's efforts, and those of the committee, being filed away and forgotten. We may hope for much from the Mansion House, the Sheffield, and other important demonstrations intended to impress the Government with the necessity for strong and forceful action before it is again "too late"; we may look for the plain-speaking of the Colonies and the desires of our Allies to have effect upon the minds of the overburdened Mr. Runciman and his staff; but the important fact remains that, unless we keep at it, everything will be far from ready when the war ends. We cannot let everything wait while political parties resume their fiscal controversies. The President has himself stated that in the trade war there are some things that "cannot wait." This report, restricted though it be in scope, must not be doomed to lie deep in departmental dust, for its purpose will not be met if we are to consider it as merely useful for making "the public" "acquainted with the information" it contains. There is too much of the stereotyped official reply "your-letter-shall-receive-attention" about this utterance. We confess that we had hoped for something better. Whether or not the committee has exceeded the anticipated scope in its recommendations, there is unquestionably much in the report which, to our way of thinking, could be adopted forthwith "without involving considerations of policy affecting many other industries and interests" unless with benefit to those industries. But we must let the report speak for itself, so we are publishing a full abstract, together with its recommendations, in our other pages, and would urge upon the Government the necessity for taking immediate steps to carry into effect those reforms upon which practically everybody is agreed.

Rubber.

The recent sharp ups and downs in the price of crude rubber have left the market for this commodity in a rather uncertain state, and its future course is therefore purely problematic, while to some extent subject to the progress of the demand especially on the part of big trans-Atlantic manufacturers. There is good reason for believing that the latter made full provision for their near requirements some time ago when prices were still well under 3s. a lb., and although some considerable American buying was again experienced on the subsequent rapid rise on the way up to over 4s. for plantation rubber under the influence of the seriously threatening aspect of shipping, the demand from that quarter has been of a distinctly more parsimonious character. The fact is worth noting, however, that the recent steady fall in prices down to about 3s. per lb. has by no means paralysed the trade demand, which has indeed been proceeding on a fairly satisfactory scale. When the price was forced up to what was generally considered an artificially high level, within a period of comparative scarcity on the spot, quite a number of consumers kept out of the market, but the subsequent fall has given them an opportunity to cover their needs to a moderate extent. The price of the commodity is certainly quite high enough in the neighbourhood of 3s., but the market, nevertheless, shows wonderful resistance at that level in spite of the fact that the position on the spot has been eased considerably of late by very liberal arrivals which has resulted in a gradual increase of the warehouse stocks. There can no longer be any fear of a shortage, for indications are precisely the other way, while quite heavy quantities are afloat from the Eastern plantation districts. Eastern shipments are now being diverted *viâ* the Cape route for there is not much chance of further shipments through the Suez Canal for some time to come in view of the precarious state of shipping across the Suez Canal and the Mediterranean. The rubber coming *viâ* the Cape will probably be a longer time in transit, but there is reason for assuming that the delay thus incurred will not be quite so serious as was apprehended at first. The progress of consumption in allied and neutral countries within the last six months has certainly surpassed the most sanguine expectations, and it is pretty certain that this progress will not be materially impaired so long as the war lasts, provided prices are kept within reasonable bounds. It is well to bear in mind that production has been making substantial headway in the Eastern plantations. The belief is now in fact expressed that the further excess of the output for the current year will be considerably above original expectations. There is still a little uneasiness on that score in the trans-Atlantic trade, and this tends to explain the comparatively keener demand which is still being experienced for delivery within the next few months, for which a small premium is obtainable over the prices current on the spot.

The Eastbourne Switch-pillar Fatality.

Elsewhere in this issue, by the courtesy of the Board of Trade, we are enabled to publish a report which has been prepared by Mr. A. P. Trotter, electrical adviser to the Board, with regard to the fatal accident at Eastbourne on Boxing Day. It will be seen that the report makes certain recommendations, to some of which no exception can be taken. Obviously, for various reasons, it is desirable that the switch-pillars should be placed in side streets, and away from the edge of the footpath; this would have the advantage of avoiding obstruction to traffic, and generally, in the case of new work, there would be no difficulty and little expense in following this course. Clauses 6 to 8 also appear reasonable, but Clauses 3, 4, and 5 reflect that spirit which, before the war, could be discerned in so many official decrees, especially in connection with electrical undertakings of every description. We refer to the bureaucratic tendency continually to impose fresh burdens upon them, to add to the multitude of restrictions by which they are bound.

New regulations are constantly being drawn up with the object of saving life, an aim which commands the approval of every citizen; but there is a reasonable limit to all such precautions, and care should be taken that the want of a due sense of proportion does not lead to the perpetration of absurdities.

In this case, the first on record in which life has been lost due to the smashing of a switch-pillar, a result which,

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Mr. Trotter says, could not have happened if the aggressor had been either a gig or a traction engine, but only when it was a motor-car, the immediate outcome has been the issue of a series of recommendations apparently based upon our military experience during the war: retreat beyond the reach of the enemy, throw up a first line of defence, 6 in. high × 20 ft. long, fortify the position with stone fenders or cast-iron spurs, fill the pillar with wire entanglements so as to ensure short circuits and dead earths, and so on—why all this panic? Men and women are dying in hundreds around us—in the metropolitan area alone on the average three persons are killed every day by vehicles, and nearly 80 are injured, but no suggestion is made to fit all vehicles with pneumatic buffers or to provide pedestrians with compulsory crinolines.

As in the case of so many legislative acts, the restrictions thus imposed may introduce other and new dangers. For example, if the Eastbourne switch-pillar had been fortified with a massive kerb, concrete pillars, &c., as suggested, it would not have given way—but the car would, and in all probability some of its occupants would have been killed. Or a person stepping off or upon the high kerbstone in the dark might stumble and crack his skull—many a man has lost his life by simpler means. The dangers of street-boxes containing high-pressure apparatus are well known. What is the use of trying to stop up mesh by mesh the sieve through which human life is always pouring by myriad paths? In our opinion, there is no need for any official action arising out of this unique accident.

German Electrical Companies After the War.

AT the recent general meeting of the Siemens & Halske Co., held in Berlin, Dr. F. A. Spiecker stated, on behalf of the directors, that it was well to assume that the new financial year would remain under the influence of the conditions of war, although, perhaps, to a diminished extent. It was probably premature to form an opinion as to the period following the conclusion of peace, but, from the company's point of view, they believed that they could look forward to it with some confidence. The amount of their credit at the banks, and that of the Siemens-Schuckert Works, were now greater than were shown in the balance-sheets, and the companies, therefore, had at disposal such considerable funds that they were fully equal to all demands which could be made upon them, especially after the declaration of peace. Concerning the proposed efforts to establish a Government monopoly in the electricity industry, the speaker stated that no idea could be formed of the possible effects before they knew what the Empire or the individual States had in contemplation. The directors' only interest in the matter was for the supply of electric power in the whole of the country to develop. If the State assisted this development so that electric power was obtainable at low prices, the company's special interests as manufacturers would be assisted too. It would be otherwise, however, if the State's designs and measures were to exercise a paralysing effect. The speaker said that orders continued to arrive from neutral countries, although not to the same extent as prior to the war. At the general meeting of the Electricity Co. (late Schuckert) of Nuremberg, general manager von Petri remarked that not much could be said in regard to the company's foreign undertakings because very little information was available. The promotion of undertakings abroad had greatly suffered under the influence of the war, but the manufacturing activity of the Siemens-Schuckert Works had rapidly been accommodated to the situation. It had been found that business in undertakings outside of Germany was accompanied by enormous risks. The company, however, would not allow itself to be disconcerted in its policy in that direction, but would continue it after the war though a different course would be assumed in the selection of the countries and the objects of the undertakings, as a result of the experience gained during the war.

BRITISH TRADE AFTER THE WAR.

THE following is an abstract of the report of a sub-committee of the Advisory Committee to the Board of Trade on Commercial Intelligence with respect to measures for securing the position, after the war, of certain branches of British industry. Those branches are detailed in our leader columns to-day, where we comment upon the report.

The Basis of the Investigation.

The Committee first asked a number of representative firms and trade associations interested in the particular branches referred to, to make observations on the general question and in regard to certain possible lines of Government action which had been suggested to it. Subsequently some of those who submitted memoranda appeared before the Committee. An attempt was made to form an estimate of the value of the imports into this country under normal conditions, of goods of the kinds covered by the inquiry, and of the extent to which they are imported from enemy sources. Exact data were not available in several cases, but a table, from which we make the following extracts, shows approximately for each branch of trade the value of the imports from all sources in 1913, and the values of the imports from enemy countries, with, in the last column, some remarks as to the other sources of supply.

Item.	Value of total imports, 1913.	Value of imports in 1913 from Germany.	Value of imports in 1913 from Austria-Hungary.	Remarks.
Glassware:	£	£	£	
Flint and manufactures thereof (except bottles)	1,385,000	636,000	180,000	The principal source of supply, other than Germany, is Belgium.
Bottles	815,000	422,000	4,000	The principal source of supply, other than Germany, is France.
				The exports of United Kingdom manufacture under this head were valued at £606,000, of which £420,000 to British Possessions, and £186,000 to foreign countries.
China and earthenware:				
Porcelain, china ware and parian.	219,000	58,000	—	The chief source of supply is France.
				The exports of United Kingdom manufacture were valued at £213,000, of which £62,000 to British Possessions, and £151,000 to foreign countries.
Electrical ware, door fittings and chemical ware.	54,000	50,000	1,000	
Other earthenware (including semi-porcelain and majolica).	716,000	617,000	4,000	The exports of United Kingdom manufacture were valued at £1,917,000, of which £989,000 to British Possessions, and £928,000 to foreign countries.
Goods and electrical apparatus (other than machinery and uninsulated wire):				
Telegraph and telephone apparatus.	232,000	39,000		The imports are chiefly from Belgium and Sweden.
				The exports of United Kingdom manufacture under this head were valued at £290,000, of which £125,000 to British Possessions, and £165,000 to foreign countries.
Electric glow lamps.	196,000	156,000	6,000	
Parts of electric lamps.	115,000	97,000	—	
Unenumerated ..	254,000	112,000	—	The remaining imports are chiefly from the U.S.A.
				The exports of United Kingdom manufacture under this head were valued at £1,063,000, of which £494,000 to British Possessions, and £569,000 to foreign countries.
Electrical machinery.	1,846,000	721,000	—	There is a large importation from the U.S.A.
				The exports of United Kingdom manufacture under this head were valued at £2,290,000, of which £1,053,000 to British Possessions, and £1,216,000 to foreign countries.
Magnetos (estimated).	500,000	475,000	—	

The value of the imports into the United Kingdom, of goods of the kinds included within the scope of the inquiry may be taken as approximately £16,000,000, and of this total nearly £7,700,000 represented goods of German origin, and £500,000 goods of Austro-Hungarian origin. But it has to be remembered that there is also a large German and Austro-Hungarian export of these classes of goods into other parts of the British Dominions. In the absence of strictly comparable statistics, no absolutely definite figures can be given, but it is estimated that the total value of such goods imported into the five self-governing Dominions and India in 1913 cannot have been less than £3,000,000. Austro-Hungarian competition is noteworthy only in the case of jewellery and glassware. As regards German competition in the branches of trade under review, it is

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to be observed that it is limited, as a rule, to certain special lines of goods and does not extend to the whole range of articles included in the class; and that in a number of cases the exports of United Kingdom manufactures included under the same general heading are larger than, or nearly as large as, the foreign imports. This is so as regards china and earthenware; telegraph and telephone apparatus; unenumerated electrical goods and apparatus; and electrical machinery.

The Committee proceeds to the consideration of the detailed representations as to the ways in which Government assistance might be given to the various branches of industry which have been under examination. We quote:—

Industrial Scientific Research.

"The value of scientific research in industry, and the desirability of Government assistance in the promotion thereof, was generally recognised both in the memoranda furnished to us and by the witnesses who appeared before us, though it was admitted that British manufacturers and workmen have not always shown themselves in the past sufficiently appreciative of the value of scientific investigation into industrial problems, or of technical training. In a number of cases reference was made to the valuable assistance given by technical institutions to German industry, and, though no very definite evidence on the point was adduced, we see no reason to doubt the validity of the opinions expressed. As regards the particular British industries with which we are now concerned, very valuable work is being done in respect of glass by the University of Sheffield and the Institute of Chemistry (by the latter body especially as regards chemical glassware and optical glass); in respect of hard porcelain, and china and earthenware generally, by the School of Pottery at Stoke-on-Trent, which is an interesting example of combined trade enterprise. . . . All these institutions are said to be handicapped by inadequate financial resources. . . . The electrical industry, of course, provides a very wide field for scientific industrial research."

"At an early stage of the inquiry our attention was directed to the fact that an extensive scheme of State aid for industrial research had recently been established by a Committee of the Privy Council, and is, we understand, to be carried out by that department in close communication with the Board of Trade. We are informed that a strong advisory council has been appointed, and that a number of applications (including requests for assistance from the Sheffield University, the Institute of Chemistry, the Stoke Pottery School, and the British Electrical and Allied Manufacturers' Association) are already before that body, and that the first grants are being made. We were accordingly able to refer to the new Council and the funds at its disposal those witnesses who expressed the desire for State assistance in this direction, and to point out to them that the Council in its consideration of any applications for help to any particular trade would no doubt be largely influenced by the extent to which the trade had already shown or would show a disposition to help itself. The new scheme is necessarily experimental, but it is capable of much enlargement, and we have no doubt that if British manufacturers are ready to co-operate with the Government in this matter and to avail themselves of the facilities put at their disposal, the operation of the scheme will be of very great value to British industry."

The recommendations of the Committee on this section of the inquiry are as follows:—

Scientific Industrial Research and Training.—(*a*) Larger sums should be placed at the disposal of the new Committee of the Privy Council, and also of the Board of Education, for the promotion of scientific and industrial research and training.

(*b*) The Universities should be encouraged to maintain and extend research work devoted to the needs of the main industry or industries located in their respective districts; and the manufacturers engaged in those industries should be encouraged to co-operate with the Universities in such work, either through their existing trade associations or through associations specially formed for the purpose. Such associations should bring to the knowledge of the Universities the difficulties and needs of the industries, and give financial and other assistance in addition to that afforded by the State. In the case of non-localised industries, trade associations should be advised to seek, in respect of centres for research, the guidance of the Advisory Council of the Committee of the Privy Council for Scientific and Industrial Research.

(*c*) An authoritative record of consultant scientists, chemists, and engineers, and of persons engaged in industrial research, should be established and maintained by some suitable Government department, for the use of manufacturers only.

Patents.

The Committee next deals with amendments of the existing law as to copyright, patents, trade marks, and merchandise marks. "Under this general heading a large number of representations were made. As regards patents, it was suggested by the representative of the fancy leather goods industry, and endorsed in some measure by the witness on behalf of the china and earthenware trade, that an inadequate search is made by the Patent Office before applications for patents are accepted, and patent rights are granted in respect of articles that have already been upon the market and are in fairly common use. It was urged that a more exhaustive inquiry should be made, responsible trade associations being taken into consultation as to the usage of an article for which an applicant is claiming a patent. In this connection reference was made to the German and United States practice, and to the supposed fact that in Germany the sealing of the patent protects the inventor against actions for infringement; but we are informed by the Patent Office that whilst both Germany and the United States profess to make comprehensive search, it has proved to be rarely possible to make such a search effective, and that in both countries the patents granted are subject to revision by the Courts. On this last point it was urged that the onus of taking action in the Courts is thrown upon the owner of an article already in use, but for which a patent has been wrongly granted, and that this is an unfair onus to place upon him." Other suggestions were made in favour of international reciprocity in patent matters.

Electrical Proposals as to Patents.

The representatives of the electrical industry made more comprehensive proposals, namely:—

(1) That three classes of patent protection be created:—

(*a*) A short term or petty patent for improvements or modifications in design, without provisional protection, and at a low cost.

(*b*) A long term patent for new inventions, the period of provisional protection being 12 months, and the full period to be at least 15 years, with an option to extend it to 21 years by payment of increased fees.

(*c*) A patent for discovery of new principles, the patentee to be permitted to claim reasonable royalties from patentees of apparatus making use of such principles.

(2) That an attempt be made to bring about the unification of the patent laws of the British Empire."

The Committee consider that the proposals under (1) call for more detailed consideration than they have been able to give them, but as regards (2) the question of the desirability of assimilating the patent laws in the United Kingdom and the Self-Governing Dominions formed the subject of discussions at the Imperial Conferences of 1902, 1907, and 1911, and of communications between the various Governments concerned during the intervening periods. At the Imperial Conference of 1911 it was unanimously agreed "that it is in the best interests of the Empire that there should be more uniformity throughout its centres and dependencies in the law of copyright, patents, trade marks, companies." The proposal made by the witnesses would appear therefore to have been long anticipated by H.M. Government, and an approach towards uniformity has been made in the recent legislation of the Australian Commonwealth and New Zealand. In this connection some exception was taken to a provision of the existing Canadian law, whereby if, after the expiration of 12 months from the granting of a patent, or any extension of such period, not exceeding one year, which may be authorised by the Commissioner of Patents on satisfactory cause being shown within three months of the expiry of the period, the patentee or any of his representatives or assigns, imports or causes to be imported into Canada the inventions for which the patent has been granted, the patent becomes void as to the interests of the importer. It was urged that this provision works to the disadvantage of the British manufacturer, as the importation of any article made under a patent in operation in Canada thus invalidates the patent, even though manufacture thereunder may be actually carried on in the Dominion, but no clear evidence as to hardship was adduced in support of this contention. Canada is the only one of the Dominions which has thought it necessary to embody such a provision in its law, and its action is probably due to the geographical propinquity of the United States. In contrast to this particular complaint of the B.E.A.M.A., one correspondent engaged in the glass industry urged that all British patents should be worked in the United Kingdom, and no articles manufactured abroad for which British patents are granted should be allowed to be imported (with possible exceptions). The same writer was of opinion (which in this instance was shared by others) that the provisions of the patent laws as to compulsory working should be more stringently enforced.

The Committee's recommendations are as follows:—

Patents.—(*a*) The efforts which have been made to secure uniformity of Patent Law throughout the Empire should be continued. (*b*) The provisions of the law as to the compulsory working of patents in the United Kingdom should be more rigorously enforced, and inspectors should be appointed to secure that such working is complete and not (as has frequently been the case) only partial. (*c*) The fullest possible information as to enemy patents should be given to British firms during the war, and every practicable assistance for their use.

Transport Facilities.

The evidence presented showed clearly that there is widespread dissatisfaction with the working of the United Kingdom railway system, and a general belief that the State railway system of Germany is operated greatly to the advantage of the export trade. Thus as regards china and earthenware, we were informed that "the very reasonable cost of transport, and the facilities given by the German Government operate against the (British) pottery manufacturers in competition for the trade of the United States and Canada, and of our Colonies generally." Whilst we have no evidence that rates for inland carriage of goods in Germany are generally lower than those prevailing in this country, when due allowance is made for the differences between the services covered

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by the two sets of rates, there can, we think, be no doubt that the German export trade has been largely assisted and stimulated by the special low rates granted on the German railways in respect of goods for export—rates which, in the case of certain combined railway and shipping rates, are believed to have been quite exceptionally low. We are also disposed to think that there is some foundation for the belief that the German railway authorities have, as a rule, shown themselves more ready to give special facilities to individual traders, and to have more regard for their individual circumstances, than has been the policy of the British railway companies. It is evident, also, that there is a widespread belief amongst manufacturers and traders generally that foreign goods are carried inland from British ports at lower rates than those charged for the carriage of British goods over similar distances, and that whatever theoretic arguments may be advanced in justification of such action by the British railways, it does, in fact, operate as an appreciable handicap to British manufacturers in meeting foreign competition. This was urged, for example, by the British Electrical and Allied Manufacturers' Association. It was urged by the representatives of the paper-making industry that railway companies should be required to divide up any through rates charged by them on imported goods, so that the actual rates charged in respect of land carriage could be publicly known. It was stated that a suspicion existed that foreign imported goods are sometimes rated in a different classification to British goods of the same kind.

B.E.A.M.A. Suggestions.

The Committee direct special attention to two suggestions put forward by the B.E.A.M.A., namely:—

(1) That the Board of Trade should, as soon as possible, call together a conference of representatives of shipowners, railway companies, and the manufacturing industries, to discuss the whole question with a view to co-operation in removing the existing handicaps under which British industries labour when in competition with foreign producers; and

(2) That an impartial tribunal of the Government be set up to exercise the functions of a tribunal for adjusting grievances existing between railway and transport companies and traders, more particularly where it can be shown that the foreigner is benefiting at the expense of British industry.

"With regard to the second suggestion, in the opinion of the witnesses the Railway and Canals Commission is not a suitable body for the exercise of these functions, as there is no adequate representation of commercial interests and experience, and its procedure is both too slow and too costly. We drew the attention of the witnesses to the fact that the elaborate investigation conducted by the Royal Commission on Railways is only in suspense owing to the war, and we urged upon them the desirability of making full representations to that body, and to furnish in support of their case the fullest possible details, instead of relying, as has not infrequently been the case, on quite general statements. Reference was made by some of the witnesses to the advantages which German trade derives from the facilities for cheap carriage, especially of bulky goods, afforded by its elaborate river and canal system, and regret was expressed at the comparative inutility to which the British canals have been reduced by railway ownership, and at the failure of H.M. Government to take any action on the report of the Royal Commission on Canals. Attention was drawn by some of the witnesses to the handicap imposed on British manufacturers before the war by the fact that in some cases British shipping companies carried continental goods from a continental port to extra-European destinations at freights lower than, or as low as, those charged on the same goods from a British port, even though the continental goods were actually carried *vid* such British port.

The Committee's recommendations are:—

Transport Facilities.—(*a*) An impartial tribunal should be set up to secure that no preference is accorded to traders in other countries by British shipping companies or shipowners, or by home railways; that is, that rates charged by British shipping companies, shipowners and railways to British traders shall in no case be higher under similar conditions than those charged to traders operating from another country, the principle adopted being that equality of payment entitles traders to equality of services. (*b*) A definite policy for the improvement and extension of the canal system of the United Kingdom should be formulated, with a view to its being carried out so soon as the national finances shall permit. (*c*) Shipping companies should be prohibited from charging higher rates of freight from British ports than from any North European ports.

Industrial Finance.

"There was a general consensus of opinion among the witnesses that the German manufacturers receive much greater and readier assistance from banks and financial houses than do their British competitors. In a number of cases it was suggested that German industry, and especially the export trade, is actually subsidised by the German Government, but apart from the special railway rates for export, to which reference has already been made, we have no evidence of this, and we are disposed to think that the belief has no other basis than the banking facilities already mentioned. Of the importance of these there can be no doubt. Thus it was pointed out to us by the representatives of the B.E.A.M.A. that there have been carried out by German firms, in British Dominions and Colonies, many engineering works of considerable magnitude which could have been equally well undertaken by British firms if the latter could have received similar financial assistance. It was also stated that the attitude of British financiers towards home industries is in direct contrast with that of German financiers, who invariably stipulate that the plant and machinery for the undertakings they assist shall be of German manufacture. We recognise fully that the conditions of German industry and its rapid growth in a country not possessed of large accumulated financial resources have caused German manufacturers to be much more dependent on the provision of facilities of the kind now in question than are their British competitors; that the principles of German banking differ widely from those which govern the policy of the British banks, and involve serious risk; and that the imposition of conditions as to foreign loans might exercise an adverse influence upon the position which London had held, until the outbreak of the war, as the chief loan market of the world, with the resultant considerable advantage to British trade as a whole. At the same time, some witnesses appeared to think that there is a large body of British manufacturers to whom a well-ordered system of industrial banks would be of very appreciable assistance. In this connection our attention was drawn to one disadvantage of the recent development of the joint-stock banking system. It was suggested to us that the old local proprietary banks were more inclined to give credit to local small manufacturers, with whose position they were intimately acquainted, than are the great combinations into which the local banks have generally been absorbed. The local manager is unable to take the risk which the local banker often took, and is indisposed to advise his principals to make any advances which even appear to carry with them any element of risk. We are of opinion that there is a good deal of truth in this view of the situation, and that the development of joint-stock banking has in some measure restricted the financial facilities of the smaller industrial enterprises."

The Committee recommends:—

Financial Assistance.—(*a*) The Joint Stock Banks should be invited by H.M. Government, so soon as opportunity offers, to consider the possibility of affording a greater measure of assistance to British industrial enterprise. (*b*) All Government departments, local authorities, and statutory bodies entrusted with the control of moneys raised by taxes or rates, should be under legal obligation to purchase, so far as possible, only goods produced within the British Empire. To meet exceptional cases, the Board of Trade might be empowered to grant licences to public bodies for the purchase of foreign goods where special circumstances, including, for example, the existence of a combine or "trust," can be proved. (*c*) British financial houses concerned in the issue of foreign loans in the United Kingdom should be urged to endeavour to secure that preferential treatment be accorded to British contractors and manufacturers in respect of the public works to be carried out by means of such loans.

(To be concluded.)

MUNICIPAL ELECTRICITY SUPPLY AT JOHANNESBURG.

BY R. TURNBULL MAWDESLEY.

(*Concluded from page* 155.)

In the inner areas the cables have been laid underground as far as possible, but in the suburban areas the wires are carried overhead, and this is a certain source of trouble during the very severe lightning storms which occur in the summer months.

The street lighting, on those streets along which the cars run, is carried out by incandescent lamps suspended from the trolley-span wires, and by incandescent lamps on pavement standards elsewhere.

Average summer and winter load curves are shown in fig. 12. (It should be noted that, as Johannesburg is south of the Line, the winter months are from April to September.)

The curves shown do not differ in any material way, in shape, from those of the moderately-sized lighting station at home—and it is strikingly obvious, on inspecting the shape of the Johannesburg load curve, that the installation of a storage battery of large capacity would be the means of cutting off the peak, and filling up the valley after 10 p.m., and thus considerably increasing the station efficiency.

The great difference between the summer and winter curves is due to two causes—one being the cold weather (when many electric heaters are in service), and the other the shop and office lighting, all shops promptly closing at 6 p.m.

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The direct-current load on the converters is also given, and it will be noticed that in the summer time the converter load drops considerably before the peak load. The reason for this is that the two turbines (6,000 KW.) on load, are loaded up by the A.C. feeder load before the converters can be fully loaded on the D.C. side.

In the winter time the converters can be fully loaded at the peak, as there are then three turbines (9,000 KW.) on load. A slight alteration has recently taken place in the average shape of the curve, and especially the converter load curve, owing to the rotary sub-station at Jeppestown taking part (about 18 per cent.) of the traction load. When the second rotary sub-station at the "Zoo" is in operation, about 30 per cent. of the traction load will be handled by the sub-stations; and the D.C. generators (and converters) in the main station will be relieved of this amount of load.

During November, 1914, 1,248.457 units were generated for lighting and power, and 597.277 units for traction. These statistics cover a summer month, and the figures would be higher for a winter month. The total number of connections made at the end of November was 15,625 KW.

Referring briefly to the tramways, there are 124 cars in daily service, the cars being partly of the single-truck double-deck type, with the upper deck roofed in, and with adjustable blind screens at the sides, and partly double bogie cars of the same type.

There are also in service at the time of writing two Tilling-Stevens petrol-electric single-deck "pay-as-you-enter" 'buses, which are used as feeders to the tramways.

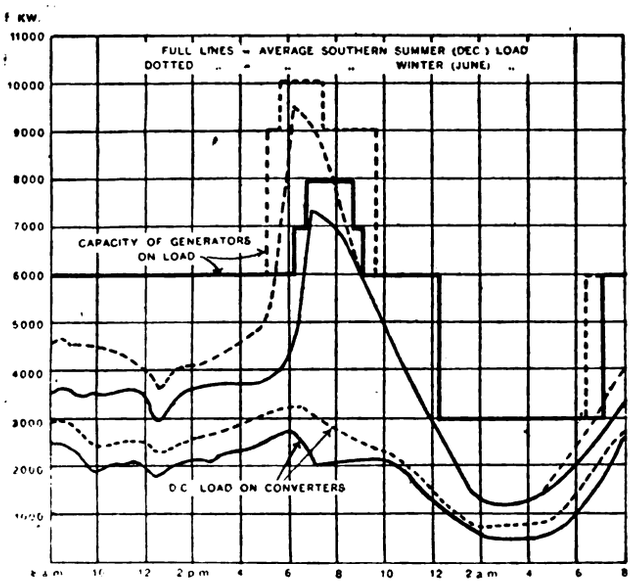

FIG. 12.—AVERAGE DAILY LOAD CURVES.

The minimum fare is 1½d. Incidentally, it may be observed that until quite recently the "tickey" (three-penny silver piece) was the coin of smallest value in general circulation, and even daily newspapers were sold at this price; but this artificial price was reduced recently to 1d., which in its turn has brought about a more general circulation of "coppers."

There is an agitation for the substitution of 1d. fares, but the general manager, in a report upon the subject, recommends the Committee to retain the existing fares for the time being; however, there can be little doubt that 1d. fares will be substituted in the near future.

"Change" on the cars is given by means of tokens valued at 1½d., and books of tickets are on sale at 33 per cent. reduction.

Regarding the permanent-way construction, there is nothing of note to be recorded. In the main thoroughfares the trolley wires are supported by span wires, and elsewhere by side-arm poles.

One petrol-engine tower-wagon and two track tower-wagons are in service for breakdowns and maintenance, and the whole of the cars are housed in sheds adjacent to the power station. The necessary repair shops, &c., are all centrally situated.

The tramway traffic returns do not vary to any extent, except upon holidays or *fête* days. For the week ending August 8th, 1914, the figures were (as compared with the same period of 1913):—

	1914.	1913.
Car-miles run	66,369	65,873
Receipts	£6,305 14s.	£6,586 8s.
Average receipts per car-mile	22·8d.	23·9d.

The average number of passengers carried monthly is 2,600,000, and the average car-milage is per month about 275,000. The present average receipts per car-mile are 2s. 2d., with 9·5 passengers carried per car-mile.

The concrete and stone building which housed the gas-engine plant has been converted partly into a car-repair shop and partly into a car-shed. This building also contains a small motor-generator for the purpose of charging the cells of an electric vehicle used in distribution work.

There is a fleet of three motor-cars for the use of the Departmental officials, and a number of motor-cycles for the mains foreman, which are all garaged and kept in order by the Department.

Finally, no account of the Johannesburg power plant would be complete without some reference to the assistant engineers who have shared in the work. Mr. E. T. Price is the chief electrical engineering assistant, under whom all electrical engineering work is carried out. Mr. J. B. Milford is the traffic manager of the tramways, and Mr. O. Petersen the resident station engineer.

NOTES FROM CANADA.

[FROM OUR SPECIAL CORRESPONDENT.]

THIS country, like the rest of the Empire, is devoting its energies largely to war, and a large part of the trade, even in manufactures other than war materials, is more or less indirectly an outcome of the requirements created by the demand for munitions, uniforms, &c. Naturally, a good deal of capital is being expended on the establishment of new, and the extension of existing, works and factories for war work, but side by side with this there is a considerable amount of planning for the future, based on the confident expectation that the Allies will be victorious.

On the outbreak of war Canada had many unemployed, and people wondered how she would come through; but now, owing to enlistments and to the enormous increase in the country's trade—this increase is altogether in exports, as imports have dropped very greatly—there is but little unemployment and the Dominion prospers financially as never before. If only this prosperity were unaccompanied by the sadness and sorrows which come to so many of those who have relatives at the Front, there would be cause for rejoicing indeed.

Apart from these things, conditions are much as usual; there are, of course, no Zeppelin raids and no darkening of streets and window lights, and if it were not for the presence of innumerable soldiers at every turn, the average man not engaged on war work would hardly notice much difference from ordinary peace times.

In the field of electrical engineering, several fairly big schemes are being projected.

At Edmonton, in Alberta, an agreement between the city and the Edmonton Power Co. has recently been approved.

The company is to supply electricity for 30 years, at prices ranging from 1·3 cents per KW.-hour to 0·85 cent, according to the demand. The power of the Saskatchewan River will be utilised, but an artificial lake will have to be created, and a total ultimate expenditure of about £1,200,000 is contemplated. Edmonton at present has a steam plant, and the company undertakes to run this until the hydroelectric scheme is in operation, which will be some three or four years hence.

The Montreal Tramways Co. is increasing its present steam plant from 10,000 H.P. to 50,000 H.P., and another plant in this city is to be built having a capacity of 60,000 H.P. A 15,000-H.P. steam turbine unit will be the first to go in.

One of the great features recently has been the voting of the people of various interested municipalities in Ontario on the question of hydro-radials. A little explanation appears necessary here: the Hydro-Electric Power Commission of Ontario has for some time been working on plans for a system of electric railways to form a network linking up the important towns, and providing facilities for rapid and cheap passenger and freight service serving both towns and rural districts.

A start on this kind of work was definitely made when the formal opening of the London and Port Stanley Railway took place last July. The Commission undertook the work of electrifying this line, which was formerly steam-operated, and is about 30 miles in length. It has been working successfully since the summer, and is now said to be making a profit of about £200 per month.

At the January elections, which took place on the 1st of this month, the people of the towns and country districts concerned were asked to vote on the question whether they wished the Hydro-Electric Power Commission actively to take up the "hydro-

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radial" work or not. This resolved itself into a question of public *versus* private ownership, and a big fight was made by the advocates of the latter, but the Commission carried the day with, in nearly every instance, very large majorities. The vote was given on the understanding that only preliminary work will be undertaken during the war, as the spending of such a large sum of money as even the present plans would involve would be a wrong policy just now, covering, as they do, an area nearly as large as England, in Southern, and especially in South-Western, Ontario.

Another matter closely connected with the foregoing is the absolute necessity under which the Commission is even now placed of going ahead with some scheme for securing more power. Five or six years ago a contract was made with the Ontario Power Co., at Niagara Falls, for the supply of power, in blocks as required, up to a maximum of 100,000 H.P. At the time Sir Adam Beck was told that it would be 20 years before he would require even 10,000 H.P., or something to that effect, but a few weeks ago the Commission's maximum load exceeded 110,000 H.P., and it is steadily growing as new municipalities are taking power, and those already connected to the system are increasing their demands. This tremendous growth has enabled the Commission to reduce the rates charged to the municipalities each year, and this month reduced rates for no fewer than 66 towns and rural districts have been published; in some of them the consumers will get energy for domestic service at as low a rate as 0·9 cent per KW.-hour.

In order to meet the demand for power, the Commission has had to make arrangements with another company at Niagara Falls, but the price being paid is naturally much higher than for the 100,000 H.P. originally contracted for.

Plans have already been drawn up by the Commission's engineers, however, for a scheme whereby 600,000 H.P. can be developed at Niagara Falls on the Canadian side, and these will be considered by the Provincial Government next month, when it is highly probable that approval will be forthcoming, as now that the people have expressed their desire to have publicly-owned electric railways, the development of this power is a greater necessity than ever.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Driving Paper-Making Machinery.

A catalogue recently issued by Messrs. Mather & Platt, Ltd., of Park Works, Manchester, which deals, not with paper-making machinery itself—for the firm does not produce this class of apparatus—but with auxiliary machinery that is of importance in paper mills, contains illustrations of electric motors that have been supplied to paper mills throughout the country; included

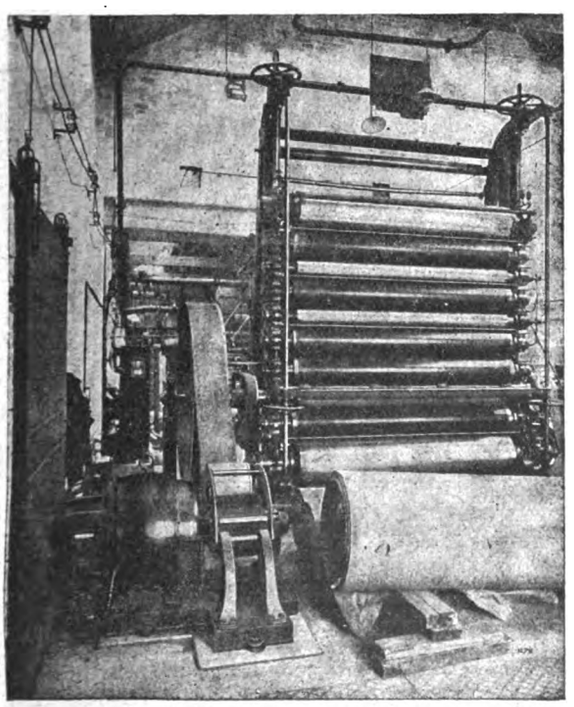

Fig. 1.—Electric Drive of Super-Calender.

amongst these is the interesting application shown in fig. 1, which illustrates a 100-H.P. "P" type motor driving a 10-bowl super-calender in a Horwich paper mill. In order to obtain, in the most economical manner, the minute variations of speed over a very wide range that are necessary in operating a super-calender, a motor-driven booster is provided. This arrangement permits of obtaining any speed between 80 ft. and 500 ft. per minute by the movement of a small hand-wheel, without loss through the employment of resistances. Among the largest paper-mill installations for which the firm have been responsible is that at the works of the Culter Mills Paper Co., Peterculter, Aberdeen, where upwards of 30 motors, with an aggregate capacity of 500 H.P., have been installed; the Darwen Paper Mill Co. uses a D.C. Mather & Platt generator of 200 KW., and Messrs. Chas. Marsden & Co., Ltd., Barnsley, employ a rope-driven 350-KW. generator and a smaller set with an output of 85 KW., the motor equipment including one of 100 H.P. and about 30 others, with a combined horse-power of something like 550. At the East Lancashire Paper Mill, Radcliffe, also, 30 similar motors are running, totalling over 500 H.P., and taking current from three generators with an output of about 550 KW.

Large Jackson Cookers.

We briefly referred in our issue of December 25th to the large Jackson electric ovens being constructed for the Park Prewett Asylum, which is being adapted for hospital purposes. Two large ovens and three smaller ones are being supplied, the former built up with a cast-iron framework, sheet-metal sides and double doors, and the latter consisting of a cast-iron oven with a sheet metal grill above it. Both types of equipment are lined internally with porcelain enamelled steel and suitably lagged.

The large ovens measure internally 2 ft. 9 in. wide × 2 ft. 6 in. deep and 4 ft. 6 in. high, and will take 300 lb. of meat. They are heated by nests of red-hot type heating bars disposed on either side, and consisting of 44 of the standard Jackson bars, described in our issue of December 25th, arranged to give the required heat distribution. These heating elements are protected by perforated metal plates inside the oven. Four heat regulations are provided, controlled by four single-pole Diamond H switches, and the maximum loading is 15 KW.

The smaller type of oven supplied measures 26 in. × 24 in. × 23 in. internally, and has a loading of 5·5 KW., with three heat regulation, the oven heating being on similar lines to the larger oven; the grill above has a 6-KW. loading. In both types of oven the wiring to the heaters is external, with non-combustible covering, and is run in sheet-metal casing to the back and thence through flexible metallic tubing to the switchboard.

We are indebted to the Jackson Electric Stove Co., Ltd., of Blandford Street, W., for allowing us to inspect this interesting equipment.

PROTECTION FROM X-RAYS.

At the meeting of the Röntgen Society on February 1st a discussion took place on the subject of protective devices for X-ray operators. Dr. Sidney Russ, the opener, pointed out that although X-ray dangers were becoming less formidable, owing to the more general knowledge of the peril, yet at the same time the neglect of precautions was all the more serious on account of the increasing power of X-ray outfits. The X-ray outfit of the most modern type was capable of fifty times greater power than the ordinary outfit of ten years ago. He thought that X-ray workers would prefer not to invoke legislation on this subject if sufficient protection could be obtained by other means, for of all the methods available for ensuring it, legislation would be the least popular and the least convenient. He and other speakers suggested that certificates of safety should be given with X-ray apparatus.

In the course of the discussion, Mr H. E. Donnithorne showed that even protective devices themselves might be a source of danger, instancing a couch which was furnished with a protective metal surface at a certain angle which the X-ray beam was just able to graze. The incident radiation was thereupon increased, and this he attributed to the generation of secondary rays from the metal itself.

Dr. F. Bailey, of Brighton, said that his own practice was to shelter himself behind a large screen, the upper third of which consisted of lead glass, and also to enclose his tube in a large lead-glass bulb. In this way the operator could hardly receive any direct X-rays at all, but he still remained subject to the ionised atmosphere of the X-ray room and its possible dangers.

Dr. W. Harwood Nutt said that some X-ray workers were returning from the seat of war with very bad ulcers on the arms and hands, and he did not believe that any man could protect himself adequately, however much he was clothed with aprons and gloves, &c., unless the tube also was enclosed. The effects of atmospheric ionisation might be overcome by efficient ventilation, using two electric fans, one drawing the air into the room, and the other drawing it out.

Dr. Herschel Harris thought that the great fault was in the glass supplied for protective purposes. It was often not lead glass nor X-ray proof at all, and the makers should be asked in all cases to notify their customers as to the quality of the glass they supplied.

Copper in Germany.—The quotations for copper wire in Germany have shown a steady rise. For 100 m. of insulated wire of 1 mm.² section 45 francs is paid, and, in some cases, even as much as 60 francs is asked. The quotations for zinc wire, on the other hand, seem to be quite normal, and this metal is generally employed.—*L'Industrie Electrique.*

D.

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THE EASTBOURNE FATALITY.

The following report has been prepared for the Board of Trade by its electrical adviser, Mr. A. P. Trotter, with reference to the fatal accident which occurred at Eastbourne in December last:—

On December 26th, 1915, a large motor car, proceeding at a moderate speed along the near side of a broad thoroughfare in Eastbourne, named Seaside, unaccountably swerved to the left and smashed an electric switch pillar into fragments. It was brought up by collision with a tree a few feet further on. The occupants of the car, two nurses and two children, were unhurt, but two men who afterwards tried to move the car were killed by electric shock. There are no obscure or doubtful points about the accident. The circumstances are quite clear.

The pillar was about 4 ft. x 2 ft. 2 in. x 1 ft. 9 in. It was constructed of cast iron; the minimum thickness was about half an inch. It stood at the edge of the footpath, which was not provided with any curb. The pillar contained three switch-fuses of the cartridge type for the purpose of connecting cables branching in three directions from this point. The cables are lead-covered, paper-insulated, concentric, for a supply of single-phase alternating current at 2,200 volts. At about 6 in. above the ground level there was a horizontal bus-bar to which the external conductors were connected by links. The lower part of the switch-fuses was about 3 ft. above the ground level, and they were connected with the inner conductors of the cables by "tails" of 7/16s about 18 in. in length. When the pillar was destroyed no connections pulled out, but the "tails" were cut through, and the end of one showed signs of fusion.

The pillar was supplied through a feeder, and owing to a momentary earth at the instant of the collision, the oil-switch on this feeder at the works tripped. The switchboard attendant replaced it, and it held in, showing that there was no short-circuit or heavy earth. The supply was further complicated by being fed from a sub-station, and by the stepping-up through transformers of the low-pressure supply, but that need not be considered.

Two men tried to push the car back on to the road. Several persons who touched it received shocks. The driver alighted and opened the bonnet, and received a slight shock which he attributed to the electrical accumulator on the car. The severe shocks received by the two men may have been due to the firm grasp which they gave, or perhaps the car did not make contact with the upstanding wire until it had been moved. It was not clear from the evidence given at the Coroner's inquest whether the car was moved or not. That is of no importance.

The driver attempted to pull one of the men off by grasping his waist with both hands. In doing this he received a shock of sufficient strength to knock him down. An attempt was made by the bystanders to pull the men off with a wire rope. They received severe shocks and burns. If a hemp rope had been used, the day being dry, they might have rescued the men without difficulty, or they could have pulled them away by loose parts of their clothing. If after getting them clear the well-known method of artificial respiration had been practised, the lives of these two men might have been saved.

If the pillar had been smashed by a runaway vehicle constructed mainly of wood, such an accident would hardly have occurred, and if by a traction engine with iron wheels, it would have been impossible, for a better contact with earth would be made by the wheels than by the feet of the bystanders. The insulation of the car on its rubber tires was an important cause of the fatal result.

The Board of Trade Regulations recognise sub-stations and street boxes. The former are receptacles for transformers large enough to admit the entrance of a person after the transformers, &c., are in position. It is recommended that they should be above ground wherever possible.

The regulations relating to street boxes imply that they will be constructed below the level of the road or pavement, and will be provided with covers forming part of the surface of the street. In addition to regulations relating to sub-stations and to street boxes, Regulation 18 provides that "every portion of any high-pressure electric line placed above the surface of the ground . . . shall be completely enclosed either in a tube of highly-insulating material embedded in brickwork, masonry, or cement concrete, or in strong metal casing efficiently connected with earth."

Pillar boxes of a kind similar to the one which was destroyed at Eastbourne have been broken by collisions with vehicles, and until recently a pillar of the dimensions and construction of this one might have been considered to comply with the regulation. But in view of the increased speed and weight of street vehicles, and their imperfect control and skidding, further attention must be given to the use of such electric pillars in the streets. This is not the first case in which the cast-iron case of a pillar has been destroyed without causing a dead earth or short-circuit among the live conductors contained in it.

Various troubles with underground street boxes resulted in the introduction of pillars, but local authorities have, with but few exceptions, permitted their use only on their own electrical undertakings. For low-pressure work, pillars present many advantages over street boxes, and are to be recommended. In the case of high-pressure distribution the accident to be feared was the possibility of the pillar becoming alive due to the bad action of a fuse or to some other defect. It was anticipated that both in the case of large transformer kiosks and of such pillars as are used at Eastbourne and elsewhere, any serious damage by a collision would cause an earth or a short-circuit which would trip the supply switch.

In most of the larger modern systems of electrical distribution supply is given at extra-high pressure to sub-stations from which medium or low-pressure mains distribute the supply to consumers. In such cases there are no high-pressure mains, and no switch pillars are used.

In older systems, such as that of Eastbourne, high-pressure feeders, originally radiating from the generating station, have become a highly complicated network. This generally arises from the necessity for tapping tees to feeders for the supply to new districts. It would be desirable in these cases that sub-stations should be increased in size or in number, and that the use of street-box transformers should be restricted, and that the lay-out of the feeders should be so simplified that tee-joints are avoided and that switch pillars or boxes need be used only in exceptional cases.

Before proceeding to consider what modifications should be made in electric switch pillars, the employment of high-pressure switches in underground street boxes may be mentioned. Many engineers have strong objections to this alternative, chiefly on account of danger to workmen who have to use them, and on account of failure of such apparatus to work properly. But investigation shows that this is another way of stating the fact that many objectionable kinds of street-box switches have been tried, the unsatisfactory results have been very apparent and sometimes serious; while a few well-designed underground high-pressure switches have worked well for years and neither require nor attract attention. Besides these, which are non-automatic and do not contain fuses, totally enclosed oil-switches with overload trip are used in mines, and could easily be adapted for street boxes.

Recommendations as to Electric Pillar Boxes for use with High-pressure Supply.

1. The suggestion made by the Coroner's jury that pillar boxes should be placed further away from the side of the road is good. It is better to place them in side streets than in main thoroughfares. If possible, they should be built into the walls of houses or gardens. Local authorities should use their influence to obtain accommodation for such boxes on reasonable terms.

2. Where pillars can be moved back from the curb by slewing the cables without entailing undue expense in cutting and re-jointing, this is desirable.

3. A curb not less than 6 in. high extending not less than 10 ft. on each side of the pillar is desirable.

4. Where pillars are set near a curb, fenders or "spurs" of rounded blocks of stone or of strong iron castings could usefully be set at the corners of pillars facing the road. A door opening on to the street must be shaped to clear them.

5. Cast-iron pillars should be reinforced by a cage of wrought-iron rods incorporated in, or attached to, the cast-iron, which will tend to hold the fragments together in case of destruction, or an inner lining of sheet or of expanded metal or wire mesh should be attached to the pillar and to the doors, and the pillar should be connected to a substantial earth-plate as well as to the lead of the cables.

6. Loose "tails" of rubber-covered wires are highly objectionable, and should be avoided by enclosing them in a metal tube carefully earthed, and filled in solid with compound.

7. It is not desirable that transformers should be placed in pillars above ground, unless loose wires and cables and exposed live parts can be altogether avoided. Where street boxes are used as transformer chambers they should be placed below ground, and properly designed switch pillars may be set over them, or, preferably, they may be built into a wall.

8. The foregoing recommendations may be applied also to low and medium-pressure pillars.

THE DESIGN OF HIGH-PRESSURE DISTRIBUTION SYSTEMS.

In the course of the discussion on Mr. Beard's paper by the Western Local Section of the Institution of Electrical Engineers, Mr. W. A. Chamen said that he took the author's statement that as time went on they would do more and more of their distribution at high pressure to mean that they would do far less of what he called low-tension distribution from any one sub-station. They would cut up their areas, and divide them over a much larger number of E.H.T. transformer sub-stations. It would be of interest to know what would be the effect if some of the waste-heat stations, from accident or any cause, suddenly ceased giving their supply. With regard to overhead lines in South Wales, in each case where they put up an overhead line working at 11,000 volts the birds had at first been a great trouble. They stood on the cross-arms or pole tops and managed to reach the wires, causing a short-circuit, and sometimes shutting down the supply as well as killing themselves. This happened for a little time,

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but soon the birds began to learn—at least the next generation of birds did—that it was dangerous, and this trouble ceased.

Mr. J. W. Burr said he supposed the author's idea was to have many high-pressure sub-stations and to supply only in the immediate locality of these sub-stations with low pressure. This would obviously require not only a great number of sub-stations but also a dense distribution area in their neighbourhood. The majority of central station engineers had not to deal with an area in which this was possible. Regarding the suitability of supply, obviously this must suit the consumers' requirements. A short time ago he was requested to give a supply to a large works, and suggested that they should take low-tension 3-phase alternating current. It was, however, pointed out that they had already a continuous-current installation at 235 volts, and it was, therefore, necessary to install a rotary converter at their particular voltage or lose the business. He agreed that money spent on preventing or minimising an interruption to the supply was money well spent, since reliability of supply must be one of their first considerations. In some cases the use of automatic apparatus was overdone; he would rather rely to some extent upon the attendant and employ qualified men. After all, even automatic contrivances sometimes went wrong. He suggested that a frequency of 50 was high for power distribution. The inductance voltage was directly proportional to the frequency, and as this factor limited the power which could be transmitted over any line it surely should be reduced as much as possible. He had been under the impression that switchgear was designed to-day that would operate successfully under almost any condition of working. He was of the opinion that it did not normally pay to operate cables at the maximum current density allowed by heating limits.

Mr. C. F. Proctor inquired what was the maximum output of the Newcastle stations, and the proportion between the power generated by the waste-heat stations and that of the main stations. He also asked whether in extra-high-tension switchboards trouble had been experienced from static charges of the parts; in a 17,000-volt switchboard he saw tested some years ago he noticed that sparks passed between any two metal parts (such as two screws) close together, although they were not supposed to be in electrical contact with any live parts.

Mr. F. Tremain was surprised to hear that the breakdowns of overhead lines were only twice as frequent as those on underground cables. A 2 to 1 ratio did not seem, at first sight, to be sufficient difference between overhead and underground systems to justify the greater cost of subterranean cables.

Mr. C. T. Allan agreed that the interconnected system was the most economical, but the problem was how to introduce the protective apparatus upon an existing system having cables already laid. With the protective systems mentioned by the author, reliance for the operation of the clearing circuit breakers had to be placed upon current transformers, and he found that trouble with current transformers was occasionally experienced during lightning storms, so that they could not be considered infallible. He could recommend the use of high steel poles, because wilful breakage of insulators was avoided; it was practically impossible to break an insulator on such a pole except by using a rifle. His experience had been that the proportion of breakdowns on overhead lines was no greater than with underground cables, and certainly for quickness and ease of repair, overhead lines were to be preferred.

In reply, Mr. Beard said that in several large towns extensive networks were being divided into sections fed from different sub-stations; on the North-East Coast, no extensions were being made to D.C. networks or to rotary sub-stations. The large number of generating stations was due to the existence of sources of waste heat, but for which the area would have been supplied from not more than three power stations. If a waste-heat station failed, the local supply was derived from the main system, and the loss in generating capacity could be made up by the spare plant at the coal-fired stations. In the event of waste-heat stations being shut down by a strike, there would usually be a corresponding drop in the load on the system. The same trouble had been experienced with birds in the North as in South Wales, and recent lines were being carried on suspension insulators. Sometimes a flock of birds might settle on a particular wire, and increase the sag so much that the wire or a bird on it comes into contact with the wire of another phase. Wayleaves were required for high-pressure overhead lines, because these could not be erected along a public road; underground cables, on the other hand, could be laid in public roads without any wayleave. The choice of frequency depended mainly upon the plant and consumers' apparatus, and had little to do with the distribution system. On the N.E. Coast system two years ago the output exceeded one million units a day, but owing to the high load factor the maximum demand had not yet reached 100,000 KW. The units generated by the waste-heat stations were about one quarter of the total. Surge effects did not cause much trouble on a large system, and the less apparatus they had for protecting against surges, the less trouble they experienced. For the overhead lines, they relied entirely on taking them into sub-stations through a short length of underground cable, which device had proved strikingly successful. All metal parts of switchgear that were not alive were earthed. The split-conductor system was the best to deal with breakages on overhead lines, which were otherwise very difficult faults, owing to the resistance of a broken wire to earth being sometimes from 50 to 100 ohms. Where cables had already been laid, the balanced-current system could only be applied by laying pilot cables; but when converting an old radial system into an interconnected one, it was better to group the old feeders in pairs and treat the double cable as a single split-conductor feeder.

WAR ITEMS.

German Engineering Industry.—Herr Fröhlich, the secretary of the Association of German Engineering Works, recently addressed a gathering of engineers in Würtemberg on "Industry and the War." There was, he said, no scarcity of the two most important raw materials, coal and iron, and the present production of pig-iron and steel exceeded the requirements of the Empire. Although the commandeering of metals by the Government had at first caused great difficulties in the engineering industry, these had been overcome, thanks to the adaptability of the works. Economy in the use of high-speed steel was necessary. The home trade had been but little affected by the war, and hardly any contracts had been cancelled; although in some cases execution had been postponed until after the war. Very few new contracts had been placed, but the absence of such was made good by the increased Army orders. As a result of the pressure put upon the industry by the military requirements the German works had acquired an experience in the rapid construction of automatic machines and in turning out machines on a wholesale scale which must have a beneficial effect upon the whole industry. The months of war were months of learning which would lay the foundation of future technical progress. The export trade had suffered greatly, for it must be remembered that in normal times about one-third of the total output of the German engineering works was exported. After the war neutral countries would probably act to a great extent as intermediaries in introducing German goods in what were now enemy countries.—"Ironmonger."

Bolton Corporation and its Contracts.—At the monthly meeting of the Bolton T.C., on February 2nd, information was sought as to whether the firm of Messrs. Falk, Stadelmann & Co., Ltd., to whom moneys had been paid by the Electricity Committee for fittings, and by the Gas Committee for mantles, was a British firm. Councillor J. H. Crook said the capital of the company named was £392,790, all the directors were British subjects, as also were the shareholders, with one exception. The firm traded with various Government departments, and no fewer than one hundred of its employés were serving with the Forces.—Councillor Haythornthwaite (who originally raised the subject) said that the last speaker was misinformed, or else he himself was misinformed. According to a document issued by the Companies Registration Office in November, this company was registered in October, 1913. The total capital was £392,790, of which £78,447 was held by two German subjects in Germany, £2,200 by a German subject in this country, £190,721 by three naturalised subjects of German origin, whilst the remaining £95,470 was held by the wife and daughters of a German member of the firm, a naturalised German. It was up to the Corporation committees to see that they did not have German goods foisted upon them.—The Mayor (Alderman Seddon) said there was a difference between two members, and he thought the Council might leave the matter with the two, along with himself, to see which of the statements was correct.—It was decided that the subject should be inquired into in this way.

Coal Supplies.—The Board of Trade announces that owing to the increasing demands of industries connected with the war, the difficulties with regard to fuel supplies to which the Board called attention on December 1st last have become more pressing in certain districts. It was decided, therefore, to appoint, on the nomination of the various coal-owners' associations, district coal and coke supplies committees, with the object of ensuring that munition firms and other important consumers obtain the supplies they need with as little delay and friction as possible. Committees have been formed, or are in course of formation, in many districts. It will be the business of these committees to see that the resources of their districts are utilised to the best advantage, and that the requirements of important industries are fully met. Any recommendations that they may be able to make with a view to greater economy in the use of coal will be carefully considered.

"Re-fitting" Wounded Soldiers.—In connection with the work of "re-fitting" wounded soldiers for industrial employment—a subject to which great attention is being paid in Germany—an exhibition of artificial limbs has just been opened in Charlottenburg. Not only are the exhibits numerous, but they show that marvellous progress has been made in providing men who, in the war, have suffered the loss of arms or legs, with artificial limbs that will not only enable them to perform ordinary duties but to follow their old employment.

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A New German Price Advance for Machinery.—The leading firms in Germany belonging to the price convention for heavy electrical engineering manufactures, have just made a further increase of 10 per cent. in the list prices owing to the present situation of the market for raw materials, thus making a total advance of 40 per cent. The higher charges apply to machines and motors, including electrically-driven ventilators, pumps, boring machines, etc., starting appliances, regulating resistances, controllers, oil, lever and automatic switches, and railway materials, whilst the list prices for machines and motors of over 100 h.p., as well as for transformers, continue suspended. Further increases are reserved in the case of articles for purely peace services. Among the firms who have signed the circular announcing the alteration are the A.E.G., Siemens-Schuckert, Bergmann, and Brown-Boveri.

Women as Engineers.—Speaking on "Women's Work during and after the War," at a meeting of the Royal Society of Arts, Lady Parsons said that a new field for women's enterprise seemed likely to develop in the important industrial profession of engineering. It would be a great advantage if provision could be made for some educated girls to go through the shops and gradually take control of unskilled women-workers. If a favourable apportunity were to arise for establishing a factory for women it would be a great step towards organising all our resources. She suggested that women might specialise on making some of the innumerable articles that we bought from Germany before the war, such as motor-cars, cycles and parts, electrical machinery, sewing machines, cheap clocks and watches. It was clearly a case for the Government to give a lead.—"Times."

After the War.—The Lambeth and Battersea B.C. have passed the following resolution, copies of which have been sent to the Government, the members of Parliament for the boroughs, and Metropolitan B.C.'s:—"That the time has arrived for legislation to be framed to protect our people against the return of trading aliens after the war; that such legislation should take the form of licensing all professional and trading concerns."

Glasgow Corporation and Enemy Contracts.—The Special Committee on Standing Orders recommends the Glasgow Corporation to resolve:—"That during the period of the war no contract be entered into with any person of German or Austrian nationality; or with any firm or company whose subscribed capital (whether by way of shares or otherwise) is held or controlled to the extent of one-third or upwards by persons of German or Austrian nationality."

Australia and Enemy Shareholders.—Reuter's Melbourne representative states that the regulations approved by the Federal Executive for the wiping out of enemy and naturalised shareholders in public companies, and making the transfer of their shares to the Public Trustee until a year after the war obligatory, also apply to persons on the London registers of Australian companies.

Excess Profits.—All applications or appeals respecting the excess profits duty should be sent to the Registrar, Board of Referees (Finance (No. 2) Act), Refuge Assurance Building, 133, Strand, W.C.

Controlled Works.—There are now 2,720 establishments controlled by the Minister of Munitions.

LEGAL.

Postmaster-General *v.* Hutchings.

Mr. Justice Lush, the Hon. Gathorne Hardy, and Sir Jas. Woodhouse, sitting as the Railway and Canal Commission on Monday, February 7th, had before them a case in which Mr. A. B. Hutchings, the respondent, as the owner of an estate at Seaford, in Sussex, which was laid out for building purposes and intersected with roads not yet built upon, sought to uphold a decision of the local County Court judge that the Postmaster-General should pay him £5 a year for the privilege of placing telephone poles on certain portions of the roads, a decision to which the Postmaster-General objected.

Mr. H. L. Murphy appeared for the Postmaster-General, and the respondent appeared in person.

Mr. Murphy said that the matter came before the Court by way of a reference under Sec. 4 of the Telegraphs Act of 1878.

Mr. Justice Lush, in giving judgment, said the question had been raised as to whether the roads were private or public within the meaning of the Act, and, in the opinion of the Court, it was quite clear that they were public roads, and had been used by the public for some 15 or 16 years. Being public roads not taken over by the local authorities, Mr. Hutchings was still the owner of the soil, and was, therefore, a person who, within the meaning of the Telegraphs Act of 1878, was entitled to withhold his consent to the placing of poles on the roads. The Postmaster-General desiring to place telephone poles on the road, and to place the wires under the streets, application was made to Mr. Hutchings for his consent, which he did not give, and differences had arisen between the parties. Under Sec. 4 of the Telegraphs Act of 1878 these differences were referred to the County Court Judge for him to say whether the consent ought to be given, and, if so, under what conditions. The Judge thought that the consent ought to be given upon the terms that Mr. Hutchings should receive a rental of £5 a year. The Postmaster-General was dissatisfied with that decision, and the matter came before that Court in consequence. It was clear that in dealing with the application they must regard Mr. Hutchings not in his capacity as owner of the adjoining land, but as the owner of the soil of any roads dedicated to the public. If Mr. Hutchings should suffer any damage as the owner of the land, the Act provided in clear terms for his compensation. It was a very unusual thing for a County Court Judge to say that a rental should be paid to the owner of a street. It appeared to the Court that it was inconsistent that he should be given a rental for that which did not affect his proprietary interest. There was no ground for saying that the Postmaster-General should pay a rental to the owner of the soil of the public road. If Mr. Hutchings could show that in his capacity of owner of the soil of the roads he would be put to any expense or damage it would be right to safeguard him. The Postmaster-General, however, would make good any damage, so that Mr. Hutchings would suffer no pecuniary damage whatever by the erection of the poles. Every possible provision would be made by the Postmaster-General to safeguard Mr. Hutchings against having his roads made unsightly. The Court, therefore, had come to the conclusion that the condition imposed by the learned County Court judge ought never to have been imposed, and that the Postmaster-General ought to be relieved from it and consent given to the application.

Sub-station Attendants.

A case of interest to central station managers and employés was brought before the Local Munitions Tribunal for the Metropolitan District at Caxton House on the 3rd inst., at the instance of W. J. Ebben, who complained that the consent of the Poplar Electricity Department to his leaving its employ was unreasonably withheld. The complainant stated that he wished to leave because he was at present engaged on work which did not utilise his engineering skill and his training as a skilled mechanic to the full; he was only required to work 48 hours a week, and an improver was doing the same work for 30s. a week.

Mr. J. H. Bowden, electrical engineer to the Borough Council, pointed out that the improver would eventually have the same status as the complainant, but was not yet sufficiently qualified to be placed in full charge of the work; 48 hours was the usual week in that class of work, for which no special skill was required.

After hearing the evidence of Mr. Bowden, the Court unanimously decided that the certificate of release asked for could not be granted. By this decision, the electricity supply undertaking appears to be placed on the same basis as a controlled establishment.

Threat to Cut off Supply at West Bromwich.

On February 4th, in the Chancery Division, Mr. Justice Eve heard a further motion in an action against the Corporation of West Bromwich, in which the plaintiff asks for an injunction to restrain the defendant Corporation from cutting off electrical energy with which he alleges they contracted to supply him.—Counsel said the motion would have to stand over for a short time, and the Corporation had agreed to abide by the undertaking they had given until the dispute was decided.—His Lordship assented.

Telegraphists' Cramp.

At the Marylebone County Court, a widow claimed £300 compensation for the death of her daughter, due, it was said, to telegraphists' cramp, set up while employed as a telegraph operator in the Government service. It was contended that the cramp set up sclerosis which affected a central portion of the brain and spread through the nervous system with fatal results. After hearing medical evidence, the judge held that the connection between the sclerosis and cramp was a surmise. He made his award in favour of the respondent, the Postmaster-General.

Coal Mines Act Prosecution.

In the Hamilton Sheriff Court last week, Sheriff Shennan heard lengthy evidence in two charges of alleged contravention of the Coal Mines Act brought against R. Hutchison and A. Shaw, firemen. The prosecutions were the sequel to a fatal accident which occurred in the Bardykes Colliery, Blantyre, last August, and the complaint bore that a fall of stones, &c., having taken place, and an unarmoured electric cable having been brought down and covered by the *débris*, the accused negligently and wilfully asked and allowed several workmen to clear away the fall while the cable was still alive, whereby the lives of the men were endangered, and one of them, McDougall, miner, made contact with the cable and was killed. Witnesses for the Crown deposed that the firemen warned the men to be careful in clearing the fall as the current had not been switched off. On numerous occasions, *débris* had been cleared from a cable while the current remained on.

Mr. William Smith, head electrician to the Summerlie Iron Co., said that the coal-cutter was working at a pressure of 500 volts.

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As a matter of practice the current was not switched off when a fall took place. It would impede the work of the pit, if, after a fall, the current was switched off, as electricity was used for ventilation and pumping purposes.

Sheriff Shennan said that as one or two rather important points of law were involved in the prosecutions, he would take time to prepare a written judgment.

Herbert Morris, Ltd., *v* Saxelby.

The House of Lords delivered its judgment in this appeal on Monday. The matter has been fully reported in our pages on several occasions. Their Lordships dismissed the firm's appeal.

BUSINESS NOTES.

Consular Notes.—JAPAN.—The British Consul, in reporting on the trade of Nagasaki, gives the figures for the machinery import trade during 1914. He shows that though the import from the United Kingdom was less under most headings than in 1913, it was still far ahead of the imports from all other countries combined. The largest part of the import was for the local shipbuilding yard. The totals for the United Kingdom were £101,469 in 1914, and £167 378 in 1913; Germany's total was £21,660 in 1914 and £25,833 in 1913; and the United States share was £7,868 in 1914 and £10,114 in 1913. The following are the figures for some of the different classes:—

	United Kingdom.	Germany.	United States.
Steam boilers	£9,419	—	£148
„ turbines	2,968	1,558	—
Electrical machinery ...	2,946	4,931	1,694
Pumps	3,110	1,493	159
Capstan and other winding machinery	5,784	799	455
Metal or wood-working machinery	21,064	—	1,094

Compared with 1913, the items showing a decrease from the United Kingdom were pumps, cranes, electrical machinery and gas, petroleum and hot air engines. Germany had an increase in electrical machinery, but a decrease in steam boilers and turbines, pumps, metal and wood-working machinery, gas, petroleum and hot air engines. From the United States the decrease was chiefly in electrical machinery.

The Mitsu Bishi Dockyard and Engine Works employed 10,445 workmen at the end of 1914. The Consul says that in mild steel bars and plates the United Kingdom makes no effort to compete, but as it is now impossible to obtain these from Belgium or Germany, there may be an increased demand for a better class of steel. The steel foundry at Wakamatsu now produces large quantities of iron plates for dockyard and other uses. Work on the construction of an electric tramway system for Nagasaki was to be begun last year. "A portion of about two miles will be first undertaken, and so far as can be learned, the promoters are buying the rails second-hand and the cars are to be made in Japan."

CHINA.—British Consul General Goffe, in his report on the trade of Mengtzu, says:—"The great drawback to British trade in this province hitherto has been the lack of any British house to represent British manufacturers and push the sale of their goods; but there is a good prospect of this deficiency being remedied in the near future. The present moment is exceptionally favourable for such an enterprise, as the two German firms of Carlowitz and Co. and Speidel & Co., who have hitherto supplied local buyers with machinery, piece-goods, dyes, paper, &c., can now obtain no further supplies, and the Chinese would welcome the establishment of a British house here. There are inquiries for irrigation pumps, electric light machinery, flour and rice mills, the installation of waterworks in Yunuanfu, locomotives and trucks for the Pishihchai Railway and other items, but they can only be dealt with by a man on the spot who is prepared to make a contract for the goods delivered c.i.f. at Haiphong, to assist possibly to some extent in their erection and to arrange the question of exchange. The representative of the machinery department of a Hong-Kong house is now in the province looking into these matters, and there is a good prospect of at least some of the inquiries resulting in the placing of orders with British manufacturers."

INDIA.—The American Consul at Karachi, in reporting a request by a firm in that town to be placed in communication with American manufacturers of small engines capable of being driven by electricity, to develop about 5 H.P., and to be as simple as possible in construction, states that this firm, if satisfied, is prepared to push such engines up-country. In India the lower and middle classes do not, as a rule, leave their homes or the districts in which they were born; but the members of enormous "families" live close together in "groups" which combine to buy a machine to grind meal. Sometimes this small mill is run by an oil engine, but recently electricity has made great strides in India and the natives are learning to use it. The local electrical works recently advertised to supply not only electricity for lighting, but also power for mechanical purposes. The firm mentioned above sees a future for small engines run by power furnished by the electrical works. Several of these engines are, as a matter of fact, in use for the purpose mentioned, and as these machines are not kept in stock, the supply must come from abroad. A complaint is made that on a previous occasion American manufacturers, when advised of the prospective market in Karachi for electrical goods some time ago, "went to sleep" and now an English firm is wiring the town and supplying all the bulbs and other fixtures.

CUBA.—Modern automatic telephone systems, with complete underground cables, are now, states a report by the American Consul at Santiago de Cuba, in operation in that and many other Cuban cities. The old magneto system, formerly in use and very unsatisfactory, has been changed throughout the island. Long-distance service is furnished to nearly all the cities and large sugar mills. The Cuban Telephone Co., an American concern which obtained its concession in 1909, owns and operates practically all the local and long-distance lines in Cuba. New central offices have been constructed in Santiago and the new switchboard now being installed is for 2,000 lines.

ITALY.—There has been, according to an American Consular report on trade in Italy, considerable increase in activity with regard to electrical goods in some districts of that country. At Bari, in recent years an important business has been done in all kinds of electrical appliances, especially motors for industrial and agricultural purposes, electric light and power plants, &c. The greater part thereof was supplied by German firms, who were specially organised for this class of work, having their own branches in Italy. They were thus in a position to furnish complete plants, and if repairs were required their engineers and workmen were near at hand, all of which gave them an unquestionable advantage over their competitors. However, the present war will undoubtedly be the cause of a considerable set-back to German trade in Italy and an interesting field for enterprise will be thus opened to other competitors. In the region of Pisa—a most flourishing industrial section, largely connected with the manufacture of alimentary products, there are more than 200 mills for the grinding of cereals, most of which use water power. The use of small electric motors of 1½ to 3 H.P., is, however, becoming more extensive, and a few of the larger plants have installed motors of 20 to 45 H.P.; but there are more than 300 olive-oil factories where the power used for pressing the olives is still largly hydraulic or animal.

TUNIS.—A recent American Commerce report draws attention to the increasing possibilities of this African market. Tunis is a rapidly growing country of great agricultural and mining resources with a population of about 2,000,000. An increasing market is being developed for all kinds of manufactured goods, and progressive methods are everywhere manifest. Increasing production has brought increasing prosperity, with its demand for a great variety of goods other than farming and mining machinery. The efficient government under the French protectorate has also raised the standard of living of the natives and stimulated their purchases of modern goods. Amongst other things, electrical goods offer a field for future development. There has been a considerable volume of German and Austrian trade, prior to the war, and the latter government has had a commercial museum in Tunis.

SOUTH AMERICA.—Evidence continues to accumulate that the American traders, despite the exceptionally favourable opportunity presented as a result of the temporary withdrawal of many European firms from South American markets as a result of the war, are not carrying all before them in their attempts to capture these valuable markets. The American Consul at Pernambuco, who has been conducting a series of interviews with business men of that city with reference to American trade, corroborates the statements of his colleague at Buenos Ayres, to which reference was made in our issue of January 7th last. Complaint is made of the carelessness of many firms whose indiscretions cause all the trade to pass through the hands of a few firms in New York and thus make it almost impossible for manufacturers and exporters, launching into foreign trade for the first time, to enter these markets, although they are well equipped with managers who know how to deal with the South American importer. These latter firms are not given a fair chance, as the merchants in Pernambuco are, as a result, afraid to deal with unknown firms.

A well-known merchant of that city remarked: "I have seen a great many letters from American firms that wanted to do business in this city, but I never considered them." When asked why, by the Consul, he replied: "Because your good firms have enough business to attend to at home. Only those that cannot sell their products at home want to find foreign markets" Several instances which have contributed to this unfavourable impression are quoted. The question of credit is also again referred to as a stumbling block to the increase of American trade. Traders still continue to demand cash against documents in Pernambuco, or even in the United States, before the delivery of goods. "If we have to pay cash," local merchants say in discussing this question, "we will buy only what we have to, and hope to do business with Europe again after the close of the war. We have a good reason for this. We must do business on credit. Here in Pernambuco most of our business is with the interior and we have to sell to our customers on credit. Another reason is the excessive Customs charges, which would surprise some of the American manufacturers. Then comes the value of the stock itself, so that to pay cash really means working with three capitals—one for the customers, one for the Custom house, and one for the American exporter." The Consul urges that longer credit should be given and also that more care should be taken in dealing with orders. He even suggests that manufacturers should pass a resolution, promising more careful attention, which could be circulated amongst local traders.

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Book Notices.—*Flood Control in California.*—We have received a copy of the report made by the Board of Engineers of Flood Control to the Supervisors of Los Angeles County, relative to an investigation made by this Board, which was appointed in April, 1914, and included the well-known engineers, Messrs. Frank H. Olmsted and J. W. Reagan. The book contains about 500 pages with complete and detailed maps and drawings. This Commission spent 18 months and about one hundred thousand dollars in making surveys and gathering data relative to both the prevention and control of the great floods which every decade visit Los Angeles County. The cost of the works recommended is estimated at more than 16 million dollars. Copies of this report may be secured by professional men, and the authorities of localities having similar flood problems, by addressing the Board of Supervisors of Los Angeles County, Los Angeles, California, or J. W. Reagan, Chief Engineer of Flood Control, Hall of Records, Los Angeles, California.

"*Journal* of the Röntgen Society." Vol. XII, No. 46. January, 1916. London: Smith & Ebbs, Ltd. Price 4s. net.

"Technical Papers of the Bureau of Standards." No. 26: "Earth Resistance and its Relation to Electrolysis of Underground Structures." No. 52: "Electrolysis and its Mitigation." No. 56: "Protection of Life and Property against Lightning." "Scientific Paper of the Bureau of Standards." No. 259: "A new relation derived from Planck's Law." Washington: Government Printing Office.

"*Transactions* of the North-East Coast Institution of Engineers and Shipbuilders." Vol. XXXII, Part 3. January, 1916. Newcastle: The Institution. Price 5s.

Messrs. Hodge & Co., publishers, have in the Press, and will shortly issue for the use of employers and workmen, a handbook on the Munitions of War Acts.

"Examinations in Science and Technology, 1915." London: Eyre & Spottiswoode. Price 9d.

Staff Supper.—The Supply Department of the BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., LTD., held their annual hot-pot supper and smoking concert on January 21st, at the Exchange Hotel, Manchester, when 32 members of the staff and friends sat down to supper. At the smoking concert which followed, Mr. J. Gibson, manager of the department, presided, and he was supported by Mr. G. Ellam (assistant manager). Over 50 were present, including visitors and the department's representatives from Leeds and Sheffield. Mr. Gibson, in giving the toast "The British Westinghouse Co.," referred to the loyal feeling which existed between the company and the staff, and said that during the nine and a-half years he had been with the company, they had treated their staff well, and in return the staff loyally carried out their duties. The department had had a record year, the turnover having increased by nearly 70 per cent. There were many faces missing that night—some, unfortunately, would never be with them again, but he hoped that others who had answered the country's call would be spared to be with them again. Mr. Ellam proposed "Our Visitors," and Mr. L. E. Wilson and Mr. E. E. Prestwich responded. Mr. Bent toasted "The Artistes," and Mr. Moon responded.

Private Arrangement.—THE CEDES ELECTRIC TRACTION CO., LTD., 112, Great Portland Street, London, W.—A conference of the principal creditors was held on January 31st, at the Institute of Chartered Accountants. A statement of affairs prepared by Messrs. J. W. Barratt & Co. showed unsecured liabilities of £7,271, while the assets were estimated to realise £5,302. There had to be deducted £255 for preferential claims and £4,090 due on debentures, and the net assets were reduced to £957. Mr. J. W. Barratt was appointed receiver and manager on January 14th last upon the application of the debenture holders, who were the Austrian Daimler Motor Co., Ltd. The company had carried on numerous contracts, on some of which money had been lost. At the present time they held a Government contract, which it was believed was profitable, and was being continued by the receiver. It was pointed out that in addition to the assets shown on the statement of affairs, there was a large amount due in connection with a sub-contract, and in certain quarters it was thought that a large sum would be realised. There was also the profit which it was expected would be made on the Government contract. There was a large creditor for over £39,000 for money lent, but that amount also was not included in the statement. It appeared that the money was lent by the Disconto Gesellschaft, but there was some doubt as to whether the claim would rank. It was not certain whether the firm named were the actual principals, and it might be that the money came from the Skoda Works, Austria. The company's business was being controlled by a Government supervisor. A petition had been filed for the winding-up of the company. After some discussion it was decided to appoint a Committee of the principal creditors to consider, in conjunction with the company's solicitor, and the receiver, a scheme by which second debentures could be given to a trustee for the benefit of the unsecured creditors. The Committee appointed consisted of the representative of Messrs. Johnson & Phillips, Mr. Hawkins, and Mr. P. Houston (Messrs. Corfield & Cripwell).

Prices Advance.—THE ST. HELENS CABLE AND RUBBER CO., LTD., announce increased prices for rubber-insulated wires and cables consequent upon the continued advance in cost of raw materials.

For Sale.—The Dundee Electricity Supply Department has for disposal one 30 KW. generating set, direct-coupled to 200-250-volt "Parker" D.C. dynamo, complete. See our advertisement pages to-day.

Bankruptcy Proceedings.—C. H. LEIBBRAND, 20, Vesta Road, Brockley, author.—The first meeting of creditors was held on Monday at the London Bankruptcy Court. The receiving order was made on January 26th, on the petition of the Capital and Counties Bank, Ltd., who tendered a proof of debt for £317 in respect of an overdrawn balance at their Felixstowe branch. Mr. F. T. Garton, Official Receiver, reported that the debtor had stated that he was a German by birth, but was de-nationalised in November, 1884, and domiciled in France in 1887-8. He was an author, but had also been engaged in the promotion of companies, though he had never promoted one in his own name. Since 1913 he had been working on a big electrical development scheme at Felixstowe for supplying electricity to East Suffolk. He was the promoter, and had expended at least £3,000 on the scheme, which had been suspended in consequence of the war. He was taken to the Alexandra Palace Detention Camp on November 17th, 1915, without warning, through his not being registered as an alien enemy, although admittedly an ally by right of domicile in France. A previous failure was recorded against the debtor in September, 1902, under which proceedings a dividend of 4½d. in the £ was paid, and from which he had been discharged. He attributed his present position entirely to the war, which stopped all his schemes and business. Debtor sent a letter asking for an adjournment with a view to submitting a proposal. The Chairman said that the debtor had not lodged a statement of his affairs. In his preliminary examination he stated that he was only legally liable to the extent of about £600, and he had in the shape of assets, book debts, amounting to £9,000. In the absence of a quorum the meeting was adjourned for a fortnight.

AUGUSTINE GARBUTT, tobacconist and electrical engineer, Bradford.—At the public examination at Leeds, on February 1st, it was stated that the liabilities were £146 and the assets nil. Debtor attributed his failure to keen competition and losses on contracts. The examination was adjourned until February 15th.

Liquidations.—SCIENTIFIC MANUFACTURES, LTD.—Meeting of creditors, February 14th, at 3, Warwick Court, Gray's Inn, W.C.

ACCUMULATOR INDUSTRIES, LTD.—Creditors should send particulars of debts, &c., to Mr. G. E. Corfield, Balfour House, E.C., or Mr. A. W. Sully, the liquidators, by March 8th.

ADNIL ELECTRIC CO., LTD.—First meeting of creditors and contributories, February 29th, at Carey Street, W.C.

CICOY MAGNETO CO., LTD.—A meeting is called for March 13th, to hear an account of the winding up.

HELE-SHAW PATENT CLUTCH CO., LTD.—A meeting is called for March 8th, at Hartford Works, Oldham, to hear an account of the winding up.

Inquiries from Italy.—The British Chamber of Commerce for Italy at Genoa sends the following inquiries from firms who formerly did business with Germany and Austria and want to establish British connections:—

No. 956.—Firm at Bari inquire for addresses of British manufacturers of electric material. B.F.R.

No. 969.—Merchant at Turin wishes to get into touch with first-class manufacturer of high-speed steel. T.M.C.

No. 987.—Commission merchant at Genoa is open to represent British firms for mechanical machinery, machine-tools, hydraulic machinery, metals and ores, paints and varnishes, oils. G.M.A.

Trade Announcements.—MESSRS. PARMITER, HOPE AND SUGDEN, LTD, have appointed Mr. David Alexander, 43, Mains Street, Waterloo Street, Glasgow, their sole selling agent for Scotland. At that address samples will be shown of all their latest Fluvent switch and fuse gear.

THE INDO-EUROPEAN TELEGRAPH CO., LTD., (Globe Radio Apparatus Department) announce that it has been found more convenient to designate by that title the business of the Wilson Apparatus Co. recently taken over from Mr. H. R. Rivers-Moore. All communications should be addressed accordingly.

Diesel Engine Insurance.—We have received from MESSRS. MIRRLEES, BICKERTON & DAY, LTD., of Hazel Grove, near Stockport, a prospectus of a new scheme of insurance of Diesel engines of their make (under arrangement with the London, Guarantee and Accident Co.), which provides for periodical inspection and examination by the firm's own experts. Those interested in the matter should communicate with the firm, asking for a copy.

Patent Restoration.—Application has been made by Nathaniel Baldwin for the restoration of Patent No. 10,774, of 1910, for "Improvements in sound reproducing devices of the telephone receiver type."

An order has been made restoring Patent No. 21,425, of 1911 (R. B. Wasson), for "Improvements in and relating to the manufacture of metal-packing rings."

Meeting of Creditors.—EMPIRE PORTLAND CEMENT CO., LTD.—The committee of creditors, appointed at the general private meeting of creditors, reported last week that a tentative offer had been made to purchase the company, and it was hoped that the sale would produce about 5s. in the £ for the creditors.

Lamp Poster.—THE "Z" ELECTRIC LAMP MANUFACTURING CO., LTD., of Southfields, have brought out a new poster advertising the lasting qualities of their drawn lamps, and a window streamer emphasising that they are made in England.

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LIGHTING AND POWER NOTES.

Aberdeen.—New Plant.—The Electricity Committee has approved of an extension of plant at sub-stations, and has authorised the engineer to procure a 500-kw. motor-converter, at a cost of £1,800.

Argentina.—The electrical power house of Messrs. Barone & Hamra, at Concepcion del Tio (Cordoba) for the supply of public lighting was inaugurated on 1st inst. The service is shortly to be extended to private houses and business premises.—*Review of the River Plate.*

Barnet.—Street Lighting.—The North Metropolitan E.P.S. Co. has allowed the District Council a sum of £66 off the account for public lighting during the past quarter.

Barrow.—Proposed Loan.—The T.C. has decided to apply for sanction to borrow £10,300 for electricity extensions, including transforming plant, cables, switches, &c., required for power purposes, and for supplying light to workmen's dwellings.

Birkenhead.—Proposed Loan.—The provision of H.T. plant and feeders in connection with the supply to the north end of the borough is recommended, at a cost of £6,400.

Birmingham.—Proposed Revision of Charges.—The Electricity Committee is proposing to increase the charges for electricity; it is expected that the Committee will be in a position to make recommendations to the City Council in March.

Coal Contracts.—The City Gas and Electric Supply Committees have decided to pool their coal contracts in future, instead of purchasing independently.

Bo'ness.—The T.C. has instructed Mr. J. M. M. Munro, of Glasgow, to report on the condition and prospects of the electric supply undertaking, and the need for an immediate extension.

Bredbury and Romiley.—The Stockport T.C. is negotiating with the U.D.C. for consent to current being supplied to Messrs. Pollock & Macnab's works.

Derby.—The T.C. has decided to extend the overhead mains so as to supply current to the works of the Parker Foundry Co.

Dover.—Public Lighting.—Owing to the restricted public lighting, there has been a loss on the capital spent on cables and time switches, and the Electricity Committee has allowed the T.C. credit for this, and to pay £150 a year for the clock switches after March 31st.

Downham Market.—E.L. Scheme.—Mr. C. H. Best has written to the U.D.C. regarding the offer of the Gas Co. to obtain powers to supply electricity, pointing out that an undesirable monopoly would be created, and that far greater satisfaction would be given by an independent supply company which he proposed to form. The Council has decided to discuss the matter with Mr. Best.

Dublin.—A comprehensive report has been submitted to the Special Investigation Committee of the Corporation by Mr. P. W. d'Alton, M.Inst.C.E., who was appointed by the Committee to inquire into the history and conduct of the electricity supply undertaking of the Corporation. By some means parts of the report were prematurely published in the local Press, and complaints were made at a meeting of the Council that the extracts were so chosen as to give an erroneous impression regarding the trend of the report. We shall deal with the report in our next issue.

Eastbourne.—The Electricity Committee has disclaimed legal liability in regard to the recent fatal collision with a switch pillar; the switchbox was placed in its position in accordance with the B. of T. regulations.

Eccles.—Plant Extensions.—The electrical engineer is to report on the cost of providing a plant for three-phase supply, with a view to application being made for borrowing powers to carry out the scheme.

Large users of electricity for lighting purposes are now to be charged a flat rate of 3d. per unit for a consumption exceeding 10,000 units per annum through one service, subject to 10 per cent. increase.

Gillingham (Kent).—The T.C. has decided to increase the charge for current supplied to the Corporation flats from 6d. to 8d. per week. Owing to the difficulty of obtaining supplies of reliable apparatus no more electric cookers are to be issued until a hire-purchase scheme is introduced after the war, and the existing outfits are to be maintained as at present.

Glasgow.—New Plant.—In connection with the placing of contracts for two 8,000-H.P. turbo-alternators, it has been officially pointed out that the Electricity Committee had only maintained the supply by overloading the existing plant. Three large factories, still to be connected, would absorb nearly the whole of the output of one of the turbines, and the other turbine would be required to meet the normal increase at the rate of 2,000 new consumers per annum. The two new sets would effect a saving in fuel equivalent to about £5,000 per annum each, a most desirable form of economy at the present time.

Horsham.—Year's Working.—The report of Mr. Morgan, the Council's electrical engineer, shows that despite adverse circumstances, there was a net profit on the electrical undertaking of £420 for the year to March, 1915, as compared with £459 for the previous year. Returns are included of the first complete year's working of the refuse destructor, showing that some 1,422 tons were burnt and 106,690 units generated during 2,458 running hours. The destructor is credited with 320 tons of coal saved and revenue from by-products, totalling £384; financial charges, labour, &c., amounted to £260, leaving a credit balance of £124.

Leek.—The U.D.C. has decided to engage Dr. Watkinson, of Liverpool University, to inspect the electricity works and report. There has been a breakdown of the Diesel engine, the crankshaft of which is cracked, and cannot readily be replaced.

Leigh.—Plant Extension.—Authority has been given to the electrical engineer to obtain tenders amounting to £18,800 for the supply and erection of additional plant.

Limerick.—The Mayor recently officially started up a new 240-H.P. generating set at the electricity works.

London.—The London Electric Supply Corporation, Ltd., has announced a further 10 per cent. increase in its charges for energy as from March.

Hackney.—The E.L. Committee recommends that the charges for electricity be increased by 17½ per cent., as compared with the scale of July, 1914; a 2½ per cent. discount will be allowed for payment within 14 days.

L.C.C.—Sanction is to be given to the borrowing of £18,000 by St. Pancras B.C., and £8,290 by Woolwich B.C. for electricity purposes.

The L.G.B. has been notified of approval of the linking-up schemes of the Woolwich B.C. and South Metropolitan Electric Light and Power Co.; of Marylebone B.C., the Central Electric Supply Co. and the Metropolitan Electric Supply Co.; and of the Hackney and Poplar B.C.'s.

The Metropolitan Asylums Board proposes to enter into a new agreement with the Charing Cross E.S. Co. for supply to the head offices; electric light is also to be installed at the Mead ambulance station.

Owing to the bursting of the compressor of a Diesel engine at the generating station of the Smithfield Market Electric Supply Co. on Monday, one man was so badly injured that he died soon afterwards; the station was only slightly damaged.

Manchester.—Motor Hiring, &c.—It is proposed to spend £40,000 on hired motors and additional plant at sub-stations; the revenue obtainable is estimated at £6,400 per annum. It is also proposed to increase hire charges for electric motors by about 20 per cent., representing £1,896 per annum. The increase will date from June 24th next. The Gas Committee has arranged for a supply of electricity to the Bradford Road works, for a period of seven years.

Newmill.—E.L. Scheme.—The U.D.C. has decided to make inquiries from Holmfirth U.D.C. as to a supply of electricity.

Pembroke (Dublin).—L.G.B. Inquiry.—An inquiry was held on February 2nd, by Mr. P. C. Cowan, into the Council's application for sanction to borrow £15,000 for electrical extensions.

Perth.—Mr. Lambert, the borough electrical engineer, has reported on the electrical appliances at the gasworks, at which there was a serious breakdown recently, and his suggestions are to be carried out as found convenient.

Queenborough.—Price Increase.—The Sheerness and District Electric Power Co. has increased the price of current to consumers by 15 per cent. as from January 1st.

Reigate.—Price Increase.—The T.C. has decided to raise the price of current for heating from 1d. to 1½d. per unit as from April 1st next.

Ripon.—E.L. Scheme.—A small Committee has been appointed to inquire into the question of the delegation of the electric supply powers to a suitable company.

Rugeley.—Prov. Order.—The Gas Co. has informed the U.D.C. that it is in some doubt as to whether the B. of T. will grant it a prov. order for electric lighting.

Salford.—Increased Charges.—The T.C. has decided to advance the increase in price of electricity for lighting and power from 7½ per cent. previously decided upon to 10 per cent. for lighting and 15 per cent. for power. The new rates are to date from April next.

Sheffield.—Mains Extensions.—Mains are to be extended in various parts of the city, at an estimated cost of £4,170, of which £2,150 will be spent in laying mains to the new sub-station in Sidney Street.

Skelton and Brotton.—The U.D.C. has decided to transfer £1,200 from the district account to the electric supply fund to meet the cost of work done outside the contract price for electricity supply.

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Southampton.—Plant Extension.—In view of possible difficulties in steam raising, due to the inferior quality of coal in use, the Electricity Committee has directed its engineer to submit a new scheme for conveying plant, but has deferred the question of new boiler plant, which had been raised, until next September.

Swaffham.—E.L. Scheme.—The proposal of Mr. C. H. Best, for an E.L. scheme for the town, to be carried out after the war, has been considered by the U.D.C., which is to interview Mr. Best.

Swansea.—Electricity Showrooms, &c.—The Corporation's new electrical showrooms were officially opened on Friday, last week, by Ald. Sinclair. It is interesting to note that the Mayor was driven to the showrooms in an electric saloon-body car—the first electric car in Wales—placed at his disposal by Messrs. Johnson & Burgess, Ltd. The Electric Lighting and Tramways Committee reports that Lord Jersey has consented to allow an overhead line through his property to the English Crown Spelter Works, on payment of a way-leave of £1 per annum.

Thirsk (Yorks.).—Public Lighting.—The Parish Council has decided to ask the electric lighting contractors for an abatement in respect of the public lighting account, the first instalment (£177) of which is due, on the ground of the restrictions.

Whitstable.—E.L. Scheme.—The U.D.C. has agreed to the offer of the E.L. Co. to accept 35s. per lamp per annum during the period of the war for public lighting. The money will be retained by the Council for past and future advances in connection with the working of the undertaking.

Wimbledon.—Messrs. Handcock & Dykes have been informed, in reply to their letter disputing their client's (the Fixed Price Light Co.'s) liability for payment for transformer losses, that the question must be settled by arbitration.

The assessment of the South-Western Co.'s new generating station, car sheds, and sidings off Durnsford Road, has been reduced to £4,200 gross and £2 800 net value, these figures to remain in force until March 31st, 1917.

Winchester.—The Electricity Committee reports that it may be necessary in the near future to increase the price of current to all consumers.

TRAMWAY and RAILWAY NOTES.

Accrington.—It has been decided to issue through tramway tickets, at existing charges, between Accrington and Blackburn.

Argentina.—The work of electrifying the Argentina Central Railway to the River Tigre has been resumed by the laying of the third rail and power cables.

Barrow.—In view of the curtailed service on Walney Island, the Corporation has agreed to allow the B.E.T. Co. a rebate of £400 per annum, and has also granted the company new licences for running motor-buses on certain conditions.

Dudley.—Inquest.—The adjourned inquest on the man Evans, killed in the recent tramway accident, was held on Thursday last week. It was admitted that the conductor did not ring the hand bell at starting as required, in order to get a return signal from the driver, and that the latter when he left the car failed to remove the controller handle, as provided in the rules. The jury's verdict imputed gross carelessness to the conductor and censured the driver, and the Coroner committed the conductor for trial at the assizes on a charge of manslaughter.

Gateshead.—Tramway Accident.—On Saturday evening last a car which was ascending Bensham Bank, and had been brought to a standstill, ran backwards despite attempts to apply the brakes; it subsequently left the rails, overturning at a corner and falling on four pedestrians, who were killed, while many of the passengers were also injured.

At an inquest, held on the 8th inst., on the four persons killed, the jury returned a verdict of "Accidental death," adding that the driver of the car—who left the vehicle in order to assist another driver—committed an error of judgment.

Glasgow.—Female Labour.—Success has attended the introduction of women conductors on the Corporation tramway system; already 1,050 women are in charge of cars, while on Sunday 26 women drivers were put on to various routes for the first time. The general manager, Mr. James Dalrymple, is awaiting the approval by the T.C. of women motor drivers before launching a bigger scheme. This course is rendered necessary by so many of the employés having attested under the Derby scheme.

Japan.—According to official statistics, there were at the end of 1913, 914 km. of tramways worked electrically, comprising 1.528 km. of track; there were at that period 413 km. of lines under construction. In 1913 these lines carried 570 000 000 passengers, and the 55 companies which worked them paid dividends amounting to 7·91 per cent. The largest network is the municipal system at Tokio, totalling 242 km.; the second in order is the electric railway company of Keohan, with 108 km. of lines. —*L'Industrie Electrique.*

Leith.—It is recommended, in view of the increased working expenses, to abolish halfpenny fares, workmen's fares in the middle of the day, and the concessions to sailors and soldiers.

Leyton.—Reduced Assessments.—The West Ham Union has agreed to reduce the rateable value of the tramway undertaking from £5,700 to £5,200, and of the electricity undertaking from £5,700 to £4,200, the reduced assessments to remain during the existence of the adverse conditions occasioned by the war.

London.—During the three months ended December last, the Highways Committee of the L.C.C. has settled 1,134 claims in respect of accidents arising in connection with the tramways, the costs amounting to £10,004. In 14 out of 35 other cases verdicts were given against the Council, and £634 and costs had to be paid.

The Local Government Records and Museum Committee of the L.C.C. recommends that it be authorised to settle outstanding questions between the Council and the Assessment Committees of the various B.C.'s regarding the L.C.C. tramway assessments.

Nelson.—Covered Cars.—A Sub-Committee of the Corporation has been authorised to meet representatives of the Colne Corporation, to discuss the advisability of providing covers for all cars.

Newcastle-on-Tyne. — Revenue Estimates, &c.—The tramway estimates for 1916-17 show a gross income of £319,000, as against an expected revenue this year of £324,400; the expenditure is put down at £196 300, as against an expected expenditure this year of £196,175. The gross surplus is estimated at £123.100, and the net surplus at £35,060, but from this is to be deducted £9,600 the cost of allowances to men on active service. This leaves a net profit of £25,460, compared with £33,640 expected this year. During the coming year the estimated expenditure from the reserve and renewals fund is £19,277.

Rotherham.—An offer has been received from the Oldham Corporation to sell a dozen single-deck bogie cars, seating 40 passengers, at £450 each; the Tramways Committee proposes to purchase one, and to ask the Oldham Corporation to keep the offer of the remaining cars open for a period.

Sheffield.—It is proposed to refer the matters in dispute with Rotherham, regarding the running of additional cars to Tinsley, to Mr. Dalrymple as sole arbitrator.

Southampton.—Top-Covered Cars.—The tramway manager has reported on the necessity of providing top-covered cars to avoid overcrowding, and suggests that the Bell Punch Co. be allowed a further 6 per cent. increase on its existing ticket contract. For the year to January 7th last traffic receipts showed an increase of £7,250 and weekly mileage an increase of 1,000 miles.

South-Western Railway Electrification. — It is expected that the Hounslow loop-line electric service will be opened on February 27th.

Stretford.—The D.C. has received a letter from the general manager of the Manchester tramways, detailing certain changes, the effect of which will be to give an improved early morning service in Trafford Park, which will be of great service to employés there.

Wigan.—Referring to the effect of the electricity breakdown upon the tramway undertaking, Ald. Fletcher stated at the T.C., on February 2nd, that the estimated net loss on receipts was £1,277, and the net loss, after deducting power expenses and wages saved, was £956.

TELEGRAPH and TELEPHONE NOTES.

Australasia.—The Pacific Cable Board announces that the deferred and week-end cable services between the United Kingdom and Australasia have been resumed, as from the 4th inst.

Italy.—The Consiglio Superiore dei Telefoni has approved of the reorganisation of the urban telephone network of Rome; extensions of the networks at several other towns, and private negotiation for the supply of 1,500 wall instruments, 1,430 kg. of bronze wire, &c.

Paraguay.—The General Electric Co. has applied for a concession to establish a telephone network at Asuncion, the capital city.

Spain.—According to a notice published in Madrid, a company has submitted a scheme to the Government for the establishment of a public service of wireless telephony in Spain, the Balearic and Canary Islands, and the Spanish possessions in the North of Africa. It is also intended to apply the system of radiotelephony to trains in motion and to the railway system in general.

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CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—April 15th. P.M.G. Common-battery multiple switchboard, or automatic or semi-automatic switchboard, and associated apparatus. See "Official Notices" December 31st.

Brisbane.—April 26th. Deputy P.M.G. Five sections of trunk line switchboard for Toowoomba Exchange. (Schedule No. 342.)*

Melbourne.—April 12th. Electrically operated runway hoist for the Jolimont car shops. Particulars at the contractors' room, Spencer Street.

Sydney.—April 10th. Municipal Council. Supply, laying and maintenance for six months of six 11,000-volt submarine cables, each 400 yards long, across Darling Harbour.*

May 1st. Two 300-kw turbo-alternators, condensers, switchboard, &c., for the pumping station at Ryde, for the Metropolitan Board of Water Supply and Sewerage at Sydney.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-kw. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.*

Bedwas (Mon.).—March 2nd. Electrical goods for the Bedwas Navigation Colliery Co., Ltd. Mr. G. Morgan, Secretary.

Belfast.—February 16th. Corporation. Tramway stores, including cable, lamp and electrical accessories. See "Official Notices" February 4th.

Birkenhead.—March 6th. Corporation. Cable and two rotary converters with switchgear. See "Official Notices" to-day.

Bolton.—March 2nd. Electricity Committee. Twelve months' supply of materials and stores, including some electrical items. See "Official Notices" to-day.

Bradford.—February 14th. B. of G. Maintenance of the electric wiring installation, bells, telephones, &c., at the Union Hospital, Horton Lane. Mr. F. Holland, Architect, 22, Manor Row.

Dewsbury.—Electricity Department. Two second-hand 250-kw. generator panels, oil separator, piping, cables, &c. See "Official Notices" to-day.

Halifax.—February 14th. Corporation. Twelve months' supply of electric lighting fittings and accessories, cables, telephone wire, meters, &c. See "Official Notices" January 21st.

Leigh (Lancs.).—February 18th. Electricity Committee. 2,000-kw. turbo-alternator, 6 600 volts; surface condenser, set of pumps, 1,000-kw. rotary or motor-converter, with switchgear. See "Official Notices" January 28th.

London.—Islington.—February 17th. B. of G. Alteration to wiring, provision of switchboards, motor starters, motors, &c. See "Official Notices" January 28th.

Hammersmith.—February 16th. Corporation. Stores for the Electricity Department. See "Official Notices" February 4th.

Battersea.—February 21st. B.C. Stores for the Electricity Department. See "Official Notices" February 4th.

L.C.C.—The Highways Committee is to invite tenders for tramway fittings, equipment, &c., for 1916-17.

Finsbury.—February 14th. B.C. Six or 12 months' supply of electric lamps. Borough Surveyor, Town Hall.

Metropolitan Water Board.—March 7th. Electric lamps, wire, and accessories. Chief Engineer, Savoy Court, Strand, W.C.

St. Marylebone. February 23rd. B.C. Cables, insulating material, &c.

Macclesfield.—March 15th. Guardians of the Cheshire County Asylum. Electrical goods. Mr. W. G. F. Tingay, Clerk of Asylum.

Manchester.—February 15th. Corporation. Stores for the Tramways Department. See "Official Notices" January 28th.

New Zealand.—Dunedin.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.*

Portsmouth.—February 15th. Corporation. Six months' supply of tramway stores, including insulating materials, lamps, motor windings. See "Official Notices" February 4th.

Salford.—February 21st. Tramways Committee. General stores. General Manager, 32, Blackfriars Street.

Southampton.—February 19th. Corporation. Stores for the Tramways Department.

Stockton-on-Tees.—February 15th. Electricity Committee. Stores.

Todmorden.—February 12th. Electricity Committee. One Lancashire boiler, superheaters, mechanical stokers, pipework, centrifugal pump. See "Official Notices" February 4th.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Accrington.—Electricity Committee. Altham Colliery Co., for a weekly supply of 70 tons of coal, at 18s. 3d. per ton, delivered, and from March until the winter months, for 30 tons per week extra, for storing, at 16s. 11d. per ton; the Corporation to cart the latter.

Batley.—The E.L. and Tramways Committee. B.I. and Helsby Cables, Ltd. Cable.

Bristol.—The Corporation Docks Committee has accepted the following tenders:—

W. T. Henley's T.W. Co., and Callender's Cable Co.—Cable.
Simplex Conduits.—Conduit and fittings.
Dorman & Smith, Ltd.—Incandescent lamps, fittings, &c.

Dover.—T.C. McIntosh Cable Co., cable, £3,395, for extensions.

Glasgow.—The Clyde Navigation Trustees have accepted the offer by Messrs. Crompton & Co., Ltd., for electrical spares for 32-ton cranes at Queen's Dock and Rothesay Dock.

London.—Hackney.—The Electricity Committee recommends that, owing to the increase in the price of materials, the contract with the B.I. & Helsby Cables, Ltd., for armoured cables, be varied according to a submitted schedule.

Battersea.—The Electricity Committee recommends that the contract with Callender's Cable Co., for cables, be renewed for one year from April 1st next, on specified terms and conditions.

L.C.C.—The Highways Committee has accepted the tenders of the Morgan Crucible Co. for carbon brushes, at £14 10s. per 1,000, items 1 and 2, Class T (tramway equipment, &c., 1915-16), and Le Carbone, for carbon brushes, item 3, at £13 10s. per 1,000.

The contract with Hadfields, Ltd., for special trackwork in connection with the tramways, is to be extended for one year from July, 1916, and thereafter until determined, by 12 months' notice, the prices to be revised every three months.

The Committee purchased 28,241 tons of coals for Greenwich generating station, for £36,755, during the last quarter of 1915.

Manchester.—Electricity Committee.

Bertram Thomas.—One low-tension switchboard.
Johnson & Phillips, Ltd.—Low-tension cable.
British Westinghouse Co.—Four 1,050/1,320 kw. rotary converters for sub-stations.
Bruce Peebles.—Two 1,050-kw. motor converters and two 200-kw. positive traction boosters for sub-stations.
Mirrlees Watson Co., Ltd.—Alterations, &c., to condensing plants.
Aitken & Co.—Pipework.
J. Hopkinson & Co., Ltd.—Valves.
B.I. & Helsby Cables, Ltd.—Cable.

Preston.—The Corporation has placed a contract for meters for the year with Messrs. Chamberlain & Hookham, Ltd.

Shanghai.—The General Electric Co. of China, Ltd., Shanghai, have for the sixth time secured the yearly contract for the supply of Osram traction type lamps to the Shanghai tramways.

Sheffield.—Tenders accepted by the Electric Supply Committee:—

C. A. Parsons & Co.—Turbo-alternator (duplicate of the one now on order), £37,625.
Stirling Boiler Co.—Three boilers and accessories, £31,400.
E. Taylor, Ltd.—Extending condensing water service, &c., at Neepsend, £3,560.
A. Reyrolle & Co.—Six-panel ironclad H.T. two-phase switchboard, £646.
J. E. Nadin.—Levelling coal storage site and laying steam crane track, £3,802.

NOTICE TO OUR READERS.

The Government has intimated its intention to reduce the supply of paper available for newspaper and other publications. The reduction will be such as to render economy in consumption imperatively necessary. The situation will have to be met in various ways, and in order to assist us in complying with the demands of the Government and to prevent disappointment due to inability to obtain copies, we shall be glad if readers of the Electrical Review will give a definite standing order to their usual newsagent or bookstall. This applies to all readers who do not receive their Review direct from these offices.

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FORTHCOMING EVENTS.

Physical Society of London.—Friday, February 11th. At 5 p.m. At the Imperial College of Science South Kensington, S.W. Papers "On a General Method for Comparing the Mutual Inductance between Two Coils with the Self-inductance of One of Them," by Prof. C. H. Lees, F.R.S., and "An Enclosed Cadmium-Vapour Arc Lamp," by Mr. H. J. S. Sand.

Manchester Association of Engineers.—Saturday, February 12th. At the Grand Hotel, Aytoun Street. Paper on "Oil Engines," by Mr. G. E. Windeler.

North of England Institute of Mining and Mechanical Engineers.—Saturday, February 12th. At 2 p.m. At Neville Hall, Newcastle-on-Tyne. General meeting.

Electro-Harmonic.—Monday, February 14th. At 6.15 p.m. At Holborn Restaurant. Ladies' Night. See our "Notes" to-day.

Society of Chemical Industry (Newcastle Section).—Wednesday, February 16th. At the Wood Memorial Hall, Newcastle-on-Tyne. At 8 p.m. Lecture on "The Problems of Coal with reference to the Complete and Proper Utilisation of Our Fuel Supplies," by Prof. H. E. Armstrong F.R.S.

Chemical Society.—Thursday, February 17th. At 8.30 p.m. At Burlington House, Piccadilly. Ordinary Scientific Meeting.

Belfast Association of Engineers.—Thursday, February 17th. Paper on "Turbine Plant," by Mr. P. J. Plevin.

Institution of Electrical Engineers.—Thursday, February 17th. At 8 p.m. At Victoria Embankment. Seventh Kelvin Lecture, on "Terrestrial Magnetism," by Dr. C. Chree, F.R.S.

(Students' Section).—Wednesday, February 16th. At 7.45 p.m. At Victoria Embankment. Paper on "The X-Ray Tube and Modern Practice," by Mr. W. J. Jones.

Institution of Mechanical Engineers.—Friday, February 18th. At 6 p.m. At Gt. George Street, Westminster, S.W. Annual General Meeting.

Greenock Electrical Society.—Friday, February 18th. At 7.45 p.m. At the Temperance Institute, 19, West Stewart Street. Paper on "Electro-Plating," by Mr. S. V. Thorp.

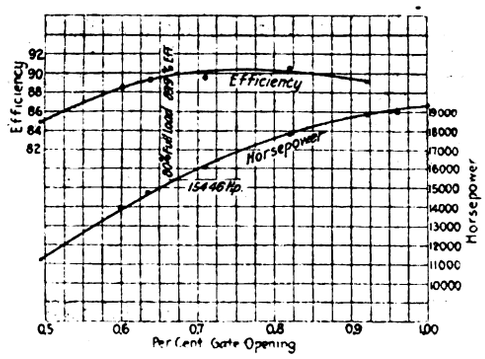
Royal Institution of Great Britain.—Friday, February 18th. At 5.30 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Polarised Light and its Applications to Engineering," by Prof. E. G. Coker.

NOTES.

Foreign Trade.—The January Figures.—The following are the electrical and machinery figures given in the official returns for January:—

	Month of January.	*Inc. or dec.*
Imports.		
Electrical goods and apparatus, excluding machinery and uninsulated wire	£118,902	+ £62,037
Machinery	700,718	+ 82,314
Exports.		
Electrical goods and apparatus, excluding machinery and uninsulated wire	279,933	+ 10,040
Machinery	1,480,131	− 183,351

Tests on High-head Water-Wheels.—In the *Electrical World* of January 8th were given the results of tests on water turbines installed in the Tallulah Falls Station of the Georgia Railway and Power Co., in 1913. These sets were intended for a normal rating of 16 000 H.P. at 580 ft. effective head, when driving 10,000-KW. generators at 514 R.P.M., but as it was found that the generators could carry 12,000 KW. continuously at 80 per cent. power factor, the output of the turbines was raised to 18,000 H.P. Five sets are in place, with room for a sixth; they



Power and Efficiency Curve of 12,000-kw. Water Turbo-Generator.

are of the vertical-shaft Francis type, with bronze runners and forged steel gates, and weigh 300,000 lb. each. The working head is 606 ft., the highest head at which turbines are working in the United States. Three sets were tested individually, at 80 per cent. of their maximum output, the efficiencies recorded being 88·3, 89·9 and 88·7 per cent. The highest efficiencies were respectively 89·3, 90·4 and 89·5 per cent., at three-quarter gate opening and about 16,900 H.P. The electrical output was absorbed by water rheostats at 63,500 volts. The accompanying curve shows the output and efficiency of No. 3 set, which gave the best results.

Proposed Standard Numerals.—In the *Journal* of the Institution of Electrical Engineers for February 1st a note by Mr. A. P. Trotter describing a set of proposed standard numerals for the scales of measuring instruments was published. After examining the numerals used on a large number of measuring instruments, including electricity meters, surveyors' staffs, and the Admiralty standard scales, the author designed the set in 1908 with the sole view of legibility (fig. 1); elegance of shape was not disregarded altogether, but wherever necessary it was sacrificed to legibility. Except, perhaps, in the case of the 1, there should be no serifs, and the figures should be of the block character—that is to say, there should be no marked difference in the thickness of

Fig. 1.—Numerals Designed by A. P. Trotter, Minimum Thickness.

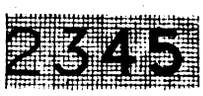


Fig. 2.—Trotter Numerals, Various Thicknesses.

the line in any part of the figure. The relations between the 3, the 5, and the 8, and between the 6, or the 9, and 0 were considered with the object of preventing confusion. A height of 10 units and a width of 7 is recommended. The thickness of the line should not be less than one-twentieth of the height of the figure—that is, half a unit—nor thicker than 1½ units. In fig. 1 the minimum width of half a unit has been adopted; fig. 2 shows thicknesses of ¾, 1, 1¼, and 1½ units. To avoid confusion with 5, as well as with 8, Mr. Trotter strongly recommends the flat-topped 3. According to the usual practice, the 9 is simply the 6 reversed.

Industrial Banks.—Speaking at the annual meeting of Lloyds Bank, Mr. J. W. Beaumont Pease, deputy chairman, according to the *Times*, dealt with the criticism recently directed against English banking practice as compared with German. He laid down the proposition that, unless the interests of a bank were subordinated to the interests of the depositors, it was being run on unsound lines. Strictly no portion of a banker's deposits should be locked up in securities not easily realisable. In practice the exigencies of business involved a certain amount being so invested, but the aim of the banks was always to be prepared for the demands that their depositors might make upon them. It was not quite the same thing as regarded share capital, for that was an investment of a shareholder who had no right to demand his money back. A banker could not be blamed if he dealt with the capital in a more permanent form. German banks had comparatively a much greater proportion of capital than English banks, and they were, therefore, enabled to make much longer loans and less liquid investments. If that were an advantage to trade it might be worth while to consider what could be done by English finance in this direction, not through a bank dealing with depositors' money, but through a financial institution with a large capital which could undertake investments of the kind. He, however, could not help thinking that danger and harm rather than good might accrue to the trade of the country as a whole if banks became identified with particular companies or enterprises. It would tend in the direction of big trusts and monopolies. Time would shortly show whether the German banks had been secured on such sound foundations as our own.

Fatality.—Newcastle-on-Tyne.—An inquiry was held on the 3rd inst. into the death of S. J. Thomas, an electrician, which occurred at the Elswick works of Armstrong, Whitworth & Co. Deceased's brother, a foreman electric tester, stated that on 1st inst. he and his brother went into the casting department to test a fan motor. Close to the switch was a way by which coke was conveyed to the furnaces, and when the vehicles containing the coke were passing, the clearance was less than two feet. Deceased went straight to the switchboard, and witness heard a shout, and saw his brother leaning face forward against the switch. Artificial respiration was tried unavailingly. On examining the switchboard witness found that a joint in the wire leading to the meter had been bared. Deceased was an experienced man, and it was most unlikely that he would start to bare the joint while it was alive. He thought his brother would have opened the switch before touching the wire, and then taken the tape off the joint, but that in avoiding the coke conveyor he had accidentally pushed the switch in, while he still had hold of the wire, and thus had received the fatal shock. A verdict of "Accidental death" was returned.

Federation of Engineering Labour.—A scheme for closer unity among the organisations forming the Engineering and Shipbuilding Trades Federation has now been approved by the majority of these societies. The scheme does not include amalgamation, but its object is to federate the unions so closely that they will act as one body in all matters of wages and conditions. Amongst the societies whose members have already accepted the scheme by an overwhelming majority are the Amalgamated Society of Engineers, the United Patternmakers' Society, the Electrical Trades Union, and the Gasworkers and General Labourers' Society.—*Standard.*

Radiograph Ambulance Cars.—At a recent meeting in aid of the Radiograph Ambulance Cars Fund, Sir James Mackenzie Davidson said the value of X-ray motor ambulances at the fighting fronts was beyond all question, and the promoters of this fund were conferring a great practical benefit upon the wounded in the war.

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Italian Hydro-Electric Works.—A decided awakening has been brought about in Italy directly and indirectly through the war, both privately and in Government circles. The campaign instituted by Signor Conti in favour of the development of the hydro-electric works has now been followed by the inauguration of propaganda by the Italian Electro-technical Association, with a view to the advancement of the production of native machinery and apparatus, and by the issue of two Government decrees which were published, and came into operation on January 18th. Both decrees aim at the securing of some relief from the extremely unfortunate coal crisis which prevails in the country owing to the comparative scarcity of the tonnage arriving from abroad, and the very high prices to which steam coal and house coal have risen when actually delivered in the country, in consequence of the enormous advance in the rates of freight. In the first decree, it is ordained from the present until further notice that the public lighting must be reduced by one-half in all towns where the supply is effected either with gas (exclusive of acetylene) or with oil or with electrical energy produced by the use of steam or gas or oil engines, or where these systems are used in combination. When the public lighting is carried out partly as mentioned, and partly by means of energy furnished by hydro-electric works, the reduction must be effected by decreasing or by entirely suppressing the service afforded by the former systems. In the case of public lighting, which is wholly supplied from hydro-electric works, the prefect of the province can enforce a reduction to one-half in order that the energy thereby rendered available may be utilised also beyond the towns or province, so as to decrease or suppress the employment of the before-mentioned systems or be utilised for heating, motive power or other industrial purposes beyond the towns or the province. The decree also empowers the town councils to curtail the number of public electric lamps and hours of lighting per day, and during the hours when the public lighting is completely suspended, it will be possible for the councils in agreement with the prefect also to stop electric lighting by private consumers.

The second decree seeks to obtain a more rapid increase in the production of electrical energy by the existing hydro-electric works. It is considered to be urgent to promote the national economy in this direction, which is seriously threatened by the augmentation in the prices of coal. As a consequence, and on the proposal of the Ministry of Finance, and in agreement with the Minister of Public Works and Agriculture and Industry, it has been arranged that concessions can be granted by the Ministry of Finance, without the formality of inquiry, for securing an increase in the water taken from the public watercourses by means of modifications in the present methods of taking off the supplies, excepting when the rights of third parties are concerned. Naturally the decree is merely a temporary expedient, but further developments appear to be in early prospect, with the object of securing substitutes for coal, as has been suggested to the Government. One of these which is now engaging the attention of the Government relates to the introduction of a measure which would be less complicated in the formalities to be complied with by those seeking the grant of concessions for the utilisation of water powers for the production of electrical energy, and there is little doubt that the industrial awakening now in progress will lead to an improvement in this respect and strengthen the hands of those members of Parliament who have been enlightened on the matter by the programme initiated by Signor Conti a few weeks ago.

National Illumination Committee of Great Britain.—The report of the chairman (Mr. W. Duddell), presented at the special annual meeting of the Committee, on January 27th, states that during the year 1915 a great part of the international work which was contemplated has been wholly suspended. Mr. Trotter's proposal that the height of the amyl-acetate flame which afforded the light of one standard candle should be determined, was adopted, and reports were received from Dr. Houstoun and Profs. Mather, Marchant and Morris. A paper by Dr. Ott, of Zurich, on the "Effect of Variations in Atmospheric Conditions on the Light of the Hefner Lamp," was received, and was published in the technical Press.

Institution and Lecture Notes.—Institution of Electrical Engineers.—As soon as the approval of the Board of Trade is obtained, the Council proposes to call a special general meeting of the corporate members to consider and, if approved, to adopt the following addition to the articles of association:—

Addition to Article 41.—"(*a*) In the event of a state of war arising between Great Britain and any other country or State, any member of any class who at any time during such war shall be a subject of such enemy country or State shall forthwith cease to be a member of the Institution, and in the case of the European War of 1914 all such members shall cease to be members of the Institution on and after . . . ." (The date to be inserted will depend on the date of confirming the resolution.)

The Council has also received a petition signed by 17 corporate members with regard to the expulsion of enemy aliens, asking that in accordance with Article 80, the Council shall call a special general meeting for the purpose of dealing with the matter. It is understood that the signatories are of opinion that the alteration proposed by the Council will effect the object of the petition.

At a meeting of the WESTERN LOCAL SECTION on Monday, at the South Wales Institute, Cardiff, a paper was read by Mr. O. L. Record on "The Testing of Underground Cables with Continuous Currents." The essence of the paper was the description of the Delon Special Testing Apparatus for testing with direct current, the principal advantages of which are that high pressure tests can be carried out without damage to the cable, and that the necessity for transporting cumbersome apparatus in case of alternating current is obviated, the Delon D.C. apparatus being capable of transportation in a suitable handcart. Mr. W. A Chamen, Mr. Tremain, Mr. C F. Proctor, and Mr. C. T. Allan asked questions on various points of detail, and expressed high appreciation of the paper. Subsequently the members sat down to an informal dinner at the Park Hotel.

At a meeting of the SCOTTISH LOCAL SECTION in Edinburgh, on Tuesday evening, Mr. H. H. Harrison's paper on "The Principles of Modern Printing Telegraphy" was read and discussed.

At the meeting of the YORKSHIRE LOCAL SECTION on Wednesday last, the paper was read by Mr. O. L. Record, on "The Testing of Underground Cables with Continuous Current," and a discussion followed.

Society of Engineers (Inc.).—At the meeting of the Society on February 7th, the President's Gold Medal was presented to Mr. Arthur H. Barker, B.A., B.Sc., for his paper on "Future Developments in Heating and Ventilation," and the Bessemer Premium, value £5 5s., to Alphonse Steiger, for his paper on "The Modern Development of Water Power." Mr. Percy Griffith, M.Inst.C.E., President for the year 1916, then delivered his Presidential address in which, after some preliminary remarks, he discussed the status of the engineering profession. He considered that it was necessary to educate the public as to the functions, qualifications, rules of conduct and basis for remuneration of the various classes of engineers, and advocated the establishment of a new organisation, having as its main objective the consideration and settlement of problems common to the whole profession.

Junior Institution of Engineers.—In the immediate future the Society's programme includes lectures on "Chemistry and Engineering," by Prof. H. E. Armstrong; "The Use of Alternating Currents in Factories," by Mr. G. H. Ayres; and on "Electricity in Factories," by Mr. R. Rankin. On February 26th, at the King's Hall, Holborn Restaurant, the Institution has arranged to hold a Bohemian Concert in aid of the British Red Cross Society in general, and the City of London Red Cross Hospital in particular. Sir Boverton Redwood, Past-President, will preside, and will be supported by the Right Hon. the Lord Mayor of London.

Royal Society of Arts.—On Wednesday, Prof. J. A. Fleming read a paper on "The Organisation of Scientific Research in this Country," dealing with the subject under the heads of "Methods, Means, and Men."

Royal Institution.—In the course of his lecture last week on the industrial application of gaseous fuels derived from coal, Prof. W. A. Bone urged that in order to achieve the economies in respect of power production which were possible, existing inefficient plant must be scrapped and the distribution of electrical energy reorganised on the large scale as it had been on Tyneside.

Croydon Wireless Society.—On Saturday last Dr. Annesley Eccles gave a lecture on the detection and localisation of foreign bodies by means of X-rays.

Two Interesting Problems.—We have received solutions of the metal-sided cube problem from Messrs. E. Redman and H. W. Underhill, the former making the diagonal resistance ⅓ ohm and the latter 0·68 ohm. We are not satisfied, however, that either is correct, owing to the ambiguity of the question, which does not state clearly between what limits the side of the cube has a resistance of 1 ohm. The only rational way in which to deal with it, in our opinion, is to regard the side as having 1 ohm resistance between opposite *edges* when the current is led in and out uniformly along the whole width of the plate. If the current enters at a point the question of its distribution immediately arises; the resistance of the plate will then depend upon the position of each point. So long as the stream lines are straight and parallel, the resistance of a sheet of metal is a definite quantity, but when the stream lines are curved the problem becomes difficult. The *Wireless World*, in giving the solution to the magnet problem, adds a note: "Next month Dr. Fleming on the cube resistance problem," which points to the same conclusion; we shall await Dr. Fleming's views with interest.

Electro-Harmonic Society.—The next Concert (Ladies' Night) will be held at the Holborn Restaurant (King's Hall) on Monday evening, February 14th, commencing at 6.15 p.m. Morning dress. Sir William Slingo will preside. The artistes will be as follows:—Miss Olive Sturgess, soprano; Miss Norah Blaney, songs at the piano; Mr. Tom Kinniburgh, baritone; Miss Ivy Angove, violin; Mr. W. V. Robinson, Canadian entertainer; Mr. Nelson Jackson, selections from his repertoire. Mr. Bernard Flanders, A.R.A.M., solo pianoforte and accompanist.

Electricity Supply Engineers and an Enemy Black List.—It is stated that the Association of Municipal Electrical Engineers is asking the Government to instruct the Board of Trade to issue an authoritative list of alien enemy manufacturing firms now operating in Great Britain, in order that the members may, as far as possible, avoid the purchase of enemy manufactures.

The Australian Trade Commissioner.—Mr. G. T. Milne, H.M. Trade Commissioner for Australia, will arrive in this country on an official visit about the middle of March. Those desirous of interviewing him should apply early to the Director, Commercial Intelligence Branch, Board of Trade, London, E.C.

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Speed and Mileage Ratings of Electrical Vehicles.—At a meeting of the American Society of Automobile Engineers recently held in New York, the following recommendations of the Electric Vehicle Division with regard to standard ratings in connection with the mileage and speed of electrical motor vehicles were adopted:—"Electric vehicle speed ratings shall be based on continuous operation with one-half load over hard, smooth and level roads or pavements at the actual average battery charge." "Electric vehicle mileage ratings shall be based on a continuous run at the S.A.E. rated speed with one-half load over hard, smooth and level roads or pavements."

Volunteer Notes.—ENGINEERING INSTITUTIONS' VOLUNTEER ENGINEER CORPS.—Orders for week commencing February 14th, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commandant.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, February 14th.—Sections 1 and 2, Technical; Sections 3 and 4, Lashings and Trestle Bridging, Signalling Class and Recruits.

Tuesday, February 15th.—School of Arms, 6 to 7 p.m.

Thursday, February 17th.—Shooting for Sections 3 and 4.

Friday, February 18th.—Sections 3 and 4, Technical; Sections 1 and 2, Lashings and Trestle Bridging; Signalling Class and Recruits.

Saturday, February 19th.—Adjutant's Instruction Class at 2.30 p.m.

E. G. FLEMING,
Company Commander and Acting Adjutant.

3RD BATT. (OLD BOYS) CENTRAL LONDON REGIMENT (VOLUNTEERS).—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, February 10th, 1916:—

Week-end Parades.—Saturday.—The Battalion, less Platoons Nos. 10, 15 North London and 11, will parade at Wembley Park at 3.15 p.m. for drill under Company Officers. "Derby" recruits are invited to attend.

Sunday.—The Battalion will parade, as strong as possible, at 9.40 a.m., outside the entrance to Euston Station (L. & N.W.R.), Euston Road, for Divine Service. Dress—Uniform, with side-arms only. Overcoats will not be carried.

After the Church Service the Parade will be inspected by the Lord Mayor.

Musketry.—The Inter-Platoon Competition will be continued on Saturday, the 12th inst. when the semi-final round will be completed. The competing platoons Nos. 10 and 15, North London and 11, to attend at the Acton Range at 1.30 p.m.

A. G. JOINER, *Major and Adjutant*, O.B.C.

Artists' Rifles, O.T.C.—One remarkable effect of the Earl of Derby's Recruiting Scheme has been that a large number of professional men from the technical trades, including architects, engineers and surveyors, having realised that they must no longer delay offering their services to the country, have applied to the Artists' Rifles, O.T.C., for direct enlistment. Moreover, of those who have attested under the scheme, many have felt impatience for their Groups to be called up, and, solving the problem for themselves, have applied for, and obtained, transfer from Army Reserve B, in which Derby recruits are placed, to some Regular or Territorial unit. This course is particularly favoured by men whose education and social position render them eligible for commissions. The transfer of men who have been placed in Army Reserve B may be effected as soon as possible after they have been approved and found medically fit, or postponed until a later date, provided that at such later date the requirements of the Service require the transfer. The Corps has a special class for training members who desire to obtain commissions in the Royal Engineers and Pioneer Battalions, and for testing candidates for such commissions.

Appointments Vacant.—Power house staff for the Southern Command, Salisbury; shift engineer for Reigate. See our advertisement pages to-day.

Submarine Power Cables.—Two 11,000-volt submarine power cables have recently been laid across the Golden Gate at San Francisco, for the extension in that city of the Pacific Gas and Electric Co.'s distributing system. The cables, which are about 13,000 ft. long, were laid under unusual difficulties, incident to swift current and deep water, as well as to dangers in the heavy fogs, from the shipping that plies in and out continuously through the entrance to the harbour. However, the work was completed on schedule time, and the cables successfully passed the 22,000-volt test to which they were subjected immediately after the work was done.—*Electrical World.*

Inquiries.—A correspondent who is erecting an overhead traveller on cast-iron columns 11 ft. high × 5 in. diameter, ⅛ in. thick, proposes to fill the columns with fine concrete, and inquires whether it would be advisable to reinforce the concrete inside with ⅝ in. iron rods; also, whether there would be any trouble through expansion of the concrete.

A correspondent asks for the address of the maker of "Castle No. 5" accumulators.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The Skelton and Brotton U.C. has appointed Mr. G. DIXON engineer of the Council's electricity supply undertaking at a salary of £177 per annum. Mr. Dixon to be allowed to continue his appointment as engineer for the Cleveland and Durham Electric Power Co. in East Cleveland.

The Melbourne City Council has increased the salary of Mr. H. R. HARPER, city electrical engineer, from £1,000 to £1,250 per annum.

General.—Mr. W. ECKFORD, electrical engineer for the Wingate, Wheatley Hill, and Thornley Collieries Co., Durham, has been presented by the officials with a marble timepiece, on the occasion of his leaving to take up similar duties under the South Moor Coal Co.

COUNCILLOR J. J. O'NEILL has been re-elected chairman of the Dublin Electricity Committee, and Councillor C. MCGUINNESS has been elected vice-chairman.

The marriage of Mr. H. F. PARSHALL to Miss Ellen Dunlop Payne, of Boston, U.S.A., was solemnized at Penn, Bucks, on January 31st.

The *London Gazette* announces that Mr. J. S. PRINGLE has been appointed an electrical engineer in H.M. Naval Establishment.

Mr. S. A. JEAVONS, chief clerk at the Stockton-on-Tees Corporation electricity works, has passed the Intermediate Examination of the Chartered Institute of Secretaries at Manchester University.

Roll of Honour.—Captain (temporary Major) A. E. E. FAWCUS, of the 7th Battalion Manchester Regiment, who has won the Military Cross, was an electrical engineer, and, with his father, was interested in estate development in East Africa.

Private HARRY HAUGHTON, of the 9th Battalion King's Own Royal Lancasters, formerly in the employ of Messrs. Mather and Platt, is reported a prisoner of war in Bulgaria.

Sapper WALTER FOX, of the Royal Engineers, who has just been gazetted a Second-Lieutenant, was, up to two years ago, employed at the Stalybridge Joint Board's generating station, and subsequently went to an appointment at Singapore.

Private J. MCCABE, of the King's Own Scottish Borderers, prior to the war employed at the British Westinghouse Works, Trafford Park, has been killed in action.

Private W. HOPE, of the 20th Hussars, reported wounded, was, prior to the war, on the electrical staff at the collieries of Messrs. Fletcher, Burrows & Co., Atherton.

Colonel BRIGHTEN, chairman of the Jackson Electric Stove Co., Ltd., was mentioned in dispatches with reference to fighting in the Gallipoli Peninsula. He has since received the Most Distinguished Order of St. Michael and St. George.

Private O. N. SOPER, of the 5th Buffs (East Kent Regiment), who has been wounded in action in Mesopotamia, was on the electricity staff at the S.E. Railway works at Ashford (Kent) before the war. Private A. L. BAKER, of the 5th Buffs (East Kent Regiment), killed in action in Mesopotamia, was engaged in the electricity department at the same works.

Private WM. T. PLAYFORD, of the 8th Buffs (East Kent Regiment), who was, until the war, on the staff of the Isle of Thanet Electric Tramways Co., has been wounded in action in France.

Sergeant HERBERT NEALE, of the 7th Norfolk Regiment, late of the staff of the Bradford City tramways department, has been killed in action in France.

Lance-Sergeant J. F. GELL, of the 3rd Company, 18th Battalion King's Liverpool Regiment, who has been killed by shell fire in France, was, before the war, on the staff of the electricity department of Wallasey Corporation.

The D.C.M. has been awarded to Regimental Sergeant-Major BEN TRIPP, of the South Lancs. Regiment, who was, prior to the war, engaged at Manchester with the British Westinghouse Electric & Manufacturing Co., Ltd.

Corporal T. FEARING, of the 3rd East Lancs. Field Ambulance, Royal Army Medical Corps, who was engaged at the Bury (Lancs.) Corporation electricity works, has been awarded the D.C.M. for gallantry at the Front.

Obituary.—MR. HERBERT KINGSFORD.—The death occurred on February 5th, in his 59th year, of Mr. Herbert Kingsford, of Lima, Peru, engineer to the Central and South American Telegraph Co.

Will.—The late Mr. H. A. TAYLOR (Clarke, Forde & Taylor) left £42,529.

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REVIEWS.

Specification and Design of Dynamo-Electric Machinery. By M. WALKER. London: Longmans, Green & Co. Price 32s. net.

The author of this book says that a serious apology is needed for adding another book on the design of dynamos to our already overcrowded shelves, but as there appeared to be no book of electrical precedents analogous to the famous "Conveyancing Precedents," compiled by Prideaux, it occurred to the author that such a book would be of some use to those engineers who from time to time have to draw up specifications for the purchase of electrical machinery. We are glad that such an idea did so occur to him. The book not only deals with specifications for electrical machinery, but also outlines a method by which the specifications may be complied with by manufacturers.

The book is divided into two parts. In Part I rules for use in the design of dynamo-electric machinery are discussed, while in Part II the specification and the design to meet the specification are treated of.

Chapter 1 is introductory, and points out certain well-known facts in a refreshing manner.

The magnetic circuit is dealt with in Chapter 2. The effect of the number of poles on the general design is well discussed, and we are glad to see that attention is drawn to the fact that revolutions per minute have a superior limit as far as reducing material goes. For example, the material for a 4-pole 25-cycle machine running at 750 revolutions per minute is rather less than for a 2-pole machine running at twice the speed. Of course, special reasons may demand the higher speed in spite of this fact. Certain neat methods for determining field forms for salient and distributed windings are given.

In Chapter 3 the electromotive force coefficient is considered in detail, and a short précis of important papers is given.

The vital subject of materials of the magnetic circuit is then discussed. The author very rightly employs throughout the book, in the main, the metric system of units. As he says, this will be the system which will probably be most generally employed in the future. The reviewer and, in fact, all the practical designers he is acquainted with, use this system, and then, where necessary, convert their millimetres into inches for the benefit of the British workman. Most designers at some time or other have known two continuous-current motors, that have been wound to the same specification, to run on test at appreciably different speeds. This kind of thing is well accounted for on page 37, where the reasons for considerably different magnetic properties of cast iron from two different pourings from the same ladle are dealt with. A number of prices are given for different kinds of material. These are quite of the right order at normal times. Iron losses are also discussed in a clear and practical manner.

Chapter 5 deals with the different parts of the magnetic circuit, such as shapes of slots and teeth, flux distribution behind teeth, and so on.

The electric circuit is next considered. A very large number of winding diagrams are given, all being for alternating-current generators and motors. The windings are all printed in one colour, the different phases being indicated by full and dotted lines. A considerable number of useful tables, not before easily accessible, are also given. The forces on armature conductors, due to short circuits, etc., are briefly considered, the reader being referred for full details to the author's classic paper on the subject, read before the I.E.E. several years ago. A useful abstract of Field's paper on eddy currents in armature conductors is also given in this chapter. A misprint occurs on page 143, in which the diameter of a No. 13 S.W.G. wire is given as .92 in.

The actual design of armature coils and the formers required for their manufacture is then dealt with in Chapter 7. A large number of photographic reproductions and line diagrams are given, together with specimen specification forms for different types of mouldings, etc. Altogether this is a valuable feature, much information not easily obtainable elsewhere being presented in a convenient form.

Insulation—in one sense the most important part of a dynamo-electric machine—is then discussed. The author has given liberally of his extensive investigations in the subject as well as of those of others. The mechanical properties and strength of many types of insulation are given, and also sound advice regarding pressure tests, insulation resistance, and so forth.

Chapter 9 treats of the difficult subject of ventilation. Turbine-driven machinery, as is natural, is discussed more fully than other types by means of diagrams giving outlines of the schemes adopted by various makers.

Chapter 10 is devoted to the predetermination of temperature rise. Much of the information published in the author's paper, "Heat Paths in Electrical Machinery," before the I.E.E. is reproduced, together with additional matter. The determination of this temperature rise will always be the most difficult part of electrical machine design, but the author deals with the matter in a searching and scientific manner. At the same time, the reviewer knows from personal experience that some of the rules given here do not fit all machines by any means, the rules, however, always giving results well on the safe side.

Part II of the volume commences in Chapter 11. The specification and design of alternating-current generators is first taken. It may be safely said that practically the whole of the theory of alternating currents that is useful in actual design is given, and also a fairly complete list of references on the subject. We are glad to see that it is pointed out that the ordinary d^2l formula for commencing the design of a new A.C. generator cannot be intelligently used unless account be taken of not only the regulating properties of the generator, but also the effect which the frequency and speed have upon the number of poles and the cooling conditions of the field coils. Though the book is certainly not of an elementary character, we think a list of $d\,l$ values might have been included as a preliminary guide. Engine, water wheel, and turbine-driven alternators are all considered in turn, the treatment on the whole being quite satisfactory.

Induction motors are next dealt with in a similar fashion. This time the circle diagram is well to the fore, and also a table of output coefficients is given.

Chapter 18 deals with continuous-current generators. The various types of continuous-current windings are not described since, as the author says, they are fully dealt with in many text books, but the principles governing good commutation receive special attention. No d^2l table is given, but several different sizes of machines are worked through.

One of the author's specialities is next considered, *i.e.*, rotary converters. Probably Prof. Miles Walker has done more towards developing this type of electrical apparatus than anyone else in the country. Much of the ordinary theory of heating of armature conductors, etc., is not given, quite rightly in a book of this kind, but a considerable quantity of useful information is put forth in an illuminating manner. The application of the various rules is exemplified by outlines of the design of two rotaries. This is a most readable chapter.

The concluding chapter gives a short account of the specification and design of phase advancers. The different types of windings, etc., peculiar to this type of apparatus, are well described.

Taken on the whole, the book is a mine of wealth for the experienced designer. Beginners will not progress very far if they commence with this book—in fact, the author assumes "that the reader is familiar with the laws of electricity and magnetism as applied to the design of dynamo-electric machines, and that he is conversant with the theory and operation of these machines as given in the many excellent text books on these subjects."

The general method of design is that developed by Mr. B. G. Lamme, of the American Westinghouse Co.

In the specification part of the volume the author—very rightly in the reviewer's opinion—takes the view that it is the function of the consulting engineer or buyer to state precisely what he wants to buy, and to leave to the manufacturer the methods of attaining the results called for.

The book is well printed, and will be for years a classic on the subject of which it treats.

Wireless Time Signals. London: E. & F. N. Spon, Ltd. Price 3s. 6d. net.

The official handbook "Réception des Signaux Radiotélégraphiques par la Tour Eiffel," issued by the Paris Bureau of Longitudes, is of such practical value to navigators, geodesians, explorers, and horologists as to justify completely the preparation of this authorised translation, to which the translators have added useful appendices, tables, and a short vocabulary, materially increasing the value of the book. To the expert this treatise will be found invaluable as a work of reference; to the amateur it provides a lucid exposition of the principles of wireless telegraphy, supplemented by practical notes on the construction of installations suitable for his use in receiving time and weather signals, etc. The arrangement and illustration of the book are admirable, and a very praiseworthy feature is that the book deals thoroughly with its subject matter, and does not wander outside the latter; this is by no means always the case in these days of ramified and detailed technology.

The instructions given for the erection and adjustment of receiving apparatus should enable anyone to get good results and to take an intelligent interest in the manipulation of his apparatus. The importance of the Eiffel Tower signals is discussed briefly in Chapter II, and the nature of the signals and the means by which they are produced is then described. The remainder of the chapter is devoted to explanation of methods by which the signals are utilised by the recipient and allowance made for various retardations, etc., to obtain a time reading accurate within 0.1 second or so—which is near enough for navigation, watchmakers', and most other practical requirements. For scientific purposes, and for the benefit of explorers and geodesians, it is desirable to make yet more accurate determinations of time, and the general means by which this is done are indicated in Chapter III. There is no purpose in seeking higher accuracy of comparison than 1/100 or 1/140 second, and this degree of accuracy is already attainable. The methods of making and calculating comparisons by aid of the scientific time signals are described very minutely, and by following the text carefully and referring to the folding plate and typical record sheets included, the reader should learn all that can be learnt from paper in this connection.

Appendix "A" enumerates the time signals and meteorological radio-telegrams transmitted daily from the Eiffel Tower

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at the time this treatise was prepared. Appendix "B" deals with augmented weather reports subsequently arranged, and presents a miscellany of useful information, including a time-table, which shows that in almost every hour of the day and night there is (in normal times) some report or official signal of interest and value, which can be picked up even by the amateur. Tables of international time signals, call letters, code and vocabulary, a useful collection of meteorological tables, and a good index conclude a volume which is indeed "indispensable to the great and ever-widening circle of all those interested in wireless." It is, moreover, a work which can be studied profitably pending the time when we can make practical application of the information which it contains.

Experimental Physics. By H. A. Wilson, F.R.S. Cambridge University Press. Price 10s. net.

This is a text-book of mechanics, heat, sound, and light issued in the now famous "Cambridge Physical Series," and although it emanates from Texas, U.S.A., the name of H. A. Wilson, "formerly Fellow of Trinity College, Cambridge," guarantees its English wholesomeness.

The author admits that the writing of such a book, primarily intended for a first-year college course, offers little scope for originality. He appears, however, to have discovered considerable scope for originality in his decisions what to include and what to leave out, justifying his selections by remarking, "the kind of text-book which contains a little about everything does more harm than good."

Dr. Wilson has obviously aimed at excluding everything not of fundamental importance. In each chapter a subject is discussed theoretically and then a few experiments are described fully and the various applications mentioned. Such subjects as Gravitation, Expansion of Solids, Change of State, Convection and Conduction, Resonance and Photometry, appear to lend themselves admirably to the author's "irreducible minimum" method; for it is very true that if a student thoroughly grasps the principles of, say, Searle's Conductivity Experiment, there is no need to teach him any more; he is then in a position to add to his knowledge of Conduction of Heat by reading up details of other experiments for himself. But it seems to us that the method breaks down when it attempts to deal with such a subject as "Motion," including uniform, accelerated and simple harmonic motion, in eight pages. Mechanics, and especially the early portions of the science, cannot be adequately treated without frequent recourse to graphical and other examples, and a mere reading of the chapter in Dr. Wilson's book would not, we fear, put the ordinary first-year college student in a position to tackle problems in Kinematics. The treatment of Force and Motion, Work and Energy, and Mechanics of Rigid Bodies is fuller and, consequently, more satisfactory. The chapter on "Properties of Liquids" is the best in Part I (Mechanics), and suffers least from the author's pronounced tendency to evaporate his subjects nearly to dryness.

Part II (Heat) is thoroughly sound and satisfactory, the best chapters out of eleven excellent ones being those on the conversion of heat into work and the properties of gases.

The subject of Sound (Part III) naturally involves more mathematical treatment, but all the essential experiments are described. The author's capacity for getting to the point in a very few words is especially noticeable in the sections on Reflection, Refraction, Interference, and the Composition of Vibrations. The diagrams in this part of the book are also exceptionally good.

The last part of the book is devoted to the treatment of Light and Radiant Energy, and the author follows the usual methods of dealing with reflection and refraction at plane and spherical surfaces. Dispersion and Colour are given considerable attention, and there are also good chapters on Velocity of Light, Interference, Diffraction, and Polarisation.

On the whole, Dr. Wilson's book is one that can be recommended to first-year college men whose knowledge of physics is scanty; but the mere reading of it will avail but little without the working of numerous examples. Unfortunately, there are no exercises given in the book, but references are given to most of the standard works on the various subjects, so that a student who has access to a good reference library and is prepared to work some examples could not do better than adopt Dr. Wilson's book, remembering in doing so that, to adapt an old maxim, "Examples are better than precepts."
—P. H. S. K.

NEW COMPANIES REGISTERED.

Brown's Motor Accessories, Ltd. (142,891).—This company was registered on February 2nd, with a capital of £6,000 in £1 shares, to take over the business of motor accessory dealers and electrical engineers carried on by H. Lodge and H. Bebbington, at 56 and 58, Renshaw Street, Liverpool, as Brown & Co. The subscribers (with one share each) are: H. Lodge, 50, Falconer Street, Liverpool, electrical engineer; H. Bebington, 51, Bagot Street, Liverpool, electrical engineer. Private company. The number of directors is not to be less than two or more than five; the first are H. Lodge and H. Bebington. Solicitor: E. Lloyd, 31, North John Street, Liverpool. Secretary (*pro tem*): Mary C. Dodd. Registered office: 56 and 58, Renshaw Street, Liverpool.

Lidgett Engineering Co., Ltd. (142,921).—This company was registered on February 4th, with a capital of £5,000 in £1 shares (1,500 pref.), to take over the business of a mining, electrical and mechanical engineer carried on by G. F. Steavenson, as Steavenson & Co., at Lidgett Electrical Engineering Works, Hoyland Common, Barnsley. The subscribers (with one share each) are: G. S. Marple, Manor House, Oakdale Road, Nether Edge, Sheffield, iron and steel merchant; G. F. Steavenson, Lidgett House, Hoyland Common, engineer. Private company. The number of directors is not to be less than two or more than five; the first are G. S. Marple and G. F. Steavenson. Qualification, £100. Remuneration (except any managing director) as fixed by the company. Solicitor: C. Crowther, 23, Abingdon Street, S.W. Registered by Jordan & Sons, Ltd., 116-117, Chancery Lane, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Railless Electric Traction Co., Ltd. (9,872).—Capital, £5,000 in 4,750 ord. shares of £1 each and 5,000 def. shares of 1s. each. Return dated January 6th, 1916. 2,571 ord. and 5,000 def. shares taken up; £1 per share called up on 2,056 ord. shares; £1,916 paid, leaving £140 in arrears; £765 considered as paid on 515 ord. and 5,000 def. Mortgages and charges: Nil.

Cordoba Light, Power and Traction Co., Ltd. (99,640).—Capital, £1,000,000 in £1 shares (300,000 pref., 600,000 ord., and 100,000 pref. or ord.). Return dated December 30th, 1915. 300,000 pref. and 600,000 ord. shares taken up; £1 per share called up on 300,000 pref. and 170,100 ord.; £470,100 paid; £429,900 considered as paid on 429,900 ord. shares. Mortgages and charges: £482,700.

Power Gas Corporation, Ltd. (70,860).—Capital, £300,000 in 250,000 ord. shares of £1 each and 100,000 def. shares of 10s. each. Return dated December 30th, 1915. 249,620 ord. and 100,000 def. shares taken up (exclusive of 380 ord. forfeited); £1 per share called up on 183,158 ord. shares; £183,478 paid (including £320 paid on 380 ord. shares forfeited); £116,462 considered as paid on 66,462 ord. and 100,000 def. shares. Mortgages and charges: £75,000.

Electro Galvanizers, Ltd. (138,767).—Capital, £20,000 in £1 shares (12,000 first pref., 5,000 second pref., and 3,000 ord.). Return dated January 14th, 1916. 11,500 first pref., 4,600 second pref., and 3,000 ord. shares taken up; £19,100 considered as paid. Mortgages and charges: Nil.

Colston Electrical Works, Ltd.—Mortgage on moneys payable to the company by the Corporation of Bristol for installing electric lighting and electric bells at the Ham Green Sanatorium, Somerset, dated January 25th, 1916, to secure all moneys due or to become due from company to Capital & Counties Bank, Ltd., Clare Street, Bristol.

Masham and District Electric Supply Co., Ltd.—Particulars of £500 debentures, created January 19th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, amount of the present issue being £440. Property charged: The company's undertaking and property, present and future, including uncalled capital (if any). No trustees.

Foote and Milne, Ltd.—Mortgage debenture, dated January 28th, 1916, to secure £6,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: London County & Westminster Bank, Ltd., 41, Lothbury, E.C.

Hindhead and District Electric Light Co., Ltd. (78,361).—Capital, £30,000 in £1 shares. Return dated May 17th, 1915. 24,142 shares taken up; £13,642 paid; £10,500 considered as paid. Mortgages and charges: £4,450. Returns of allotments made up to October 21st and December 19th, 1915, show a further 465 ord. and 42 ord. shares respectively allotted for cash.

Burmah Electric Tramways and Lighting Co., Ltd. (75,090).—Capital, £200,000 in £5 shares (20,000 pref.). Return dated January 7th, 1916. All shares taken up; £5 per share called up on the pref.; £100,000 paid; £100,000 considered as paid on the ord. Mortgages and charges: Nil.

CITY NOTES.

Yorkshire Electric Power Co.

The net profit for 1915 was £21,209 (1914, £20,535), plus £3,049 brought forward. Preference dividend (6 per cent.) has been paid, £7,500 put to general reserve, £1,908 written off the 1915 Bill, 1 per cent. is to be paid on the ordinary shares, and £2,478 is to be carried forward. Costs of all materials, especially coal, have been very heavy, but there has been a substantial growth of gross revenue. 27 per cent. of the staff enlisted, and men of military age have attested, and there has been difficulty in obtaining experienced labour and in maintaining the supply. The supply has been largely used by munitions factories, and the demands upon the company in connection with collieries and coke ovens with their associated chemical works for the extraction of valuable products from coal have grown considerably. £13,840 cum. pref. shares have been taken up during the year. Of the 5½ per cent. first mortgage debenture stock of the Yorkshire Waste Heat Co., Ltd., only £19,205 is left, and the directors commend this stock to the proprietors of the Power Co. Annual meeting: February 15th.

Lanarkshire Tramways Co.

During 1915 the revenue was £106,044, an increase of £6,866, and the expenses were £66,091, an increase of £1,896. £11,000 is to be transferred to depreciation reserve, and after providing for debenture and other interest and other items £20,971 is available. A dividend of 5¾ per cent. for the year is paid, and £958 is carried forward. £4,500 debentures have been purchased and redeemed during the year. Four more motor omnibuses will be put into service in March. The accounts will be issued yearly in future, instead of half-yearly. Passengers carried 20,526,000, as against 19,994,282; traffic receipts £104,990, as against £97,958; mileage, 2,264,922, as against 2,330,903.

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St. James' and Pall Mall Electric Light Co., Ltd. During 1915 the connections increased from 15,423 kw. to 16,305 kw., and 10,674,609 units were supplied; the Central Electric Supply Co. is paying no dividend for the year. War conditions have again reduced revenue. The net profit was £18,856, plus £2,417 brought forward, and £4,500 is transferred from the contingency fund. After paying 7 per cent. on the preference shares and 8 per cent. on the ordinary, £2,752 is to be carried forward. The units generated by steam plant were 970,514, and purchased 12,842,237 = 13,812,751. Private supply required the number stated above, works accounted for 242,343, batteries 267,103, transmission and transformation for 1,899,552, and distribution, &c., for 729,144. At the annual meeting on Tuesday next shareholders will be asked to increase the borrowing powers from one-half the nominal capital to £50,000 in excess of that amount.

Metropolitan Railway Co. The directors' report for 1915 shows as follows:—Total net income £595,676, plus £11,458 brought forward. Deducting interest, renewals, and preference dividend, £77,693 is available for ordinary dividend, which is 1 per cent. for the year, leaving £13,041 to carry forward; £15,000 has been transferred to general renewals fund. The ordinary dividend for 1914 was £1 4s., and £11,458 was carried forward. The new viaduct at Kilburn had brought considerable additional traffic, owing to the improved train service that it had made possible. Under the arrangement with the Government, the company pays interest on the capital outlay on new lines and works, but receives no benefit from the improved earnings, and representations have been made to the Government on the point. Traffic on the G.N. and City section has largely increased. Notwithstanding the dislocation of business, the traffic of the entire railway was larger than in 1914 and 1913, and, while every possible economy had been introduced, they had not materially reduced the number of trains run. The annual meeting was held yesterday.

Llandudno and Colwyn Bay Electric Railway, Ltd. Traffic receipts during 1915 increased by £1,811, largely due to the Old Colwyn extension, but increased cost of stores and frequent changes in staff caused less efficient and less economical working, so that the net profit is £5,414, only slightly larger than for 1914 (£5,144). Adding £562 brought forward and deducting sinking fund instalment, etc., £4,408 is available, and a dividend of 4 per cent. absorbs £3,976, leaving £432 to carry forward. The sinking fund instalment is considered sufficient to meet depreciation. The route length in operation is now 8¼ miles, and all the lines for which powers have been obtained have been constructed. Annual meeting: February 11th.

Paisley District Tramways Co. For 1915 the revenue was £68,079 and the expenditure £45,737. After allowing for debenture and other interest and sinking fund charges, and including £3,200 brought forward, the balance is £19,488. £6,500 is put to reserve, 5 per cent. is paid on the preference shares, £2,000 is put to preference share sinking fund, and £3,478 is to be carried forward. Traffic receipts increased by £6,141, but expenses have largely increased. Work on the maintenance of track and rolling stock is deferred owing to scarcity of labour, and £2,000 more than usual has been carried to reserve for this purpose in future. The system is being carried on with difficulty, owing to abnormal circumstances, but so many munition workers use the system that the number of cars run cannot be reduced. Passengers carried 14,978,962, as against 13,755,904; car mileage 1,367,926, as against 1,378,120. Annual meeting: February 29th.

Chatham and District Light Railways Co. During 1915 the revenue was £60,917, an increase of £9,865, and the expenses were £32,230, a heavy increase. £6,000 is to be transferred to depreciation reserve, and after providing for rent of Rochester Corporation lines £3,744, debenture and other interest, and other items, £15,733 is available. After paying 6 per cent. on the ordinary shares for the year, £3,150 is carried forward. Owing to shortage of labour and other causes, the track and rolling stock have not been maintained in their usual state of repair; £1,000 has been put to maintenance reserve to enable these repairs to be carried out when labour conditions are more favourable. A reduced service of cars has been run. £8,200 debentures have been repurchased and redeemed. Passengers carried 12,755,428, as against 10,662,928; traffic receipts, £60,357, as against £50,439; car mileage 1,029,535, as against 1,133,762.

Calcutta Electric Supply Corporation, Ltd.—The units sold during the five weeks ended December 31st, 1915, were 1,778,448, compared with 1,224,134 units in 1914.

Liverpool Overhead Railway Co.—A final dividend on the ordinary shares at the rate of 4 per cent. per annum brings up the total distribution to 3½ per cent. for the year.

Cambridge Electric Supply Co., Ltd.—A final dividend of 3 per cent. on the ordinary shares brings the total distribution up to 5 per cent. for 1915.

Dublin United Tramways Co., Ltd.—Mr. W. M. Murphy, the chairman, told shareholders at the annual meeting that the gross receipts for 1915 were the largest in their history, being £333,589, against £321,896 in 1914, of which £11,677 was due to an increase in passenger traffic. The gross expenses exceeded those of 1914 by £18,143, the increase in expenses being greater than that in receipts by £6,140. Besides producing 803,389 more units of electric current, the average cost of about 24,000 tons of coal consumed was 3s. a ton higher than in 1914, being 18s 5d. against 15s. 5d. The greatest increase in expenses was under the head of maintenance, amounting to £10,154, £2,700 of which represented new car motors and electrical car equipment.

Tyneside Tramways and Tramroads Co.—The directors recommend a dividend of 3 per cent., less income-tax, on the ordinary shares, £1,400 is placed to reserve for renewals, £500 to special reserve, £290 is applied to loss on conversion of Consols into War Loan, and £625 is to be carried forward.

Dr. J. T. Merz, at the meeting on Tuesday, said that the receipts had not been materially interfered with. There had been a marked increase in the ordinary traffic, but the holiday traffic had been less by some £1,400. They had run fewer cars, but had carried more passengers. The increase in expenditure was largely due to repairs and upkeep of the line.

Sunderland District Electric Tramways, Ltd.—After providing for interest on the prior lien bonds and the first mortgage debentures, and for sinking fund instalment, and making provision for depreciation on investments, there remains a net profit of £1,759. After paying interest at the rate of 2½ per cent. per annum (less income-tax) on the first income bonds, £651 is to be carried forward. The traffic receipts show a decrease of £522, but owing to economies in working expenses there is an increase in the profit of £580. The annual meeting was held in London on Tuesday.

Electrical and Industrial Investment Co., Ltd.—The net revenue for 1915 was £11,500, plus £10,377 brought forward. After paying 6 per cent. on the preference and 5 per cent. on the preferred ordinary shares, £10,878 is to be carried forward. The investments have been written down in accordance with the capital reduction scheme (£85,500). The balance at credit of reserve is £29,372. The company holds 225 investments standing at £545,681. Annual meeting: February 16th.

Central Electric Supply Co., Ltd.—During 1915 energy was supplied to the Westminster, St. James', and Chelsea Companies to the tune of 28,984,437 units. After allowing for sinking fund and depreciation, the net balance is £1 17s. 1d., plus £6 brought forward, and the amount is to be carried forward.

City of Buenos Aires Tramways Co. (1904), Ltd.—The annuity has been received from the Anglo-Argentine Tramways Co., and the net revenue for 1915 was £66,341. After paying 5 per cent. dividend for the year, £4,200 is transferred to the general amortisation fund, carrying forward £141.

National Electric Supply Co., Ltd.—A final dividend of 4s. 6d., making 7s. per share for the year, as compared with 8s. for 1914, is announced. £633 is carried forward, as compared with £1,310 brought in. £5,000 is put to depreciation.

National Gas Engine Co., Ltd.—The net profit for 1915 is £70,960. After paying 7½ per cent. on the ordinary, £30,520 is to be carried forward. Annual meeting: February 15th.

Smithfield Markets Electric Supply Co., Ltd.—Dividend 2 per cent. for year, carrying forward £1,300.

Parsons Marine Steam Turbine Co., Ltd.—Interim dividend 10 per cent., less tax.

Wadebridge and District Electric Supply Co., Ltd.—A dividend of 6 per cent. is announced.

STOCKS AND SHARES.

Tuesday Evening.

The electricity supply market was not affected by the dividend declarations which have been made up to the present. The West End companies, as it was generally supposed they would, have lowered their rates, but the South London provided a pleasant surprise by announcing the same dividend as that of a year ago—namely, 5 per cent.—on the strength of which the shares rose 7s. 6d to 3½. The St. James' & Pall Mall Co. has lowered its dividend to 8 per cent., being a reduction of 2 per cent. as compared with last year. Business for weeks past has been very quiet in the whole of this section, as we have noted from time to time; so it can scarcely be said that the Stock Exchange market has undergone any pronounced change. There is more doing in Latin-Canadian issues than in most of the home electrical securities; while the activity in rubber shares has been resumed to some extent.

The effect of the removal of minimum prices from Colonial Government stocks has been carried still further amongst the ranks of gilt-edged descriptions in the industrial departments. Where prices remain the same as they stood before the changes came about, the holder should hesitate to congratulate him-

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self until he finds that the nominal quotation is an actual one from the point of view of the seller. It is, however, cheerful to observe how the Colonial stocks, which were exceedingly weak when the market in them was allowed to become a free one, have now mended considerably. Buyers have come forward to such an extent that the trouble is at present to find stock to satisfy them, instead of the other way round; and this, of course, exerts its sympathetic influence upon the debenture stocks, preference shares, and pre-ordinary issues of industrial and most other companies.

Business generally is quiet, and the declaration of a satisfactory batch of Home Railway dividends left the market cold. The railways are certainly doing better than might have been expected or supposed; and if they can make such good progress under the present difficult conditions, the outlook may be regarded with composure for the future.

Reference has already been made to the revival of orders in the Latin-Canadian list. It has been fairly well distributed over the principal companies concerned, and a good part of the buying is known to proceed from New York—this in spite of the fact that United States investors are obviously troubled as to the potentialities contained in the present diplomatic situation between their country and Germany.

Pennsylvania Water & Power shares have risen 3 points to 78¾, Shawinigan is 2½ up at 138, there are buyers about for Kaministiquia Power capital stock, and Canadian General Electrics are harder. On the other hand, the Mexican group is very dull. Several of the bonds in the utility companies are lower, the falls ranging from 1 to 3 points. The news from Mexico is far from encouraging; and although hope has not yet been lost, and optimists avow that Mexico stands upon the very eve of a turn in her fortunes, there are certainly no buyers of Mexican stocks. Per contra, if good news does come in, quotations will be restored with a rapidity even greater than that with which they fell; and the risky speculator has plenty of scope for his fancy in this department just now.

British Columbia Electric preference stock has fallen 3 points, and the yield therefore rises to over 9 per cent. on the money. The information which comes from Vancouver seems to suggest that British Columbia has so far missed its proper share of the more cheerful financial conditions that prevail in Canada, as compared, say, with a year ago.

In the foreign section, Brazilian Tractions have fallen back to 49¾, two or three hundred shares coming to market and finding no willing home awaiting them. Anglo-Argentine Trams second preference rose to 3½, and the remaining issues in this group are steady. The Telegraph market is irregular. Great Northerns are 5s. better, and Anglo-American preferred gained a point to 101½—this, by the way, being the price which the Treasury is bidding for New York Telephone 4½ per cent. bonds. Oriental Telephones have weakened, the price going back 3s. 9d. on the offer of shares the other day. Marconis are dull at 37s. 6d., the subsidiaries being also inclined to weaken after their recent spurt. Globe ordinary at 10½ are the fraction down.

Amongst manufacturing shares, British Westinghouse preference are prominent with a rise of 2s. to 2¼, more than recovering their reaction of last week. Callenders gained ½, and Edison & Swan fully-paid shares rose 5s. to 1¼, although the partly-paid at 7s. are a trifle lower. Babcock & Wilcox declined 1/16, while other iron and steel shares are mainly good.

The price of copper had a dramatic jump of £4 a ton on Tuesday morning, and this brought about a sharp rise in the prices of most copper shares. The rubber market exhibits noticeable strength, and there is still a remarkable amount of business doing, the demand for shares coming from all parts of the country. The spring reports of the companies and the final dividends are sure to make good reading for the shareholders, and it is largely upon the strength of expectations connected with these that the market is so hard in tone.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month.		No. of weeks.	Total to date.		Route miles open.	
		£	£		£	£		Inc.
Blackpool-Fleetw'd	Jan. 29	1,858	+ 111	4	1,856	+ 111	8	..
Bristol (Trams) ..	,, 28	18,605	+1,073	4	18,8 5	+ 1,078	80·5	..
Cork	,, 27	1,792	+ 78	4	1,792	+ 78	54·25	..
Dublin	,, 28	24,149	+ 1,840	4	24,149	+ 1,840	9·89	..
Hastings	,, 28	756	+ 263	4	756	+ 263	19·8	..
Lancashire United	,, 26	6,705	- 507	4	6,199	+ 4?2	42	..
Llandudno-Col. Bay	,, 28	753	+ 86	8	1,576	+ 116	6·5	..
Tyneside	,, 19	1,947	— 81	8	1,852	— 59	11	..
Anglo-Argentine ..	,, 29	196,071	—6,691	4	196,071	— 6,691	..	..
Auckland	,, 17	21,801	+ 1,890	42⅔	125,810	+ 908	25·42	1·06
Calcutta	,, 29	18,9 8	+1,16?	4	18,958	+ 1,169	..	..
Kalgoorlie, W.A. ..	Nov.	2,611	..	48	30,402	..	..	..
Madras	Jan. 31	4,425	+ 598	4	4,425	+ 598	..	..
Montevideo ..	Jan.	34,252	+1,798	13	93,961	+ 5,818	..	..
Dublin-Lucan Rly.	Jan. 28	458	— 5	4	458	— 5	?	..

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Feb. 8, 1916.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.				
Brompton Ordinary	10	7½	—	£3 18 4
do. 7 per cent. Pref.	7	7	—	5 0 0
Charing Cross Ordinary	5	8½	—	7 2 2
do. do. do. 4½ Pref.	4½	8½	—	6 0 0
do. do. City Pref.	4½	8	—	7 10 0
do. 4 Deb.	4	75	—	5 6 8
Chelsea	5	4	—	6 5 0
do. 4½ Deb.	4½	87	—	5 3 6
City of London	9	12½	—	7 1 7
do. do. 6 per cent. Pref.	6	11	—	5 9 1
do. do. 5 Deb.	5	98	—	5 2 9
do. do. 4½ Deb.	4½	85	—	5 6 0
County of London	7	10	—	7 0 0
do. do. 6 per cent. Pref.	6	10½	—	5 17 2
do. do. 1st Deb.	4½	85	—	5 5 0
do. do. 2nd Deb.	4½	88	—	5 8 0
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	18	—	8 8 0
do. do. 6 per cent. Pref.	6	4½	—	7 1 2
do. do. 4 Deb.	4	75	—	5 4 0
Metropolitan	8½	2½	—	7 15 0
do. 4½ per cent. Pref.	4½	8	—	7 10 0
do. 4½ Deb.	4½	85	—	5 6 0
do. 5½ Deb.	5½	70	—	5 0 0
St. James' and Pall Mall	10	6	—	8 8 8
do. do. do. 7 per cent. Pref.	7	6	—	5 16 8
do. do. do. 8½ Deb.	8½	70	—	5 0 0
South London	5	8½	+ ⅛	6 8 0
South Metropolitan Pref.	7	1?/16	—	6 14 0
Westminster Ordinary	9	6	—	7 10 0
do. 4½ Pref.	4½	4	—	5 12 6
TELEGRAPHS AND TELEPHONES.				
Anglo-Am. Tel. Pref.	6	101½	+1	5 18 6
do. Def.	38/6	81½	—	? 14 3
Chile Telephone	8	6½	—	6 10 8
Cuba Sub. Ord.	5	7½	—	6 9 0
do. Pref.	10	14½	—	6 18 0
Eastern Extension	7	12½	—	*6 5 0
do. 4 Deb.	4	75	—	5 6 8
Eastern Tel. Ord.	7	126½	—1	*6 6 0
do. 8½ Pref.	8½	64⅜	—	5 8 6
do. 4 Deb.	4	75	—	5 6 8
Globe Tel. and T. Ord.	6	10½	— ¼	*6 12 6
do. Pref.	6	10½	—	5 17 1
Gt. Northern Tel.	22	84	+ ½	6 8 6
Indo-European	18	49	—	6 15 4
Marconi	5	1⅝	— 1/16	5 6 8
New York Tel. 4½	4½	101½	— ⅛	4 8 4
Oriental Telephone Ord.	10	1?/16	— 1/16	5 18 6
do. Pref.	6	⅜	—	6 17 2
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	5	5?	—	*7 19 0
do. Pref.	1	4½	—	5 8 1
West India and Pan.	7	1½	—	8 17 9
Western Telegraph	4	12⅝	—	*6 4 6
do. 4 Deb.		77	—	5 4 0
HOME RAILS.				
Central London, Ord. Assented	4	69	—	5 16
Metropolitan	1⅜	24½	— ½	5 9
do. District	Nil	16	—	Nil
Underground Electric Ordinary	Nil	1⅛	—	Nil
do. do. "A"	Nil	6/6	—	Nil
do. do. Income	6	81	+ ⅛	*8 8 0
FOREIGN TRAMS, &c.				
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
do. 5 Deb.	5	95	—	5 5 0
Anglo-Arg. Trams, First Pref.	5½	4⅜	—	6 13 6
do. 2nd Pref.	5½	8½	+ ⅛	7 17 2
do. 4 Deb.	4	71½	—	5 12 8
do. 4½ Deb.	4½	77	—	5 17 0
do. 5 Deb.	5	80	—	6 5 0
Brazil Tractions	4	49½ xd	—2½	8 0 6
Bombay Electric Pref.	6	10 xd	—	6 0 0
do. 4½ Deb.	4½	85	—	5 5 0
British Columbia Elec. Rly. Pfce.	5	55	—3	9 1 10
do. do. Preferred	—	87	—1	Nil
do. do. Deferred	—	84	—	Nil
do. do. Deb.	4½	64	—	6 12 10
Mexico Trams	Nil	38	—1	Nil
do. 5 per cent. Bonds	—	42	- 8	Nil
do. 6 per cent. Bonds	—	57	—1	Nil
Mexican Light Common	Nil	29	—	Nil
do. Pref.	Nil	58	—	Nil
do. 1st Bonds	—	42	—3	—
MANUFACTURING COMPANIES.				
Babcock & Wilcox	14	2?	— 1/16	5 6 8
British Aluminium Ord.	5	22/6	—	4 9 0
do. Pref.	6	12/-	—	6 13 4
British Insulated Ord.	15	10?	—	? ? 10
do. Pref.	6	5?	—	5 11 ?
British Westinghouse Pref.	7½	45/-	- 2/-	6 13 4
do. 4 Deb.	4	69	—	5 14 10
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	11?	+ ⅛	6 11 10
do. 5 Pref.	5	4?	—	6 17 8
do. 4½ Deb.	4½	90	—	5 0 6
Castner-Kellner	20	?/-	- 6d.	6 8 0
Edison & Swan, £3 pd.	Nil	?/-	+ ¼	Nil
do. do. fully paid	Nil	1?	—	Nil
do. do. 4 Deb.	4	60	—	6 18 4
do. do. 5 % Deb.	5	60	—	8 6 8
Electric Construction	6	15/-	—	8 0 0
do. do. Pref.	?	1	—	? 0 0
Gen. Elec. Pref.	6	9?	—	6 3 1
Henley	20	12?	—	*8 6 8
do. 4½ Pref.	4½	4?	—	5 6 0
do. 4½ Deb.	4½	92	—	4 17 9
India-Rubber	10	9?	—	*13 19 0
Telegraph Con.	20	26	—	*? 13 6

* Allowance made for dividends being paid free of income-tax.

The Batti-Wallahs.—The committee of the Batti-Wallahs' Society is calling an informal meeting of the society for Friday, February 25th, at 6 o'clock for 6.30, at the Victoria Mansions Restaurant, Victoria Street, S.W. The usual informal meal will be followed by a concert.

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NOTES ON ELECTRIC WELDING PRACTICE.

(*Continued from page* 133.)

Clamping.—The question of the arrangement of the clamping jaws is important in any butt welding operation. The jaws have necessarily to be heavy and to have large contact surface to carry the heavy welding current without overheating themselves or the work. On the other hand, their considerable mass and clamping surface offers a ready path for escape of heat by conduction from the weld, and a certain projection of the work is desirable to hasten and localise heating and save current. If the nature of the work demands support close up to the joint, the current used must be heavier to "overtake" the more rapid cooling.

Wrought iron or mild steel bars of equal section each project ¼ to ⅜ of their diameter if the weld is to be made on the impact or flash principle, but if a boss is to be built up, more extensive heating is required, and each rod projects ½ to ¾ diameter. Copper and brass, owing to their high thermal conductivity and the greater amount of stock absorbed in the weld (due to the metal being practically molten at the moment of upsetting), must project considerably more than iron—say, 1½ to 2½ diameters for copper and rather less for brass. A weld in small copper wire may take up 1 diameter or more of stock.

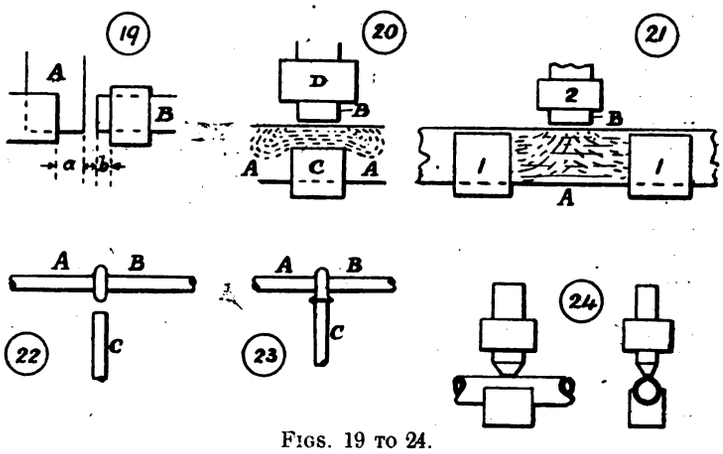
In order that both pieces welded may reach welding heat at the same moment, it is necessary that the relative cooling facilities be the same for each, and this is particularly important where copper, aluminium or brass are concerned, for the weld must then be completed directly welding heat is reached. It therefore follows that if one piece is of larger section or of more highly conducting metal than the other, it (the first) should project further from the jaws. The projection is roughly proportional to sectional area of work in the case of unequal sizes of the same metal; and where different metals are concerned compensation should be made by projection or sectional area (or both) for differences in thermal conductivity. The conductivity of copper being about six times that of wrought iron, the copper should project say three times as far as the wrought iron in case of a weld being desired between the two. If possible, the section of the copper should be reduced as well. To secure correct degree and timing of heating, a low carbon steel to be welded on to a high carbon steel should project 2½ or 3 times as far as the latter—say, 1¾ and ⅝ diameter respectively.

The procedure in practice is to set up two pieces with approximately correct actual and relative projections as determined by experience, and then to make a trial weld, noting the time taken to attain welding heat and the uniformity of heating, etc. Locating stops and upsetting springs or weights being once adjusted, their setting should be noted for future guidance, and repetition work can be at once commenced. Tables or charts can be drawn up to facilitate adjustments for given classes of work.

In cases other than that of simple end to end welding of round or rectangular stock, the disposition of the jaws is of even greater importance, and it is sometimes necessary to employ auxiliary heating to allow for the greater mass or conductivity of one piece. Typical examples of the kind of problem involved are illustrated by figs. 19-21. In the case of the simple right angle corner weld a projection ratio (a/b) of 2:1 will generally allow for the easier escape of heat along A as compared with B. A tee-joint offers yet greater opportunity for heat escape along A (fig. 20) as compared with B, and, unless the jaw C is comparatively near that edge of A remote from B, the zone of heating is as dotted due to lateral conduction in A and heat absorption by C. A simple means of getting over the trouble is to use three jaws as in fig. 21, first passing current between 1, 1 till the piece A is sufficiently preheated, and then passed between 2 and 1, 1 to complete the weld. This course is practically essential if the piece B is considerably lighter in section than A. The two current distributions may be effected by a 2-way switch, or two distinct transformers may be used as shown diagrammatically in fig. 25, if the nature and amount of work justifies the construction of a special machine. The sketch is self-explanatory, the essential feature being the use of two transformers, S T, to preheat the heavier piece and weld on the tee-piece respectively. In the past gas flames have been used for preheating, but, except for filling-in or building-up work using arc equipment, it is difficult to conceive any case to which electric preheating-clamps cannot be applied advantageously.

Building up a tee-piece from three separate pieces is easily effected by a 3-jaw arrangement, as in figs. 22, 23. The pieces A, B are first butt-welded, and incidentally preheated for the second operation of welding C into the first-formed burr.

The question of jaw or electrode shape is closely associated with that of clamp arrangement, and, whilst demanding special consideration for each case, is solved by application of the general principles already enunciated. For ordinary butt welding the clamping jaws have to represent a compromise between massiveness required to carry very heavy currents and lightness required to reduce heat abstraction from the work; from the mechanical standpoint, they must admit quick insertion and removal of work, and transfer sufficient clamping and lateral force to the latter without injuring its surface. To



Figs. 19 to 24.

hold strips (or the ends of hoops) which are wide for their thickness, in exact alignment, serrated intermeshing jaws may be used, these supporting the work practically at its edge yet permitting more rapid and even heating than straight-edged jaws. In spot or seam-welding the bearing surface of the two electrodes may be unequal to allow for difference in section or conductivity of the pieces joined. For instance, using a truncated cone or electrode against spot or seam-welding, the bearing surface of the two sheets, the sheet of higher conductivity would be placed on top. Similarly, a conical and troughed electrode combination, as in fig. 24, concentrates heat at the seam of a tube to be welded.

Preparation of Work.—Some of the work which should be done before starting to weld is, one might think, obvious, but it is not always performed. Before filling in blowholes by the arc process, the top of the hole should be opened out, so that the cavity is accessible to complete filling, and the interior surfaces cleaned thoroughly. Though butt welding on the "flash" principle expels automatically any reasonable amount of foreign material from the weld, it is unreasonable to deliberately leave the surfaces to be joined in a dirty state. A sandblast or grinding wheel, as may be most convenient, should be used to remove scale or oxide. Forging scale may be removed by a hot pickle of 1 : 50 volumes of sulphuric acid and water, followed by rinsing and dipping

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in milk of lime. The gripping surface for the jaws (in butt welding) should be clean as well as the actual welding surface. By attending to preliminary cleaning overheating at the jaws is prevented, time and current are saved, and the risk of flaws is eliminated.

Something has already been said regarding electric preheating by resistance-heat; generally it is limited by considerations of cost to comparatively light pieces. Any piece which can be welded by the resistance process can, of course, be preheated by the same means, and having welded, say, a wheel tire, the whole of the latter can be heated electrically for shrinking-on purposes, conveniently and with

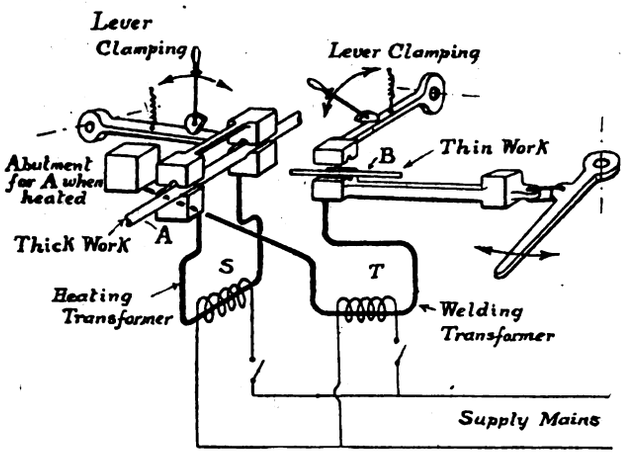

Fig. 25.

economy. In the case of castings or other massive pieces, preheating by gas-torch or by gas ring or coke fire or muffle furnace is generally desirable. Electric resistance welding is then impracticable, and though an arc between separate electrodes (*e.g.*, Voltex) could be used, the heating effect would generally be too intense and too local.

More or less mechanical preparation is necessary in all but the simplest welding jobs. Except in the case of very thin plates (to which arc welding is not very safely applicable), the edges of plates to be arc welded should be chamfered to ensure penetration of heat and added metal. To allow for the difficulty of sound welding throughout the thickness of a flange on a pipe, the former should be bored taper and the latter bell-mouthed, thus affording valuable mechanical support to the weld.

Various means of clamping and preheating to allow for inequality of section or mass in butt welding have been described, but best of all is to arrange that the sections welded are equal whenever possible. This can frequently be arranged either by preliminary

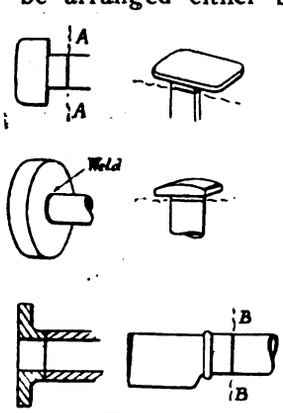

Fig. 26.

machining or by judicious selection of the position of the joint. For instance, in welding bolt heads to bar stock (to save machining the whole belt from the solid), the weld should not be at the base of the head itself: rather should the head blank be chosen large enough to permit ½ in. or so to be turned down to the bolt diameter, the weld being then made on the end of the stub so formed (A, fig. 26). Not only is the ease and reliability of welding thus increased, but cleaning up the finished joint is facilitated.

Similarly, the joint between a knife and metal handle should be made at B B, fig. 26—where there is uniform section on either side, and the small welding fin is easily ground off.

(To be continued.)

MODERN PRINTING TELEGRAPHY.

On January 27th Mr. H. H. Harrison, A.M.I.E.E., read a paper before the Institution of Electrical Engineers on the principles of modern printing telegraphy, in the course of which he reviewed the history of the subject, and described the essential features of the various systems that have been evolved. The system invented by David Hughes in 1854 was the first to achieve permanent success, and was followed by the Baudot multiple system 20 years later. The broad principles on which a printing telegraph should be designed were first clearly defined by Donald Murray, in his classic paper read before the Institution in 1905. Almost all inventors of modern systems have adopted the five-unit alphabet, with the result that the devices employed by them follow similar lines. A fundamental requirement for success is that the operation of the system shall not depend upon the strength, but the direction of the received current, unless, as in the case of a submarine cable, the line is far removed from external electrical disturbances. By varying the number, duration, or moment of appearance of the signal elements a single wire can be employed to transmit impulses which select the desired characters, cause them to be printed on a tape, and advance the tape for the next letter.

Using the five-unit system, means have been devised to enable each combination of signals representing a letter to be dispatched by the simple depression of a key, as in ordinary typewriting; but in order to avoid loss of time due to other necessary operations it is found better to store the signal permutations so that the line can be kept working whilst the operator is otherwise engaged, rather than to send the signals direct to line as formed. The usual method of storage is by causing the depression of each key to perforate a paper tape in a corresponding manner, the tape being then fed into a mechanical transmitter. Arrangements have been devised for enabling errors in keying to be obliterated without affecting the receiving apparatus, and for stopping the transmitter when it outruns the perforating mechanism, in order to avoid tearing the tape. The transmitter is automatically started again directly the operator catches up with it by a device due to Murray. At the receiving end the signal sequences are stored, and combined to set the printing wheel, which then prints the proper character, and the mechanism is automatically reset for the next letter. Ingenious devices have been developed to enable the printing to be effected either on a tape, on a continuous web of paper, or on separate pages, which are automatically fed into the mechanism; not only so, but the sender can ensure starting each message on a fresh page, and the mechanism even sends him a warning signal when a page is full.

For circuits carrying comparatively little traffic, the single-channel low-speed step-by-step printer, using the Baudot alphabet, and perforated tape, and manually-operated, is quite suitable. Several systems are described by the author, including one of his own invention. A feature worthy of note in single-channel printers is that in order to give time for printing a letter without delaying the working of the system, two groups of setting magnets can be employed, so that while one character is being printed the next can be prepared. This is known as the "overlap" principle.

All modern high-capacity systems depend for their operation on the maintenance of synchronism between rotating mechanisms at both ends of the line, which involves two main requirements—the maintenance of uniform angular velocity of the rotary devices, and the maintenance of a definite phase relationship between the sending and receiving apparatus. Numerous devices have been worked out for these purposes, and are described by the author. Usually a shunt-wound electric motor is the driving agent, and is provided with a fly-wheel with special fluid damping features.

Speed governing is effected with the aid of a tuning-fork, so connected with regard to the motor that resistance in series with the armature is periodically short-circuited for longer or shorter periods and the speed maintained constant. The "phonic wheel" of Rayleigh and La Cour, which consists of an iron star-wheel kept in rotation by alternating currents supplied by means of a vibrating reed, makes a most satisfactory and reliable motor of constant speed. To keep the sending and receiving apparatus in step with one another, one is made the controller and the other is adjusted to run slightly faster or slower; means are then provided for automatically correcting the phase of the latter whenever it departs

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from exact agreement by a known amount. The corrections can be generated by the signals themselves; several methods of doing this have been devised and are described.

Th last section of the paper deals with modern developments, tending to economise time and plant. The high-speed one-channel apparatus is known as "automatic," and the low-speed multi-channel apparatus "multiplex," but in many respects they are identical. The latest high-speed system is capable of printing 1,000 letters per minute without blurring, the paper being struck against the type-wheel by an electro-magnetic hammer which is actuated by a condenser discharge. The printing time in any multiple system does not involve waste of line time, so that overlap is not necessary; the line is practically placed at the disposal of one, two, or more, up to five or six, operators in succession for the transmission of signals, by the rotation of distributors divided into sectors. As the signals may be sent in either direction, by each channel, it is evident that a variety of combinations of traffic can be made. Here a difficulty arises on long lines, due to the appreciable lag of the incoming signals, so that they begin to encroach on the outgoing signals, and special means have to be adopted for dealing with this trouble, which reduces the efficiency of line use; in fact, if the lag is serious, it is preferable to use separate lines for up and down traffic. The signals can be automatically repeated at intermediate stations, and as distortion of the signals results from repeated repetitions, they can also be retransmitted in as perfect a form as that in which they were first dispatched, and this process greatly increases the flexibility of the multiplex telegraph.

The author concludes that the five-unit equal-letter alphabet now holds the field, and that high-capacity systems transmitting letter by letter at 40-45 words per minute per printer unit can be made of strong construction and at diminishing first cost. Except where saving of line time is of the first importance, it is better to provide special segments for the correcting impulses rather than to correct by the signals themselves, the former method having the advantage of automatic phase-finding. On the less important circuits the type-wheel tape printer of low first cost has a large field, but for the high-capacity circuit the page printer holds undisputed sway.

In the discussion which followed the author received many congratulations on the comprehensive character of his paper, which Mr. DONALD MURRAY regarded as sufficiently detailed to enable any competent engineer to construct such apparatus.

In opening the discussion, Sir WILLIAM SLINGO pointed out that printing telegraphy had been hindered in its early stages by conservative feeling, but its increased legibility, saving in time of transcription, &c., were now appreciated, and it was now a question of high-speed automatic *versus* multiplex working. He noted the absence of reference to photographic methods, which the author subsequently discounted from a practical standpoint, and discussed at some length the Siemens automatic system, which, he said, attained a working speed of 166 words a minute, but Mr. Harrison did not think this speed would be maintained in practice. The Morse code was not twice as long as the five-unit code, the proportion being 8 : 5. He disagreed with some of the author's conclusions, and thought that page printing would in the end prove more satisfactory than tape printing.

Col. SQUIER urged telephone and telegraph engineers to draw freely on wireless developments with a view to improving their art, while Mr. WALTER JUDD pointed out that the Eastern Co.'s long-distance cables were fitted with the Creed system and perforators; all messages were printed off ready for delivery in the city.

Mr. DONALD MURRAY pointed out by comparison with the interconnected electric supply system on the N.E. Coast (see ELEC. REV., page 28) that a great deal remained to be accomplished before a paper on printing telegraph networks could be written. Mr. RAYMOND-BARKER suggested that to complete the comparison of telegraphic codes, a graph of the cable code should be added; the word "London" would represent 49 units as against 69 units with Morse, and Major BOOTH, referring to the same comparison, said the results could not be taken as an indication of value for line working; he thought Mr. Murray had been surprised to see the Hughes instrument printing as fast as his up-to-date apparatus, but it was illegible. He also doubted whether any ordinary typewriting mechanism would stand the high speeds of modern telegraphy.

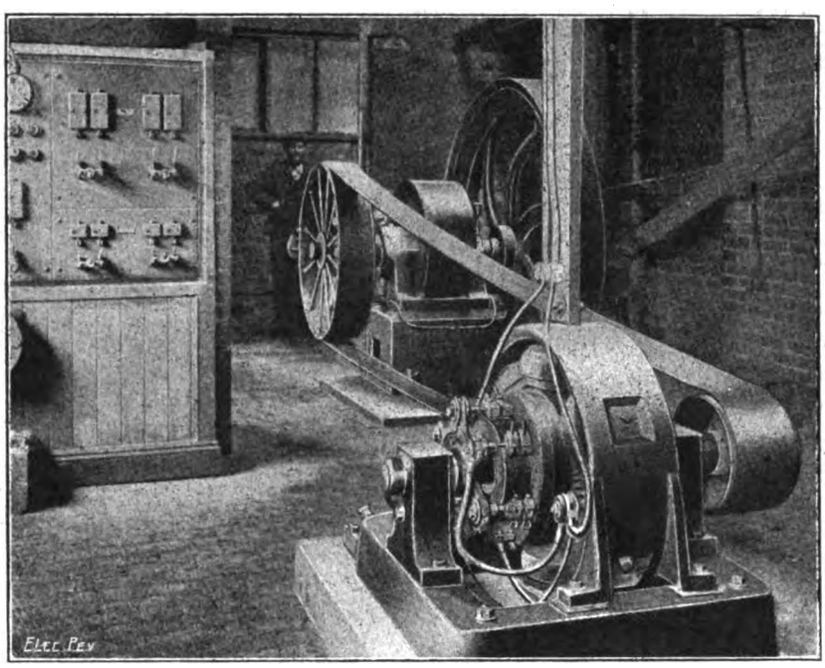
Mr. TYRRELL mentioned the reliability of the Baudot apparatus at Antwerp just at the time of its surrender, and despite the efforts made to interfere with the working; he pointed out, in reply to Sir William Slingo's suggestion that printed messages would not have been trusted 20 years ago, that many thousands of printed telegraph messages were being distributed in the city, to stockbrokers and others, quite 30 years ago.

THE "MACHINERY AGE" IN FARMING.

AN interesting review of the economic conditions which will confront the British farming community after the present war—and which are even now influencing this industry—was contained in a paper presented at the last meeting of the Farmers' Club in London recently, by Mr. W. J. MALDEN. The theme of both the paper and discussion which followed it, was the inevitable necessity of meeting the deficiency of manual and animal labour by the introduction of power-driven appliances on a wholesale scale, particular stress being laid on the value of the oil motor for ploughing and other purposes.

It is not for us to discuss the pros and cons of oil or steam power on the farm, but rather to point out that at the best, either is merely a stepping-stone to the use of electricity for all farm purposes: for power, traction, light, intensive cultivation of crops, poultry incubation, and the production of artificial fertilisers. At present the farmer is groping in the dark, and we share with the author his difficulty in understanding why the Board of Agriculture should not employ the highest engineering skill, as well as the best chemical, veterinary, bacteriological, and poultry experts. Assuredly there is need of expert guidance to ensure that the future of agricultural engineering generally shall not be wrecked on a side issue.

We have previously drawn attention to this subject* and urged on the Board the necessity of opening an inquiry into the subject of agricultural electric supply generally, with a view to studying our national requirements in this connection, because sufficient evidence has been obtained to place beyond doubt the utility of electrical methods on the farm, and, furthermore, because the economic prosperity of the country demands that steps shall be taken to co-ordinate our industrial operations, particularly where they can be made interdependent and mutually helpful to one another. Although, judging from the remarks made by Mr. Malden, one might almost assume that an oil or petrol motor-driven tractor for ploughing, or other purposes, represents the panacea for all present and future farming troubles, and that the newly-discovered adaptability of this type of machine is such as to discount experiment in other directions, yet he himself admits that the (oil) motor is in a comparatively crude form, and that whether it would be so valuable in cultivating small British fields in a climate so wet as ours, and where so much land is on the heavy side, as a tractor or windlass hauler—avoiding the necessity of running heavy engines over land after it has been ploughed—has yet to be proved.



GENERATING PLANT ON A NOTTINGHAMSHIRE FARM.

We have touched on this matter because it would be a great mistake to defer consideration of the known utility of electrical methods generally on the farm, solely because an unproved oil or petrol tractor for ploughing and haulage has made its appearance, especially as electrical ploughing has distinct possibilities of its own. Experimental electric ploughing on an extensive scale has taken place in several European countries with favourable results in comparison with steam and oil power; in Germany a number of electric ploughing equipments are in operation, while in this country we can point to a small Nottinghamshire farm—to which we refer later on—which has depended on electricity for ploughing, thrashing, and power and lighting generally, for several years past, apparently with satisfaction to the owner.

* ELEC. REV., December 3rd, 1915, page 729.

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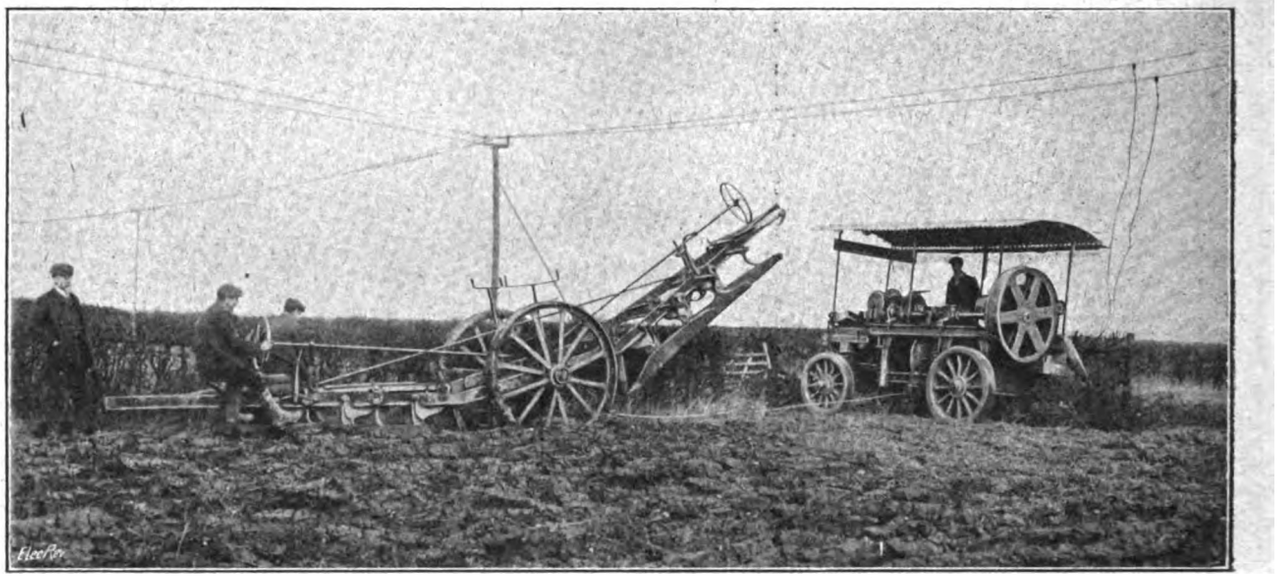
Given suitable recognition of the utility of electrical methods on the farm, the apparent obstacle of the moment—the lack of supply facilities in agricultural areas—could be easily overcome, especially in the neighbourhood of the established supply undertakings which, as has been shown in our pages, are sufficiently numerous and widespread to cater for the initial requirements of any general scheme for farm and village supply. We have it on the authority of Mr. Malden's paper that an almost unlimited number of "motors" (oil or petrol engines and tractors) could be sold to the farming community at the present time—in fact, the machinery age in farming has arrived, and, despite the difficulties which beset us at the moment, the present is a golden opportunity which may not occur again to introduce power appliances to the farmer and one which electrical engineers and electricity suppliers would do well to seize on with a view to the future development of electricity supply in the hitherto neglected agricultural districts.



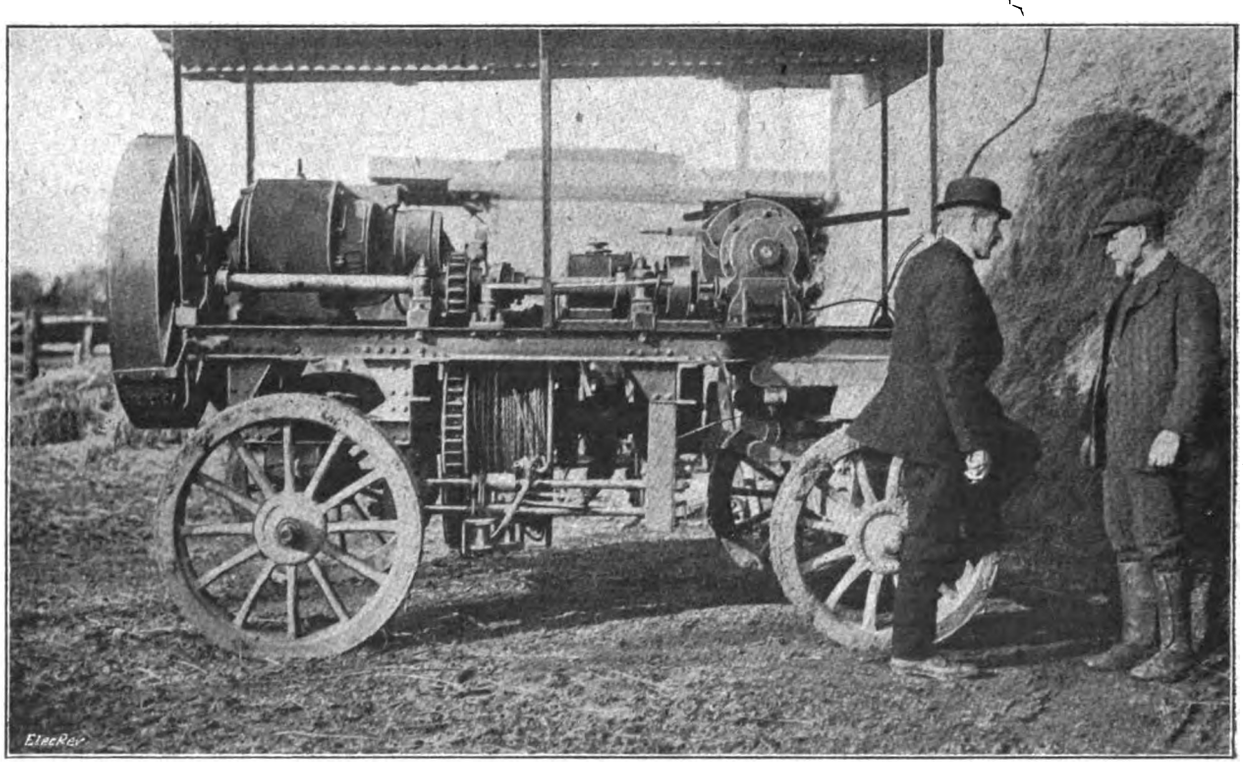
Electrically-operated Plough, with Haulage Trolley, Overhead Wires, &c.

Electricity on a Nottinghamshire Farm.

Some five years ago, a Mr. Chorlton conceived the idea of introducing electrical methods at his 240-acre farm at Cotgrave, near Nottingham, more particularly with a view to overcoming ploughing difficulties arising from the heavy clayey nature of the land, which had necessitated the use of three and four horses to pull the plough through a furrow, resulting in excessive puddling of the latter. While steam ploughing tackle overcame this difficulty it introduced others equally serious—the ploughing engine being too heavy to run over the land in wet weather, and in any case requiring the services of two or three men and a horse to carry fuel and water, in addition to three men working the ploughing tackle.

Mr. Chorlton called in Messrs. E. O. Walker & Co., engineers, of Manchester, who designed and installed the equipment which has been in use since 1910. This consists of a 25-h.p. suction gas engine, with producer, &c., driving by means of a belt a 500-volt direct-current dynamo, this plant being installed in an outbuilding at the farm, where it supplies electric lighting and local power requirements. In addition, this plant supplies overhead distribution wires, which are carried on poles to various parts of the farm, and which supply the electric ploughing tackle in the field.

The ploughing gear is on similar lines to steam ploughing tackle, consisting of two special trolleys carrying electrically-driven haulage gears, which are placed at opposite sides of the field and haul a reversible three-furrow plough to and fro between them by means of a wire cable; the haulage trolleys are moved on a short distance after each successive journey of the plough, a cable drum being fitted to the trolley for this purpose, the cable of which is anchored at the farther end of the field. It will be noted in our view of the plough at work that the overhead wires are tapped by flexible cables arranged to hook over and slide along them.



Haulage Trolley fitted with Electric Motor and Pulley for Belt Driving.

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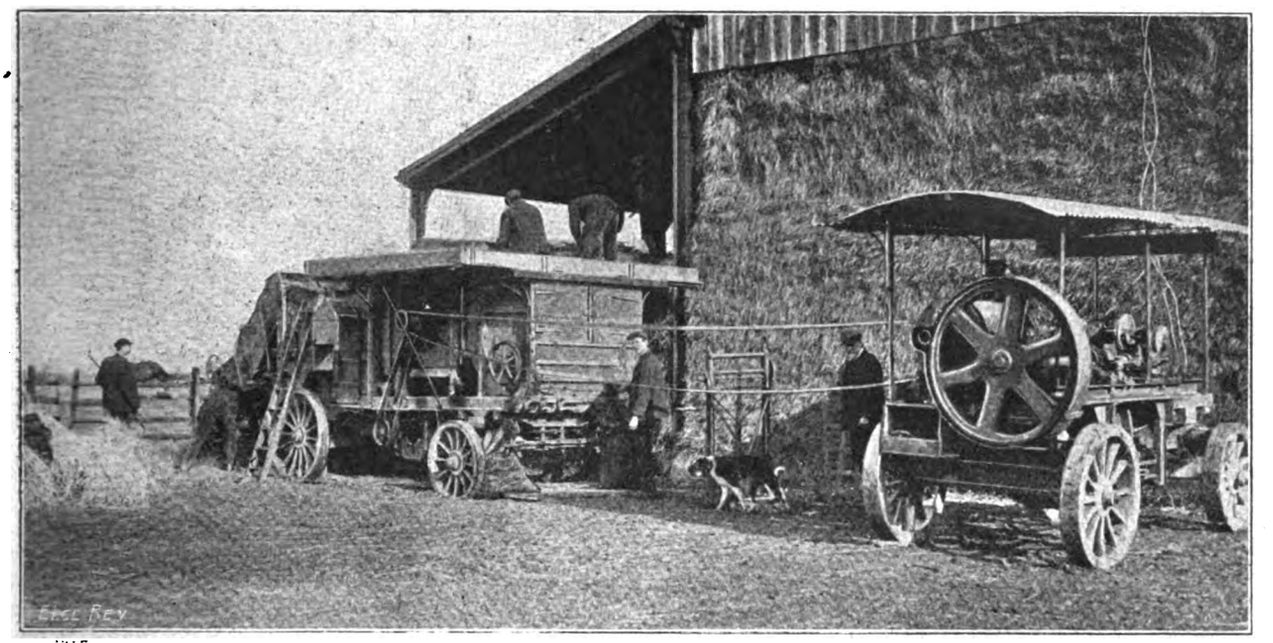
Originally a double-ended five-furrow plough was in use, but this has been superseded by a lighter double-ended three-furrow plough in view of the experience gained; as regards the matter of experience, Messrs. Walker found it necessary to experiment in the first instance with a two-horse plough fitted with a dynamometer, in order to obtain some idea of the tractive effort required. In the case of the tackle actually employed now, the hauling rope, about 400 yards long, weighs about half a ton, and a pull of up to five tons is required when hauling up hill. It may be added that the 25-H.P. gas engine requires some coaxing before it will take the load after it has been running light, while the ploughing tackle is being adjusted;-but despite this—and contrary to the views held before the installation was put in, that a 25-H.P. plant would not pull a single-furrow plough—it is found possible to pull three shares through the heaviest and stickiest clay, ploughing three furrows 8 in. or 9 in. deep and 9 in. or 10 in. wide.

The haulage trolleys weigh about 4 tons each, and they are employed where possible to pull each other on heavy land, but experience shows that they can be greatly improved by making them self-moving in future.

It is obvious that with electric power available in different parts of the farm, many operations can be facilitated by its use.

The electric motors on the haulage trolleys are provided with pulleys providing for a belt-drive to any type of machine,



Thrashing Machine Electrically Driven from Haulage Trolley.

and one of our views shows a thrashing machine being driven in this way. Harrowing, mowing, cutting drains with the implement already used with steam ploughs and any other operation done with steam ploughing tackle can be done with the electric tackle used on Mr. Chorlton's farm. We understand that this gentleman is well satisfied with his installation, which is run by farm hands—the farm foreman being the chief engineer. We may add that a field, 280 by 280 yards, of heavy clayey soil has been ploughed to a depth of 8 in. with a coal consumption of 1½ tons; obviously the cost would be less were it possible to obtain electricity at power rates for ploughing, and Messrs. Walker estimate that nine miles of single-furrow could be cut per hour at a cost for energy of 4d. on the basis of ½d. per unit, or *pro rata* for higher prices.

We are indebted to Messrs. E. O. Walker & Co. for the particulars of this installation; we have also drawn on a short article published in the *Manchester Guardian*, through whose courtesy we are enabled to publish the accompanying views.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Electric Iron Connections.

We understand that one of your interested readers a few weeks ago made reference to the unsatisfactory flat-iron connector which he had been in the habit of using. We should specially like to draw your attention to the sample connector which we are taking the liberty of sending to you, and would bring to your notice the specially prepared flexible wire, which we use together with the special fibre bar attached to the connector. By this arrangement all the strain is taken from the actual connection, and, further, practically no heat touches the flexible cord itself. Again, it will interest you to note that there are four points of contact on each terminal.

Hotpoint Electric Heating Co.,
L. G. Hawkins.

London, W., *February 3rd*, 1916.

[The connector referred to is certainly a very good one, which ought to give very little trouble.

We drew attention to this connector in our issue of November 27th, 1914, when writing of the "El Radio" radiator, without, however, giving details.—Eds. Elec. Rev.]

The I.E.E. and Alien Enemy Members.

With reference to the correspondence in your columns regarding the Institution of Electrical Engineers and Alien Enemy Members, all those who wish this matter settled in the only patriotic and reasonable way should refuse to pay their subscriptions until the matter is properly dealt with.

May I, at the same time, ask the following questions:—

What are the advantages of being a member of the Institution in any grade?

What inducement is there for a student to apply for transference, with its fee and extra subscription?

What has the Institution done to assist young, struggling engineers to earn a sufficient salary to meet such new liabilities?

Admitted there are the lectures and the lending library, but, apart from these, it seems to me that the advantages are nil.

The Institution is closed, or, at least, the library is, during the hours when most members of the electrical profession can visit it, and it is impossible for a student to use the library to his advantage.

Is it correct that members of the Council have facilities for dining on the Institution premises? and what would happen to the student who took his frugal lunch to consume on the Institution premises?—yet his 1½ guineas is more to him than the higher subscription to the member.

What is needed is an Institution on the lines of the American Westinghouse Electric Club.

A Student.

February 6th, 1916.

With reference to the letter of "Alien-ate(r)" in your issue of February 4th, we shall be glad to receive the support of other members if you will be good enough to accept them.

The dastardly air raid of January 31st should assist in enforcing our demands.

Six Borough Electrical Engineers.

February 7th, 1916.

[An important decision of the Council of the Institution will be found in our "Notes" section.—Eds. Elec. Rev.]

B.E.A.M.A.—The following firms have been elected members of the B.E.A.M.A.:—**Ferguson, Pailin & Co., Openshaw; Mirrlees Bickerton & Day, Ltd., Hazel Grove, near Stockport. Callender's Cable and Construction Co., Ltd., has been elected a member of the Council for the session.**

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FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

EGYPT.—Revised tariff valuations for use in assessing import duties on certain metals have been issued, with effect from December 1st, 1915, to January 31st, 1916, or until denunciation, as follows:—

	Valuation per kilogramme. Millièmes.
Copper and brass sheets, round and bottoms	114
Copper sheets, plain	111
Copper sheets in rolls, bars, round and flat ...	111
Copper ingots	108
Copper wire	*ad valorem.*
Brass wire	,,
Brass sheets, plain, 24 by 48, 8 lb. to 5 lb. ...	,,
Tin ingots and bars	168
Lead sheets	31
Lead shot	32
Lead pipe	31
Lead, pig	31
Zinc sheets	105
Zinc ingots	105
Phosphor bronze	105
Antimony	130
Quicksilver	600

Duty is leviable on the valuations shown at the rate of 8 per cent. (1,000 millièmes = £E1 = £1 0s. 6d.)

SWEDEN.—The Board of Trade have compiled a list of articles which are at present prohibited to be exported from Sweden in virtue of a series of Swedish Royal Decrees issued since August, 1914. The following are included in the list:—Galvanic batteries; carbon electrodes; electro-magnetic igniting apparatus for motor ignition, detached; ferro-chrome; ferro-manganese and spiegeleisen; ferro-tungsten (ferro-wolfram) and ferro-vanadium; ferro-silicon and ferro-silico-manganese.

Copper and alloys thereof with zinc, tin, or other non-precious metal, such as brass, bronze, German silver, Britannia metal, etc.; also aluminium, nickel, chrome, and antimony:—

Unmanufactured or in the rough (including refined copper produced from raw material (not from scrap) at a Swedish refinery).

Anodes of copper, copper alloys and nickel, cast, even if with ears, with or without holes.

Scrap.

Copper and alloys thereof with zinc, tin, or other non-precious metal, such as brass, bronze, German silver, Britannia metal, etc.; also aluminium and nickel. Manufactures, viz.:—

Sheets and hoops:—

Rolled or pressed, even if with sheared edges (rectangular, and other kinds).

Hammered, bent, bell-shaped, with turned-up edges, including cup-shaped materials for making cartridges, etc., provided with holes, polished or otherwise worked.

Perforated sheets, including so-called strainer plates.

Rods (even if in bundles or coils), rolled, drawn, hammered or profile pressed, but not further worked, whatever be the shape of the section.

Solder, moulded, crushed, or granulated.

Nails and rivets; also bolts, wormed or not.

Pipes and tubes, whatever be the shape of the section, even if turned on the exterior and interior.

Wire, rolled or drawn, whatever be the shape of the section, including so-called trolley wire (contact wire).

Woven wire (gauze, wire tissue, etc.).

NOTE.—So-called wire gauze (endless) of nickel, and nickel wire tissue more than 1 metre wide are *not* prohibited.

Copper and alloys thereof with zinc, tin, and other non-precious metal, such as brass, bronze, German silver, Britannia metal, etc.:—

Wire twisted into cords or cables, not insulated.

Wire furnished with sheath of lead or other metal, with or without armouring, even if in combination with other materials; also electric cables or lines with similar sheaths, with or without armouring.

Wire insulated with rubber, gutta-percha, etc., even if in combination with other materials; also electric cables, lines, and cords insulated in this way.

Wire insulated with textile materials, paper, asbestos, or varnish, even if in combination with other materials; also electric cables, lines, and cords insulated in this way.

Wire, electric cables, lines, and cords insulated in any other way.

Rubber in various forms, viz.:—Rubbered plaster; rubber articles for medical or hygienic use; raw rubber, gutta-percha and balata, also so-called reclaimed rubber; rubber, in solution or in the form of paste (but not rolled into sheets or further manufactured), with or without admixture of other substances such as sulphur, graphite, and resin; also artificial soft rubber; manufactures of soft rubber, except driving and transmission belts, and except rubber boots and shoes; manufactures of hard rubber (ebonite, etc.), even if in combination with other materials; rubber waste and worn-out articles of rubber; rubber toys, and parts thereof.

Zinc:—

Unmanufactured (with the exception of zinc produced from raw material (not from scrap) at a Swedish refinery); also scrap.

Sheets, even with a coating of other non-precious metal.

Wire, pipes and parts of pipes; anodes, even if provided with ears, with or without holes.

Rolled sheets furnished with holes (so-called boiler zinc).

Rods.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

1,076. "Vibrating diaphragms for telephones, transmitters, gramophones, &c." T. CHALMERS. January 24th.

1,097. "Lock-nuts, &c." MARCONI'S WIRELESS TELEGRAPH Co. January 24th.

1,098. "Automatic or semi-automatic telephone systems." RELAY AUTOMATIC TELEPHONE Co. & T. M. INMAN. January 24th.

1,116. "Means for placing collectors in contact with electric conductors." H. J. DOVER, VACUUM BRAKE Co., & W. P. WALKER. January 24th.

1,123. "Telephone systems." AUTOMATIC TELEPHONE MANUFACTURING Co. AND J. SAVIN. January 24th.

1,143. "Generator for electric oscillations or for alternating-currents of high frequency." F. W. LANCHESTER. January 25th.

1,157. "Electrolytic cells." C. CHURCHILL & Co. AND E. GERRARD. January 25th.

1,183. "Apparatus for controlling electrical currents by rise and fall of temperature." A. J. BENNETT, W. BENNETT, & L. SANDOZ. January 25th.

1,189. "Telephonic receiving apparatus for aviators." G. H. NASH AND WESTERN ELECTRIC Co. January 25th.

1,227. "Magneto-electric gun with propulsive retro-action." E. MERCER. January 26th.

1,246. "Circuit controllers." CUTLER-HAMMER MANUFACTURING Co. AND IGRANIC ELECTRIC Co. January 26th.

1,247. "Resistance units, and manufacture thereof." CUTLER-HAMMER MANUFACTURING Co. & IGRANIC ELECTRIC Co. January 26th.

1,248. "Means for controlling electric circuits." CUTLER-HAMMER MANUFACTURING Co. & IGRANIC ELECTRIC Co. January 26th.

1,255. "Dynamo-electric machines." BRITISH THOMSON-HOUSTON Co. AND N. SHUTTLEWORTH. January 26th.

1,266. "Switch-operating mechanism." A. ROBERT & A. TANQUAY. January 26th.

1,271. "Electric glow lamps, electric arc lamps, electric heaters, &c." C. O. BASTIAN. January 26th.

1,378. "Electrolytic battery." MACKAY COPPER PROCESS Co. January 26th. (April 9th, 1915, U.S.A.)

1,282. "Arrangements for transmitting impulses." RELAY AUTOMATIC TELEPHONE Co. & L. C. BYGRAVE. January 26th.

1,287. "Joint box for armoured electric cables." H. HAIR. January 27th.

1,299. "Gas and electric globe gallery screw." T. CRACKNELL. January 27th.

1,309. "Means for supporting and insulating electric lines." BULLERS, LTD., AND G. V. TWISS. January 27th.

1,368. "Electric lampholder." A. H. SHORT. January 28th.

1,374. "Means for controlling and regulating electric motors." CUTLER-HAMMER MANUFACTURING Co. & IGRANIC ELECTRIC Co. January 28th.

1,381. "Electric accumulators." H. LEITNER. January 28th.

1,384. "Electric lamps." A. J. WEST. January 28th.

1,390. "Apparatus for observation of azimuth angles and simultaneous electrical transmission of value of such angles to remote indicators." E. A. GRAHAM & W. J. RICKETS. January 28th.

1,417. "Cores for Pupin loading coils, magnets, &c." WESTERN ELECTRIC Co. (Western Electric Co.). January 29th.

1,418. "Arc incandescent lamp for therapeutic, &c., purposes." E. A. GIMINGHAM. January 29th.

1,434. "Multi-speed alternating-current motors." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.). January 29th.

1,436. "Device for controlling electric ignition in internal-combustion engines." M. PENSUTI. January 29th. (February 3rd, 1915, Italy.)

PUBLISHED SPECIFICATIONS.

1914.

23,938. PERMANENT MAGNETS FOR ELECTRIC METERS. British Thomson-Houston Co. (General Electric Co., U.S.A.). December 11th.

24,659. AUTOMATIC MAGNETICALLY-OPERATED CLUTCHES FOR ELECTRIC MOTORS. J. G. Stirk. December 28th. (June 28th, 1915.)

1915.

370. ELECTRIC METERS FOR REGISTERING EXCESS. A. W. Burke. January 7th. (January 21st, 1914.)

324. ELECTRICAL TRANSMITTER MICROPHONES. B. H. Pilkington. January 8th.

353. CENTRIFUGAL COMPRESSORS. British Thomson-Houston Co. (General Electric Co., U.S.A.). January 8th.

482. SHADEHOLDERS AND THE LIKE FOR ELECTRIC LAMPS. J. N. Mollett and E. Mollett. January 12th.

1,091. DETECTORS, PARTICULARLY FOR WIRELESS SIGNALLING. Sterling Telephone & Electric Co., Ltd., and T. D. Ward-Miller. January 22nd.

2,546. ELECTRIC FIRES. H. H. Berry & W. J. Markham. February 17th.

4,911. ELECTRO-MAGNETIC SWITCHES. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 30th.

7,869. RONTGEN TUBE APPARATUS. C. B. Burdon (Siemens & Halske Akt. Ges.). May 27th.

10,429. ELECTRIC TRANSMISSION SYSTEMS FOR MOTOR VEHICLES. N. Shuttleworth & Shackleton. July 1st.

11,3 9. ELECTROLYTIC CURRENT MAGNIFIERS. W. Judd, A. Fraser, & Eastern Telegraph Co., Ltd. August 5th.

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THE
ELECTRICAL REVIEW.

VOL. LXXVIII. FEBRUARY 18, 1916. No. 1,995.

ELECTRICAL REVIEW.

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NOTICE.

IN view of the recent Increase in the Postal Charges, our Subscription Rates for Great Britain and Canada will until further notice be increased to £1 1s. 8d. and £1 3s. 10d. respectively.

LIGHTING CONTRACTS IN WAR TIME.

THE case of the Leiston Gas Co. *v.* Leiston-cum-Sizewill U.D.C., which was decided in the King's Bench Division on February 1st, raised a point of considerable interest to those who supply gas or electricity for lighting purposes. Yet it requires careful study, for some people may be tempted to quote it as an authority for propositions which are rather too wide. The facts are very briefly these: The plaintiffs, a gas company, undertook to provide columns, lanterns, and gas burners, to connect the same to their mains within the district of the defendants, a local authority, and to light, extinguish, and clean and repair, the lamps for a period of five years, in consideration of certain quarterly payments. The lamps, etc., were to remain the property of the gas company; but there was nothing in the agreement to show how the price payable was divided between expenditure on capital account and the sums to be paid for gas. The contract ran from June, 1911. In January, 1915, however, owing to an order issued by the military authorities under the Regulations for the Defence of the Realm, the lights were extinguished in the defendants' district. The defendants therefore refused to pay the sums due under the agreement from January to September, 1915. Upon being sued, they pleaded that the contract was either illegal or impossible to perform, and that it could not be enforced. Mr. Justice Low refused to adopt this contention. Having pointed out that the plaintiffs had not only to supply gas but to provide and maintain a number of lamps and certain apparatus, he said:—

> I do not think it is correct to say that, because in time of emergency power is given for a competent authority to suspend the actual lighting in a given area for such times as may be considered necessary for national safety, and because such power is exercised, a provision for lighting within that area becomes unlawful.

If it "became unlawful within the meaning of the authorities" the Courts could not enforce it. He next dealt with the contention that performance had been rendered impossible. Impossibility might, of course, have excused performance, but his lordship pointed out that in one respect the contract had been performed, in that the gas company had already provided the lamps and plant. Further, they were bound to "stand by" to light the district at any moment, should the lighting restrictions be removed.

The important point to note about this decision is that the gas company had to do something more than supply gas; they had to provide lamps and other plant. In that sense, and to that extent, the contract on their side was performed. It was not a case where the gas company had *merely* connected up to their mains and agreed to supply gas for a period, making no special outlay on behalf of the new consumer.

It is interesting to consider what the position would be in case a lighting restriction order was applied in a case where no outlay was necessary or actually made. Suppose, for instance, an electric lighting company are under agreement to supply all *necessary* current to street lamps for a period of five years at so much per lamp—the lamps being the property of the local authority. In such a case, it is conceived that the question whether the lamps are lit or not is a matter which concerns the local

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authority. If circumstances occur which render it impossible to light the lamps, so much the better for the lighting company. As was pointed out by Mr. Justice Low, in the case under review, they would be bound to have everything in readiness to supply the load if and whenever required to do so.

Another kind of case may occur. Suppose the lighting company are under liability to supply current for every lamp and when required, subject to a minimum consumption of, and payment for, so many units. In consequence of the restriction of lighting even the minimum may not be attained; yet the local authority will still have to pay for it.

In each of the foregoing cases it seems to be clear that the lighting authority would be to a large extent protected. The loss would fall on the local authority. But where the contract is perfectly open—the local authority being entitled to demand enough light "to light the town" (or as may be) at so much a unit, it would seem that the lighting company could assert no claim for damages if, owing to the action of the military authorities acting in the interests of the defence of the realm, no public lamps could be lit.

Having regard to recent happenings, cases of these various kinds may occur in many different parts of the country. It is possible, however, that some agreements extending over a long period contain classes enabling them to be determined. In such instances no difficulty is likely to occur.

Copper. Copper prices continue to soar under the growing scarcity which has been characteristic of the market for months past, and which has seriously alarmed consumers. The speculative account is, presumably, exceedingly small, but the position of those who have uncovered contracts in standard metal has become most uncomfortable, and there is no indication whatever of the least relief coming forward for months to come. The statistics continue to indicate a perilous condition of affairs, and the scepticism which has been expressed in some quarters for months past regarding the actual position of the metal not being as represented by the available returns, is now seen to have been wholly misplaced. The fact that the world's consumption has overtaken output is, no doubt, a very regrettable circumstance, but it is blind folly for consumers to close their eyes to the patent facts in the situation, which is entirely controlled now by what appears to be a chronic state of scarcity. In America prices have reached a higher level than those ruling here, absolute famine conditions having driven consumers into the market for immediate supplies, for which they have had to pay quite extravagant figures. American producers now are in the fortunate position of having nothing but odds and ends to sell for several months to come, and this condition shows no sign of relaxing as long as the war lasts. The American exports of copper during the last few weeks have been very large indeed, and some records have been broken. It is a matter for regret that the issuing of weekly statements as to exports of copper has been discontinued by the United States authorities, though the monthly returns will no doubt appear in due course. The United States copper exports for 1915 are given as 276,000 tons against 360,000 tons in 1914, details of the principal countries' takings for the last three years being as follows, in tons :—

To	1913.	1914.	1915.
United Kingdom ...	55,682	87,556	80,985
France	65,826	66,326	102 400
Italy	18,877	26,068	44 705
Russia	40	425	20,456
Germany	145 529	88,452	*Nil*
Austria	15,539	13,809	*Nil*
Holland	77,129	58,940	1,678

The most striking feature in the above returns is the enormous increase in the French takings, the collapse in the shipments to Holland, and also the entire absence of clearances to Germany and Austria. Russia took a good deal less copper than had been expected.

The I.E.E. and Alien Enemy Members. At a meeting of the Chief Technical Assistants' Association which was held on Saturday last, which Association comprises practically all the deputy electrical engineers of Greater London, together with certain senior technical assistants, advantage was taken of the assembly of so large a number of corporate members of the Institution of Electrical Engineers to raise the question of the exclusion of alien enemy members, whether naturalised or not.

The Association, we understand, expressed regret that no action was taken, immediately after war was declared, to exclude such members, and complains that, though it has been in communication with the secretary of the Institution of Electrical Engineers for the past six months, it has obtained little satisfaction and less sympathy. In view of the announcement that steps are to be taken by the Council with regard to the exclusion of alien enemy members, the corporate members of the Institution who were assembled at the meeting passed the two following resolutions :—

(*a*) The corporate members of the Institution of Electrical Engineers present at a meeting of the Chief Technical Assistants' Association of Greater London place on record their unanimous dissatisfaction at the attitude of the Council of the Institution of Electrical Engineers, inasmuch as no steps are proposed to be taken to remove persons of alien enemy origin (naturalised or not) from the roll of membership of that Institution.

(*b*) They also consider that the Council of the Institution should obtain powers at the General Meeting, which it is stated is to be held, to secure a ballot by post from their members; such ballot to ascertain the exact wishes of all corporate members at present resident in this country as to whether such persons of alien enemy origin should, or should not, be retained as members of the Institution, and the by-laws to be amended accordingly.

The Association also authorised the hon. secretary to state that its members are in accord with the communication from "Six Borough Electrical Engineers" which appeared in our "Correspondence" columns on January 28th, and will support the writers in any action that they may decide upon in furtherance of the principles laid down in their letter.

In this connection we may draw attention to the notice issued by the Institution of Electrical Engineers to its members, which appears in another column, with regard to the Special General Meeting. It will be noticed that the meeting is called for 5 p.m., an hour at which only a small proportion of the members can be present. Almost the same procedure was followed in the case of the meeting held to consider the new draft Articles of Association in 1911, and called forth vigorous protests. It is difficult to understand why a more appropriate and convenient hour, such as 6.30, should not have been adopted. If the Council wishes, as we have no doubt it does, to ascertain and carry out the desires of the majority of the members, it is more likely to attain that object by consulting their convenience. The fact that the members of the Electro-Harmonic Society, prior to the concert held on Monday last, by a postcard vote decided that the concert should commence at 6.15, rather than at 7.30 or 8 p.m., is not without significance; and both the Civil and Mechanical Engineers' Institutions are commencing their meetings at 5.30 or 6 p.m.

Another point, of considerable importance, is the fact that many of the members who feel most deeply on the subject of alien enemy members—not only the rank and file, but also men of prominence in electrical engineering—are convinced that if they take any overt action against alien enemies, the latter will eventually find ways and means to strike at them, and in that thought they will not appear at any meeting, or vote in any way except by secret ballot. This, no doubt, explains the demand of the above-named Association for a postal bailot.

No provision is made in the existing Articles for the taking of such a ballot except in the case of the election of the Council; no doubt the authorities are chary of spending £20 or £25 on such a vote, but surely this is a trifle compared with the importance of obtaining the true opinions of the majority of the members, which can never be done at any general meeting. This question, however, cannot be dealt with at the special meeting, as 14 days' notice must be given.

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The Italian Electro-mechanical Industry.

The first official step in conection with the scheme for securing the emancipation of Italy from the German yoke in the electromechanical engineering industry was taken at Milan, on January 15th, when Signor Guido Semenza, President of the Associazione Elettrotechnica Italiana, delivered before the members of the Association the first of a series of lectures which are to be given by way of propaganda throughout the country in favour of the development of the native industry and the definite exclusion of the Teutonic element in the future. Very appropriately the title of the address was chosen: "Dal V.D.E., all' A.E.I."—"From the Verband Deutscher Elektrotechniker to the Italian Electrotechnical Association." Taking as the starting point the fact that the rules and standards of the German Verband have hitherto prevailed in Italy, the President outlined the history of the native industry, and set forth the reasons why, after a brilliant beginning, it had to surrender its arms in face of foreign competition—the expansionist German policy, together with the irrationality of the protection afforded by the import duties and the hostility in the air, since the position in Italy in the past had been dominated by the fetish for foreign goods. When the war broke out it was found how profoundly German influence had taken possession of the Italian market, and the Association had therefore assumed the task of seeing whether it would not be convenient to promote an agitation so that the electromechanical industry might attain to that development which was its due. The manufactures of the industry were precisely those which utilised hydraulic power, which was to-day a very important branch, as it supplied the Italians with motive power. But serious difficulties stood in the way of progress, including those of the import duties, which, instead of dealing with heavy machines according to weight as at present, ought to be applied to them on an *ad valorem* basis.

The next duty of the Association, the President proceeded to explain, would be in the direction of endeavouring to persuade the Government, the provincial authorities, the town councils, and the large companies, that it would be appropriate to give a clear preference to machinery constructed in Italy. It was necessary for the machinery and materials to be of high quality and to be able to vanquish foreign competition. There had, however, hitherto been very little co-operation between science and industry in the country, whereas the German industry had reached its present degree of perfection by the application of science to all industrial processes. The Association intended in a short time to issue Italian rules and standards for the construction of machinery, which would have the effect of improving the types of machinery made. These rules, the President concluded, would be known as those of the A.E.I., and would be in opposition to those of the V.D.E., if assistance were rendered by the Government, the professors, the consulting engineers, and the manufacturers.

Telegraph Wires over Roads.—The case of the Postmaster-General *v.* Hutchings, which we report elsewhere in this issue, involved the discussion of an interesting point as to the right of the Postmaster-General to suspend telegraph lines over roads. The facts were very simple. He required to suspend lines over a building estate at Salford, across which there were certain public roads which had not been taken over by the local authority. The owner of the estate having objected, the matter was referred to the County Court Judge, who awarded that the Postmaster-General should pay £5 a year for the privilege. On appeal to the Railway and Canal Commissioners, this decision was reversed, the Court holding that for the suspension of wires over the public roads, no compensation was payable without proof of actual damage, and that in so far as his rights as an "adjoining owner" were concerned, the landowner would have to avail himself of the remedy given by Sec. 12 of the Telegraph Act, 1863. This decision applies to telephone as well as to telegraph wires, and it seems to accord with justice and good sense. It is difficult to conceive what harm is occasioned to anyone by the mere suspension of a light wire well above the surface of a road. If there is any technical wrong done, it is amply compensated by the fact that the extension of the telephone system is a boon to the public.

ELECTRICITY SUPPLY DEVELOPMENT IN A STRAGGLING INDUSTRIAL AREA.

By Lewis W. Dixon, A.I.E.E.

I had the pleasure a few years ago of describing in the Electrical Review a somewhat intricate overhead system in Dowlais in the area of the Merthyr Electric Traction and Lighting Co., Ltd., for the purposes of private and street lighting supply.

Since then another extensive development has been carried out by the company, to link up all the colliery towns

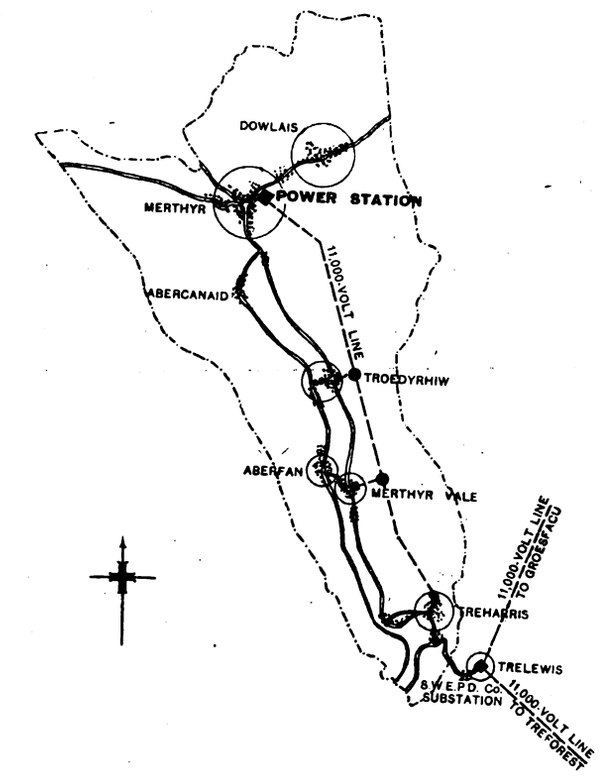

Fig. 1.—Map of Area of Supply.

in the area of supply for lighting and power purposes. The object of this article is not to lay claim to any particular engineering feat, but to show what high-voltage transmission at a moderate cost can do in industrial areas, which may prove of interest to similar undertakings that have a portion of their area undeveloped.

For some years the Merthyr Co. devoted their attention solely to the tramway, lighting and power business in the

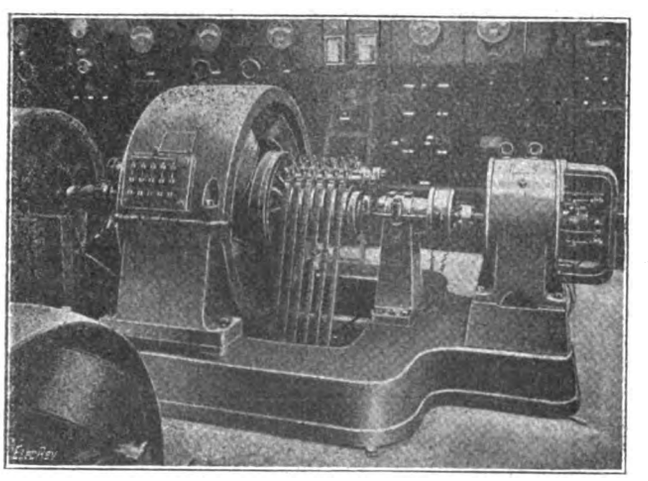

Fig. 2.—Rotary Converter Plant.

districts of Merthyr and Dowlais only; but as time went on the inhabitants of the lower districts of the borough, which are situated in a wide valley some eight miles in length, were constantly approaching the company to introduce electricity supply there also. In 1912 it was decided

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to erect an 11,000-volt three-phase transmission line between Merthyr and Treharris, and to erect transforming stations and provide a low-tension distribution system in Merthyr Vale, Aberfan, Treharris and Quaker's Yard, and subsequently to Troedyrhiw as well. A periodicity of 25 cycles was adopted to enable the company to effect a junction with the South Wales Electrical Power Distribution Co. at Trelewis, which took place in March, 1914.

A rough map of the area of supply, fig. 1, shows the principal places served and a few views will serve to show

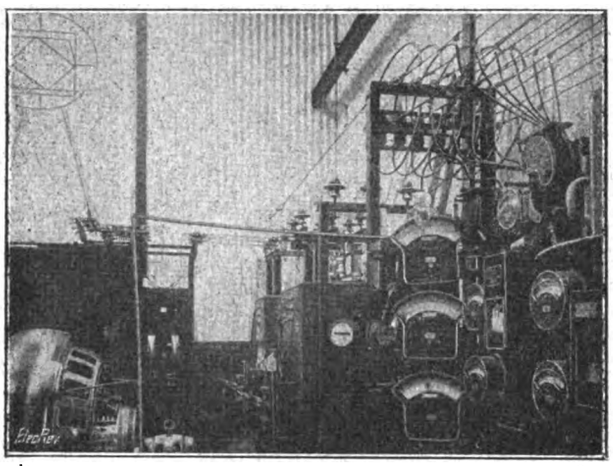

Fig. 3.—Step-up Transformers.

some of the essential features of the development. Figs. 2 and 3 show rotary converter and step-up transformer plant supplied by the British Thomson-Houston Co.

Special Plant.—The design of the rotary converter is worthy of mention, as it can be worked with excellent regulation when supplying D.C. to A.C., a direct-current booster being used to counteract the D.C. bus-bar variation, in order to keep the A.C. voltage constant. I do not believe there are many machines of its kind in the country, and the design certainly does the makers credit. The step-up trans-

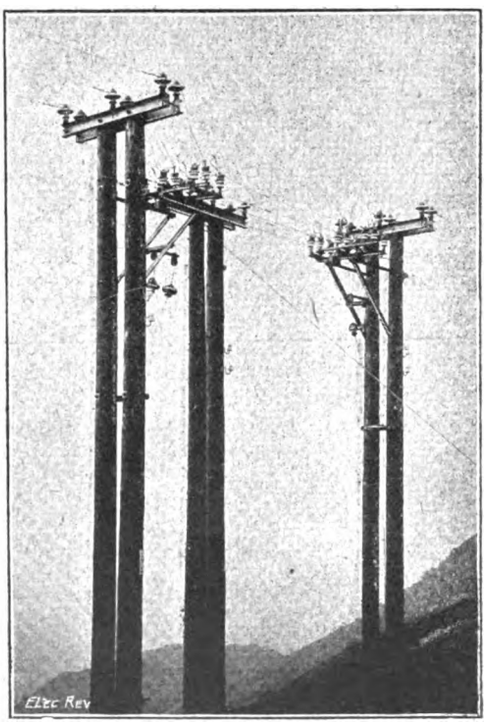

Fig. 4.—Aerial 11,000-volt Switching or Sectioning Station.

formers are three-phase, oil cooled, with half-voltage tappings on the low-tension windings for starting rotaries from the A.C. side, if required.

Transmission Line.—There is nothing very special about the transmission, except that it is probably one of the most exposed lines in the country. It had perforce, on account of wayleaves and the lie of the mountain, to be erected on the summit for two-thirds of its length (a distance of about 5 miles), and could not be in a better position for catching the full force of westerly and south-westerly winds, being at an altitude of some 1,500 ft. in places.

The exposed position of the line can be better realised by referring to figs. 4 and 5. The conductors are only ·035 sq. in.

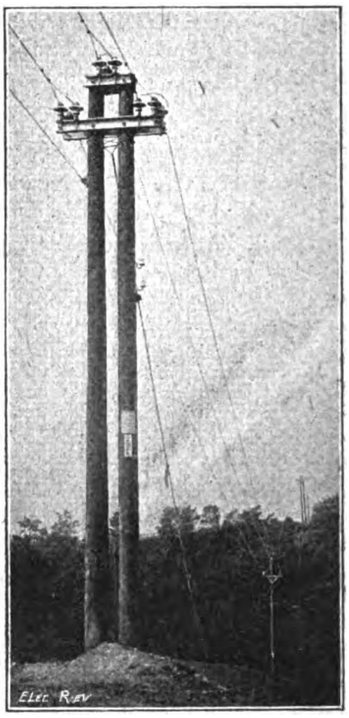

Fig 5.—Pole Line Crossing Difficult Country.

in section, but the insulation, including a piece of underground cable, is such that the line can be converted to a pressure of 22,000 volts, if necessary.

Trouble was first experienced by conductors becoming forcibly detached from the insulators, and was overcome

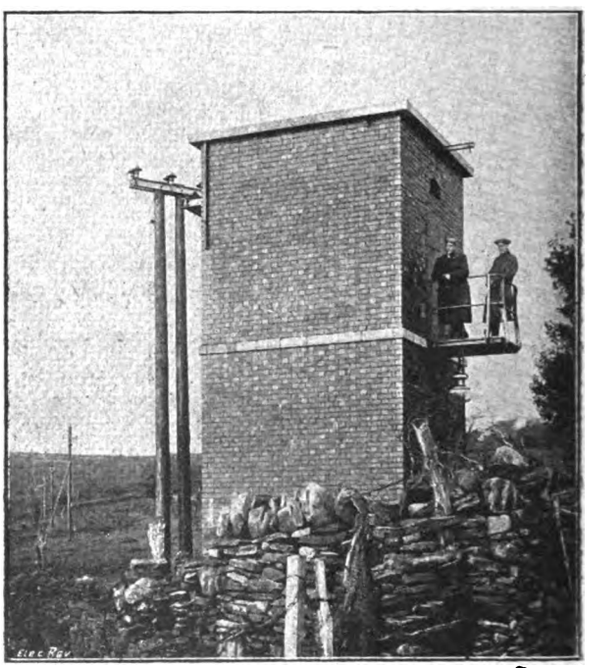

Fig. 6.—Typical Sub-station.

by using No. 8 S.W.G. check binders in addition to the ordinary chafer binders.

It is, perhaps, worthy of notice that the line was very little the worse for the hurricanes that blew on Boxing Day and January 1st last; a few poles were blown out of the perpendicular, the force of the wind being phenomenal.

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A continuous copper earth-wire runs the whole length of the line, and is grounded, by request of the Board of Trade, at every fifth pole. All ironwork, stays, &c., are bonded to this earth-wire, and, should a line fall on a cross-arm, the tripping-out is instantaneous, which has been proved from experience.

Commercially, the development has been successful. The Welsh collier likes plenty of light, and there are over 300 consumers connected to the various networks.

Sub-stations.—Fig. 6 shows the standard type of building adopted by the company, with switch-chambers and lightning arresters in the top storey.

All the high-tension switchgear is the sheet steel type made by Messrs. A. Reyrolle & Co., Ltd., which, so far, has given every satisfaction.

Transformers are provided in duplicate, and are all three-phase, oil-cooled, and made by the Brush Co.

There is every prospect of an increased demand, and it is possible that more rotary plant may be installed at Merthyr to deal with the tramway and lighting load in the main town of Merthyr. All this development work, as in the case of Dowlais, &c., was designed and carried out by the writer and staff.

In conclusion, it may be of interest to mention that the company's generating station is built on the site of the old Penydarren Iron Works, where the first steam locomotive to run on rails was made for goods traffic by Richard Trevethick some 106 years ago.

THE FRENCH ELECTRICAL INDUSTRY.

About a year ago the French Société d'Encouragement pour l'Industrie Nationale suggested that an investigation should be made into the question of the means to be adopted for competing with German industry after the war. M. Hillairet, with the authority which is associated with one of the founders of the French electrical industry, responded to the call, and showed that the French had no reason to be envious of their rivals from the standpoints of staff and workmen, execution, price and the quality and abundance of raw materials. It was also contended that the home market could be fully supplied by native firms without having recourse to other countries, and that, with some efforts, the manufacturers would be able to increase their exports, whilst customers, with some consideration, could reduce their imports almost to a negligible quantity. In this connection our contemporary, *L'Industrie Electrique*, recently endeavoured to prove how this result may be accomplished. The journal leaves out of account the question of carbons, the progress in the manufacture of which more than balances the French inferiority in porcelain; lamps, which are in process of complete transformation; and secondary and primary batteries, which only represent a small fraction of the foreign trade. As a consequence, the discussion is devoted solely to machines, apparatus and cables, which comprise 82 per cent. of the value of the total imports. The accompanying table gives the values for the four years ended with 1913:—

The French Turnover in Machinery, Apparatus and Cables.

	Imports. 1910.	*Exports.* 1910.	*Imports.* 1911.	*Exports.* 1911.
Dynamos...	£339 000	£128 000	£370 000	£186,000
Electrical apparatus ...	481.000	212 000	573,000	369 000
Armatures and parts ...	140.000	173 000	123,000	110,000
Total	£960,000	£513,000	£1,066 000	£665,000
Difference in favour of imports	£447.000		£401.000	
	1912.	**1912.**	**1913.**	**1913.**
Dynamos...	£353.000	£119,000	£362 000	£164.000
Electrical apparatus ...	677,000	423,000	740,000	583 000
Armatures and parts ...	150,000	132,000	184,000	98,000
Total	£1,180,000	£674,000	£1,286,000	£845,000
Difference in favour of imports	£506 000		£441,000	
	1910.	**1910.**	**1911.**	**1911.**
Cables and wire... ...	£9,900	£70,000	£23,000	£142,000
Difference in favour of exports	£60,100		£119 000	
	1912.	**1912.**	**1913.**	**1913.**
Cables and wire... ...	£24,000	£118,000	£66,000	£136,000
Difference in favour of exports	£94 000		£70,000	

It will be seen that notwithstanding the increase in the absolute values, the difference between the imports and exports has remained substantially constant, being an average of £448 000 for machines and apparatus, while the difference in the average for cables and wires has been £85 000. Among the causes adduced to explain why the efforts made to break through this constant difference have not succeeded is mentioned the scarcity of labour, which becomes accentuated every year. The quality of the manufactures is declared to be excellent, and, notwithstanding the higher cost of materials, it is possible to maintain competition by accepting reduced profits, but owing to the lack of labour it is impossible to produce in adequate quantities and consequently with sufficient rapidity. It is admitted that the French are invariably beaten on the question of the period required for delivery. The same reason must be attributed as the cause of the weakness of the export figures as compared with those of German industry. The importance of this cause of inferiority arises from two facts. In the first place, the progress made is much more accentuated in the case of electrical apparatus, which is manufactured above all in Paris, where skilled labour is relatively abundant, than in the case of machines, which are generally made in the provinces where labour becomes scarce. Secondly, in regard to cables and wire, in the manufacture of which labour only plays a secondary part, there is a surplus of exports, whilst for machines and apparatus, where the proportion of labour in the cost price ranges from ⅓ to ½, the imports have the advantage. Without wishing to conclude that the scarcity of labour is the sole cause which hampers the development of the industry, our contemporary affirms that it is an important factor in the situation.

If there are left out of consideration other causes of a general kind, such as banking and commercial organisation, the question arises as to what the national resources in labour will be after the war. The results hitherto achieved will probably be reduced then owing to the voids brought about through deaths and incapacity; while, on the other hand, the labour requirements throughout the country will be increased for numerous purposes. It is, therefore, necessary to consider directly the problem of how to produce as much as possible, and even more than hitherto, with the aid of fewer workmen, and at greater cost. In the course of a lecture delivered before the Société d'Encouragement, M. H. Ernault recommended the use of improved plant and the adoption of specialisation for mechanical construction; in other words, the production of standard types. What is good for the latter should also be good for the electrical engineering industry. But as soon as the electrical industry wishes to embark upon this path it is going to meet, particularly in the home market, with great difficulties and deplorable customs. Each purchaser has assumed the habit of asking for a particular machine to fulfil his special requirements, which are almost fantastic. He compels the maker to lose his proficiency and his money in undertaking perpetual investigations, to make patterns constantly, and to change his winding, which requires much time and labour, and is opposed to the use of improved machinery, rapidly producing excellent products at low prices and with a minimum of labour. Very often the maker refuses the order, and the intending customer then applies to a foreign firm, who accepts, or pretends to accept, the conditions. In the opinion of the French journal, it will be necessary to struggle with the greatest tenacity in order to bring about a change in such disastrous commercial morals.

An initial step in this direction, it is contended, should be taken by the unification of specifications for machinery, transformers and cables. Starting from three different principles—the defence of the interests of French industrialists or the interests of buyers and the scrupulous respect for scientific data—the Union des Syndicats de l'Electricité, the Association de Propriétaires des Machines à Vapeur, or the consulting engineers and the Comité Electrotechnique, have recommended conditions to be imposed upon makers. These conditions which are far from being in agreement, are a great obstacle to the creation of standard types. If, however, an appeal be made to each of these Associations, it is considered that each will be able, without abandoning its legitimate claims, to adapt them to the needs of an industry which requires aid to overcome the difficulties which threaten it, and to place it in a position to compete on equal terms in foreign markets. Circumstances more favourable for the purpose than those now obtaining will never be met with again. Everyone feels to-day the need for sacrificing his opinions as an individual in favour of the general interest—the superior interest of France. It is to this work that the journal would like to see manufacturers devote their efforts, as it would represent, our contemporary concludes, an excellent response to the patriotic wishes expressed by M. Hillairet some time ago.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Universal Test Clips.

We have received from the L.P.S. Electrical Co., of 18, Adam Street, W.C., particulars concerning their "current-carrying" Universal test clips, which we illustrate herewith. These are particularly designed for making quick temporary electrical connections when testing telephonic, telegraphic or power apparatus.

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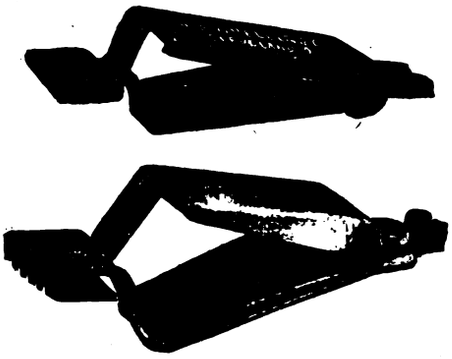
Fig. 1 shows the No. 8 size for 15 amperes; it is made in copper, with an internal spring, and the toothed jaws, having a spread of ⅛ in., are suitable for gripping either fine wire or storage-cell lugs. To attach the clip at its other extremity to the other wire, the latter is bared of insulation a little way, and the end inserted in the hole in the heel of the clip and soldered in place; the lips of the trough are then pinched over the insulation to put the strain on the latter. The heel of the clip can then be taped over.

Fig. 2 shows a 20-amp. clip, arranged for screw connection at the heel, the bared wire being secured under a washer or cleat,



Figs. 1 and 2.—Testing Clips with Soldered and Screwed Connections respectively.

and the adjacent lips being pinched over the insulation of the connecting cord. Standard 100-amp. clips are made, which will carry 200 amps. for a short period.

These clips can be supplied with rubber insulating covers to protect the user from shock and prevent short-circuiting with adjacent terminal clips. These covers are coloured red and black for distinguishing polarity, &c. Special lead-plated clips, with enamelled springs, are supplied for storage-battery charging.

The Premier Electric Suction Cleaner.

We were recently enabled, by the courtesy of the Electric Suction Cleaner Co., of 56 Victoria Street, S.W., to inspect the latest patterns of their "Premier" suction cleaner, which has been developed up to a high degree of perfection. Fig. 3 shows

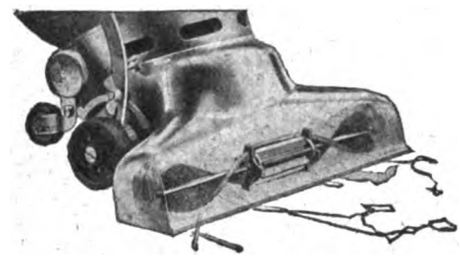


Fig. 3.—Ghost View of Premier Cleaner, showing High-speed Revolving Brush.

the ordinary or domestic type, which is operated by a vertical motor, and is provided with a revolving brush (to pick up threads and lint) in the nozzle driven at high speed by the incoming air, a roller at the rear which is adjustable to suit the nap of carpets or upholstery, a switch in the handle, an adjustable yoke, and a variety of attachments for the many purposes for which such

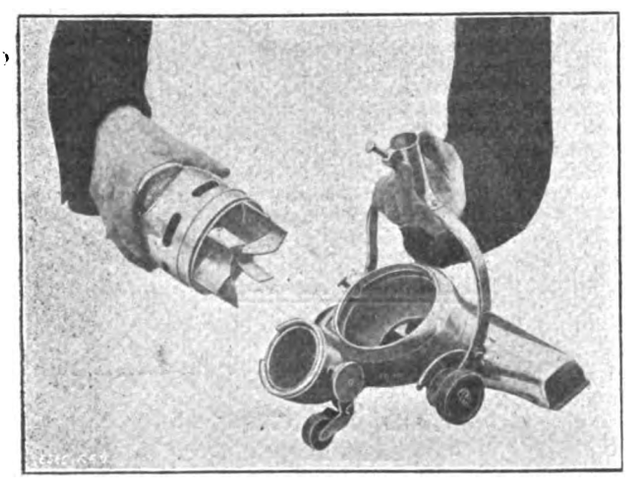


Fig. 4.—Motor and Fan removed from Head of Cleaner.

machines are suitable, either as suckers or blowers. The brush is here shown as if the nozzle were transparent, and is provided with curved blades upon which the air-current impinges. The motor, which is a beautiful piece of work, and is made for pressures up to 260 volts, D.C. or A.C., can be lifted out very easily, together with the fan, which has blades of a particular shape found by experiment to be best adapted to the purpose (fig. 4). The position of the switch in the handle, which has an insulating cap so that the user is secure from possibility of shock, is shown in fig. 5. Wherever possible, the metal parts are made of aluminium, and the convenience of the user has been carefully studied.

The pattern shown in fig. 6 is a novel development intended for industrial use; by means of a specially designed belt it can be

Fig. 5.—Switch on End of Handle.

attached to the waist of the user, leaving both hands free, so that he can use the cleaner at the top of a ladder. Alternatively he can carry it by a substantial handle. This type is particularly suitable for use in stores, warehouses, theatres, cars, &c., being extremely handy and convenient. In the main the industrial cleaner is identical with the domestic type.

The company point out that the electric suction cleaner is not a toy, nor is it an article of luxury; it has become a very necessary domestic aid, especially in these days when servants are scarce. The "Premier" is made for all voltages from 25 to 260 volts, and

Fig. 6.—Premier Industrial Cleaner in use.

all frequencies from 25 to 133. Careful tests by independent experts show that the special form of fan blades that has been developed enables the machine to give a pressure equivalent to more than 10 in. water gauge, and in the industrial type a still higher pressure is attained. The device has proved to be exceedingly effective for switchboards, and is specially useful for cleaning filter cloths in turbine stations, as well as for many other purposes.

Commercial Vehicle Inspection.—The Electric Vehicle Committee of the I.M.E.A. is providing three cash prizes in connection with the tenth annual inspection of commercial motor vehicles, organised by the Commercial Motor Users' Association, to take place in May.

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TESTING UNDERGROUND CABLES.

At the meeting of the INSTITUTION OF ELECTRICAL ENGINEERS on February 10th, Mr. O. L. RECORD, A.M.I.E.E., read a paper on the testing of underground cables with direct current by means of the Delon apparatus. The author pointed out that as there was no definite relation between insulation resistance and dielectric strength, it was necessary to measure the latter directly, and in order to provide against possible pressure rises, it was usual to make tests on cables in the course of manufacture at not less than twice the working pressure for which they were intended. It was also necessary to apply similar tests after laying the cables, and the Engineering Standards Committee specified that such tests should be made at about twice the normal voltage for a period of 30 minutes. In the case of cables for moderate pressures this presented no difficulty; usually a small transformer could be taken to the spot. But when cables for high pressures and of great length were concerned, difficulties arose. The apparent power, and therefore the dimensions of the transformer, increased as the square of the test pressure and as the capacity of the cable, and consequently the weight of the transformer became excessive. For example, the apparatus required to test 15 km. of 3-core cable at 6,000 volts after laying might weigh as much as 25 tons. In such cases the tests after laying were often not made, and the lack of certainty regarding the condition of the cable caused uneasiness. On this account it had been proposed to make the tests with continuous current at a pressure equal to the maximum reached in the case of alternating current.

It had been shown that the breakdown voltage for a dielectric under alternating pressure was a function of the time of application, and of the frequency employed, tending to decrease as the time was prolonged or the frequency increased; and for a given cable this reduction of dielectric strength by the application of a high-pressure test was permanent. Consequently, manufacturers were strongly opposed to the application of an A.C. test higher than the working pressure being repeated on cables for which they had undertaken the guarantee, and this had the unfortunate result that supply engineers were prevented from employing this method of ascertaining the condition of their mains from time to time; hence another method of testing was desirable.

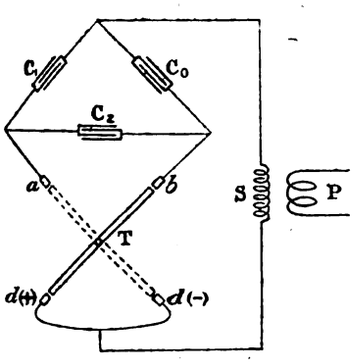

FIG. 1.—PRINCIPLE OF THE DELON APPARATUS.

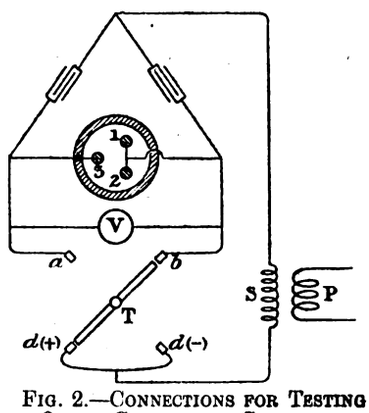

FIG. 2.—CONNECTIONS FOR TESTING A 3-CORE CABLE WITH CONDENSERS.

Testing by continuous current had the advantage that, once the cable was charged, no more energy was expended, no matter what the capacity of the cable, provided that the insulation was good; therefore tests after laying could be carried out with apparatus of small power. Moreover, observation had shown that such tests did not fatigue the dielectric, and the period of application had no effect on the breakdown voltage. Hence, with continuous current supply authorities could repeat their tests as often as desired without objection on the part of the cable manufacturers, and at the same time they could determine the insulation resistance of all the feeders.

The Delon apparatus worked on a principle described by the author as follows:—

The essence of the apparatus is a high-tension contact-maker which charges condensers by making at each half period a connection through a short spark between the transformer and condenser to be charged. By means of a suitable arrangement the contact is made at the moment when the electromotive force is at its maximum value, and, by means of auxiliary condensers, the voltage of one half-period is added to that of the other, with the result that finally the principal condenser is charged to a pressure double the maximum of the alternating current employed.

As shown diagrammatically in fig. 1, the contact-maker formed by a conductor, T, embedded in an ebonite disk, revolves round a spindle perpendicular to the plane of the disk. Four fixed brushes are placed a very short distance from the disk in such a manner as almost to make contact with the conductor when the latter passes between them. These four brushes are placed at the extremities of two diameters which are perpendicular to the axis of the disk. Two of the adjacent brushes *d* are joined together and connected to one of the secondary terminals of the transformer. The other two brushes, *a* and *b*, are connected each to an apex of the triangular group of condensers to be charged, the other apex being joined to the second terminal of the transformer S.

The disk is driven by means of a synchronous motor fed from the alternating-current circuit which furnishes the high-tension current by means of the transformer. The group of fixed brushes can be placed at a convenient angle to allow of their coming opposite the moving conductor at the moment of maximum voltage; the condenser C_2 to be charged, and the two auxiliaries C_0 and C_1 form a triangle.

At the outset, the synchronous motor being started, if the primary circuit of the transformer is closed the moving conductor T passes, say, first of all between the pair of fixed brushes *b* and *d* (+). The condenser C takes a charge which depends on the self-induction of the transformer and the maximum voltage of the secondary current. The other two condensers C_1 and C_2 take a charge such that the sum of their potentials U_1 and U_2 is equal to the potential, U_0 of the condenser C_0.

At the following half-period it is the condenser C_1 which is directly connected to the secondary, and as the direction of the current is changed this condenser is charged in the same direction as in the previous case. The condenser C, on the contrary, receives a charge in the opposite direction to the first. As a result the condenser C_2, which is the one that it is desired to charge up to a high potential, receives charges which are always in the same direction, whatever the position of the moving conductor. The quantity of electricity supplied at each contact will then charge simultaneously one of the two auxiliary condensers in parallel with the group formed by the secondary auxiliary condenser and the condenser C_2. As the time during which contact is established between the transformer and the condensers is very short, and as, moreover, the self-induction of the secondary of the transformer is considerable, the quantity of electricity that can be introduced into the system at each half period is limited, but the repetition of the phenomenon is so rapid that at the end of a relatively short time the condenser C reaches a potential equal to twice the maximum pressure of the alternating current. In practice the charging-up is effected in less than a minute at a frequency of 50, that is, in less than 6,000 contacts.

The word "contact" signifies the passage of the conductor past the fixed brushes and not actual contact, the closing of the circuit being always produced by means of a spark, very short and of low resistance. With such a system it is possible to reach continuous charges as high as desired by using transformers of only comparatively small power.

The author then went on to state that the whole of the apparatus could be carried on a handcart, the total weight being about half a ton, so that two men could easily wheel it. The cart contained a small switchboard, a synchronous motor and contact-maker, the auxiliary condensers and the transformer. The conductor T (fig. 1) was completely embedded in an ebonite disk except at the ends, and the four contacts were mounted on an ebonite carrier which could be rotated to give the brushes the correct position. The transformer was wound for 110 and 220 volts on the primary side, and gave 15,000 or 30,000 volts on the secondary side. Hence it could be used for a continuous pressure of $2 \times 30{,}000 \times 1.4 = 84{,}000$ volts, and by increasing the primary voltage a test pressure of 100,000 volts could be attained. Apparatus for 150,000 volts could be made portable, but for higher pressures the sparking distances became too great to be dealt with on a handcart. The transformer need not be larger than 3 KW. The electrostatic voltmeter should not be carried on the cart.

Fig. 2 shows the connections for testing a 3-core cable, which takes the place of the condenser C_2. One of the conductors is connected to the lead and then to one of the fixed brushes, and the other two conductors are joined together and connected to the second brush. The two condensers are joined together and their common point is connected to one of the secondary terminals of the transformer. As will be seen, the test is made between conductors 1 and 2, and conductor 3 and the lead. In order to complete the test it is therefore necessary to make a second test, joining conductors 1 and 2 to the lead and the other two conductors to the fixed brush *b*. In actual practice the auxiliary condensers are usually dispensed with, the cable itself providing the capacity.

Fig. 3 shows the connections for a 2-core cable. In this case one of the conductors of the cable is subjected to a pressure always of the same sign and equal to the maximum positive value of the alternating electromotive force, viz., $+ E\sqrt{2}$ and the other to a pressure equal to the maximum negative value, viz., $- E\sqrt{2}$ so that there is at any instant between the two conductors under test a difference of potential equal to double the maximum voltage, viz., $2E\sqrt{2}$.

The same test can similarly be applied between either conductor and the lead, and cables with three or four conductors can be tested as shown in fig. 4, where the maximum pressure is established between cores 1 and 2, and the lead.

In the case of single-conductor cables, which are usually used for low pressures, a test pressure up to 100,000 volts can

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be applied by connecting the core to one brush only and leaving the other idle.

For measuring the pressure, the author recommended the Abraham-Villard electrostatic voltmeter as a really practical apparatus, easy to set up and to pack in a case.

As a continuous current test does not fatigue the dielectric, the question arises whether the continuous pressure and the A.C. pressure are equivalent in effectiveness. The author quoted experimental observations showing that a continuous pressure only produced the same breaking-down effect as an alternating pressure of one-third to one-fourth its value. It had been proved possible to reduce the resistance of a fault by the Delon test sufficiently to enable its position to be ascertained by the ordinary methods. The system had been definitely adopted by several important electric supply undertakings on the Continent, and the tests could be applied at frequent intervals without harm to the cable. Tests made

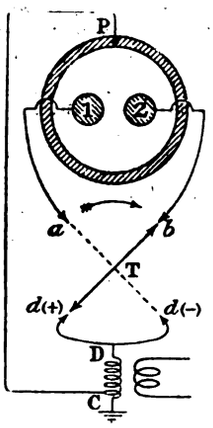

Fig. 3.—Connections for Testing a 2-core Cable.

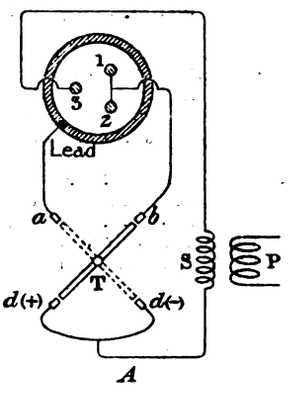

Fig. 4.—Connections for Testing a 3-core Cable.

with the oscillograph showed that the pressure variation was less than 8 volts in 30,000, so that the pressure was much more constant than that of a dynamo.

If the cable makers and supply authorities could agree as to the proper test pressures to be adopted, all objections to the use of the method would disappear.

In an appendix the author gave particulars of German experiments on the system, which showed a ratio of effectiveness in producing breakdown of about 1 to 2.6, compared with alternating current. A portable plant rated at 10 K.V.A. was provided with a 500-volt 50-cycle supply for the primary of the transformer by a petrol-driven alternator of 9 KW.; the apparatus was carried on two wagons, weighing in all 8 tons, and could test as much as 50 km. of cable to 150,000 volts.

Discussion.

The discussion was opened by Mr. Welbourn, who felt that some mention should have been made of the work carried out in direct-current testing by others. There was nothing new in using direct-current machines for testing networks, it was common practice 15 years ago, but fell into disuse with the growth of alternating networks for various reasons, one being the flimsy character of the D.C. high-voltage machines which were available. It had, however, been a matter of considerable thought whether there should be a reversion to direct-current testing, which was quite practicable in view of the high voltage D.C. machines now available. Transformer equipment for testing completed A.C. installations was a serious item and would be more so with the 33,000 and, possibly, 50,000-volt cables which were coming, so that some suitable alternative method, such as suggested, was wanted. But it was necessary to satisfy the user that the method was a practicable one; the 14 minutes mentioned to burn out a fault might not be practicable, but he believed that the static discharge through a puncture would give the cleanest burn-out possible. As to the nature of the current produced by the apparatus, he would have been glad to see some oscillograph records. The curve showing the relation between A.C. breakdown voltage and duration of test was exactly similar to one published in Sir John Snell's book, and prepared 10 years ago from tests on the first 20,000-volt cable made in this country. He was uncertain whether the author's remarks on dielectric fatigue would hold good with modern cables.

Mr. A. P. Trotter suggested that more consideration should be given to the period of time in testing, as it was open to doubt whether half-an-hour was really necessary.

Mr. F. C. Raphael said that the paper by Mr. Evershed and discussion on a similar subject contained much information as to what actually occurred in the cable. The strain resulting from direct current must be entirely different from that with alternating current, and they must still have the factory test; further, some kinds of fault would probably not be broken down with the direct-current method.

Mr. Watson referred to some experiments carried out by himself with a view to testing a large cable at 150,000 volts with an influence machine, built on practical engineering lines. Unfortunately, the result was not entirely successful; the machine was run in compressed air for dielectric reasons, and was built to give ½ KW. at 150,000 volts. It had 30 revolving plates 12½ in. dia., and metal sectors of sheet brass, while the stator consisted of steel plates built up into units mounted on ebonite insulators—all glass being done away with. The machine was separately excited by an exciter through which the output of the main machine was controlled. In the end the machine broke down by the general disintegration of the ebonite, and he thought they had possibly neglected precautions which were not found necessary with a small machine.

Mr. Warren said some simple means of varying and controlling test pressure were, he supposed, included with the Delon apparatus. The single-core cable testing arrangement should receive every attention as far higher pressures would be used with single than multi-core cables. The use of the apparatus seemed complicated, because the actual D.C. pressure was a variable; and the small power available for localising faults was not very convincing, but the apparatus certainly got over the transformer difficulty.

Mr. H. M. Sayers said the author had left out one of the greatest advantages of D.C. testing, *i.e.*, it was possible to measure the actual dielectric resistance of the cable. This was of direct interest to the man in charge of the cable network, as it gave him an indication of coming trouble before the cable broke down. The usefulness of the cable sheath was proved by experience with lead-sheathed single-phase cables; the earthed outer gave an indication of coming faults. In testing he had often found it advantageous to run the engine of the testing set slower and reduce the frequency, thus reducing the size of transformer plant required.

Mr. Rosling said the Delon apparatus was a reasonable proposition from the cable maker's point of view, and it would indicate moisture in cables being laid better than A.C. testing. Installed cables were tested for the joints, and long lengths could be cut into sections, the final joints being made under the personal supervision of the engineer, which was the best method of ensuring a sound joint.

The President felt that the paper rather reflected on British cable makers. Cables underwent an A.C. test during manufacture, but after laying it was only a question of testing joints. Up to now there had been no great difficulty in testing with transformers, but when they began to use 30,000-volt cables, the Delon apparatus became of interest—for testing joints, not cables. There was no continual pressure testing under present conditions, as implied in the paper; only rarely were there accidents involving such testing.

The Author, in replying, pointed out that the title of the paper might have misled them; it was not intended as a treatise, and only referred to higher pressure cables than now in use; also, it was intended to describe a particular apparatus. He quite agreed with A.C. testing in the factory, but it must be noted that with pressures of 30,000 or 40,000 volts there would not be the same margin of safety, and greater precautions would be necessary subsequently. He thought Mr. Evershed's paper only dealt with the first part of the curve showing relation of pressure to time of test, but breakdowns occurred in the second part. The Delon apparatus was provided with suitable resistance on the L.P. side of the transformer to vary the test pressure.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Salaries in Power Stations.

The Electrical Review for January 21st has just come to hand (after its journey of nearly 3,000 miles), and I note that Mr. Ebben, the energetic hon. secretary of the A.E.S.E., has replied to my letter and taken up the subject of power-station salaries. I am afraid he has not taken the spirit of my letter in quite the right way, for I have no personal grievance at present, and the letter was written in an honest endeavour to draw attention to what is really a most important matter. I have been in a position to appreciate Mr. Ebben's good work for the benefit of station engineers, having taken an interest in the Association since its inception in January, 1913, and also having proposed or seconded for election several of its present members.

In my letter, kindly published in the Review under date of January 7th, I endeavoured to point out the unsatisfactory, and even dangerous, state of affairs existing in many power stations owing to shortage of staff, and also to put underpaid charge engineers and technical assistants on their guard in the event of central stations becoming "controlled establishments," as I have very good reason to believe that certain managers have left no stone unturned to secure the protection of the Ministry of Munitions in their self-made plight.

The Ministry of Munitions may intervene, and, being a Government department, their knowledge of electrical station matters will probably be on a par with that of other Government departments; and as the managers will not enlighten them, for obvious reasons, the position of technical assistants

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may be worse than in the *ante bellum* period, for they will be treated as mere operatives in a controlled establishment.

I fully agree with Mr. Ebben when he says that station engineers must follow the lead of their managers and build up a strong association themselves, instead of waiting on the I.E.E., the B.O.T., or the Home Office; but, unfortunately, of late very little interest has been evinced in the subject, and one can only conclude that if the present apathy continues the end of the war will find station men in a very backward position with regard to their own interests. Owing to shortage of staff and the craze for cheap labour, young women are being successfully employed in power stations, and it is interesting to note that for at least seven months now an important municipal power house of some 23,000-kw. plant capacity has employed on all three shifts female switchboard attendants. Who knows but that we may see in the *post bellum* period managers advertising in the Review for charge engineers, married men preferred, wife to act as switchboard attendant, combined salary 35s. per week of seven 8-hour shifts!

If station engineers could look ahead they would see the futility of a "wait and see" policy, even during the present European crisis, for undoubtedly this is no time for any man worthy of the name to remain an inert mass. If central station men are not required in H.M. Forces, their energies should be directed towards improving their status and conditions of employment by the honourable means at their command, and in this connection I am glad to note that the official policy of the A.E.S.E. is still against that detestable weapon of Labour—strikes.

Undoubtedly the Association has a future before it, particularly if it tackles the question of competency of engineers, for I am convinced that at present the chaotic state of the profession is largely due to there being no standard of training required, and rather than "kick against the pricks" it would be to the advantage of chief engineers to encourage the pioneer work of the A.E.S.E.

Chief Assistant.

Malta, *February 3rd*, 1916.

WAR ITEMS.

Copperless Machines in Germany.—About two or three months ago we referred to the Government notice issued in Germany imposing upon electrical firms the obligation to make a return of the dynamos, motors, transformers, apparatus, etc., in stock, and in which copper was used, so that the military authorities might requisition these machines, etc., as occasion might arise. In this connection a further notice of a remarkable kind has now been published. It states that the electrical firms have been constructing transformers having zinc windings for some time past, and that they are now engaged on the production of generators and motors with windings made entirely or partly of zinc and commutators of steel, for which principles have already been settled by the Union of Electrical Engineers. As doubts have arisen as to whether electrical machinery and transformers in which no copper is used come within the scope of the notice regarding the obligatory return previously mentioned, the second notice announces that this is not the case. But in those instances where copper is partly employed in the construction of machines, transformers, and apparatus the original obligation holds good. At the same time, it is stated that the voluntary notification of machines possessing no copper is admissible.

Licences for Export.—The Director of the War Trade Department calls attention to the fact that where a licence is granted for the export of prohibited or restricted goods the licence does not relieve the owner of the goods, or the consignor or other person to whom the licence is granted, from any responsibility to which he may be liable for any breach of law or regulations. It is therefore incumbent on persons before applying for licences or exporting goods to take all reasonable steps to satisfy themselves that the ultimate destination and intended use of the goods are unobjectionable. Failure to do so may involve serious consequences.

Trading with the Enemy.—The Board of Trade has appointed Mr. E. R. Moon, C.B., K.C. (chairman), the Hon. J. D. FitzGerald, K.C., Sir G. Croydon Marks, M.P., and Mr. Gershom Stewart, M.P., to be a committee to advise it on matters arising under the Trading with the Enemy Amendment Act, 1916. Mr. W. P. Bowyer is secretary to the committee, and all communications should be addressed to the Board of Trade, 38-39, Parliament Street, S.W.

Australian Preference.—It is announced that the New South Wales Government has recently had under consideration the question of preference to British manufacturers, and has decided that in the purchase of supplies for the public service of New South Wales a 10 per cent. preference shall be extended to local British or Empire manufacturers as against those of other countries.

Prohibited Exports.—The exportation of carbon electrodes for electric furnaces has been prohibited by an Order in Council.

Munitions Manufacture in Italy.—La Società Partenopea per Industrie Metallurgichi ed Elettriche is the name of a new undertaking which has lately been formed in Naples with a capital of £40,000, mainly to engage in the manufacture of war munitions.

Station Men with the Forces.—The Lowestoft T.C. reports 20 electricity works employés on active service. One, Mr. W. Smith, has fallen in action in Flanders, while 18 have received war badges.

Controlled Works.—The number of establishments controlled by the Minister of Munitions on February 10th was 2,834.

THE HIRSCH PORTABLE ELECTRIC LAMPS.

On February 12th, Mr. Hiram H. Hirsch read a paper before the N. of E. Institute of Mining and Mechanical Engineers, describing the Hirsch lamps, which, though largely used in the United States of America, have not yet been adopted in Great Britain. The lamps have been designed for use by watchmen, and in mines, and other places where special precautions become necessary on account of the presence of explosive materials or gases. They are operated by a storage battery contained within a casing.

The hand-lamp is provided with a storage battery placed on an asbestos cushion, in a cast aluminium casing with a hinged top. The top piece is also of cast aluminium, and is provided with a hook, a reflector, and terminals for making contact with both poles of the battery. The reflector unit consists of concentric safety shells, an incandescent lamp, a safety glass, a crystal, and a switch.

The battery consists of two horizontal lead plates, each about an inch thick, placed in the bottom of an ebonite jar, and separated by wood and perforated ebonite, the bottom plate being positive. The positive and negative leads extending from the battery-plates are enclosed in glass tubing. The solidified electrolyte consists of a gelatinous substance developed by the manufacturers. The battery is provided with a vent-plug, and the top of the battery is sealed with an insulating compound. The terminals consist of antimonious lead.

A magnetic spring lock is housed in the bottom casing, and a rubber cushion is placed in the bottom.

The reflector is constructed with three concentric shells, the intermediate shell being insulated from the other two and connected to the negative pole, and the other two shells to the positive pole of the battery. The distance between these shells varies at different points from $\frac{3}{32}$ to $\frac{1}{4}$ in. The shells are so arranged that if the reflector should be crushed or punctured, the current to the lamp would be cut off by the shells being short-circuited between the battery and the lamp before the lamp-bulb could be broken.

The incandescent lamp used is of the 2-volt 0·55-ampere tungsten-filament type. The safety glass consists of a piece of window glass $2\frac{1}{16}$ in. long, 1 in. wide, and about 0·05 in. thick, supported across the reflector shell behind the crystal.

The miner's lamp consists of a storage battery placed in a cast-aluminium box designed for mounting on the miner's belt. The box is supplied with a handle, and contains the necessary contact springs for making contact with the battery terminals. Through the upper part of the box an armoured flexible cord extends, the other end of which is fastened to the head-piece. This head-piece is similar in construction to the reflector of the watchman's lamp, and consists of an incandescent lamp, a reflector, safety shells, a safety glass, a crystal, and a switch. The battery is of the same construction as that of the watchman's lamp.

The weight of the lamp complete is $3\frac{1}{4}$ lb., and of the battery only $1\frac{3}{4}$ lb.

It is claimed that the storage-batteries are easily and quickly handled in charging, easy to take apart and repair when necessary, and quickly accessible. The sediment that tends to loosen from the positive plate still remains part of the plate. Jarring or upsetting the battery will not affect the plates as in batteries having thin vertical plates. Short-circuiting the battery will not injure the plates. The battery will not upon short-circuit arc sufficiently to ignite gas, black powder, &c. Immediately on short-circuit the voltage drops to zero, on account of the peculiar characteristics of the battery plates.

The solidified electrolyte always remains in contact with the plates, whether upside down or not, and when in any position will not ruin a man's clothes by the spilling of acid. The batteries will give an average light of 5 c.p. for 12 hours or more on each charge.

If the crystal and safety-glass should get broken in an explosive atmosphere, the lamp is extinguished by the safety-glass opening the circuit at the switch and thereby eliminating the risk of igniting anything explosive on account of breakage of the lamp-bulb. The lamp becomes extinguished before the bulb breaks.

The arrangement of the three shells in the reflector or headpiece will prevent any danger from the bulb igniting anything explosive if the shells should be crushed or punctured, as the shells short-circuit the lamp and the light is extinguished before the bulb is broken.

Board of Trade Inquiries.—The Board of Trade Commercial Intelligence Branch has received applications from firms in this country for makers of 2 to 30-H.P. electric motors (various voltages, D.C. and A.C.) to drive ventilating fans.

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LEGAL.

Electric Generator Co. v. Jackson.

On February 10th, in the West London County Court, before his Honour Sir W. Lucius Selfe, plaintiffs, electrical contractors, of Shepherd's Bush Road, W., sued defendant, an electrical engineer, of Fulham Road, S.W., for £17 15s., the price of an electric motor and starter which the defendant had hired and had retained.

After hearing the evidence, his Honour said that, allowing defendant credit for half of the first quarter's hire, he would give judgment for the plaintiffs for £10 3s. and costs, payable in two monthly instalments.

Herbert Morris, Ltd., v. Saxelby.

As briefly mentioned last week, the House of Lords, on Feb. 8th, gave their considered judgment in the appeal by Messrs. Herbert Morris, Ltd., against an order of the Court of Appeal affirming a judgment of Mr. Justice Sargant in favour of the respondent, Mr. Fred. Albert Saxelby. The arguments were concluded on November 29th last. Their Lordships decided that the decision appealed from was right, and dismissed the appeal with costs.

Lord Atkinson, in the course of his judgment, said that the action out of which the appeal arose was brought to restrain the respondent (1) from being concerned in the sale or manufacture of pulley blocks, hand overhead runaways, electric overhead runaways, hand overhead travelling cranes, or any part thereof, and (2) from divulging or using confidential information acquired by him whilst in their employ. In all these cases one had to ask oneself what were the interests of the employer that were to be protected, and against what was he entitled to have them protected? He was undoubtedly entitled to have his interests in his trade secrets protected, such as secret process of manufacture, which might be of vast value; and that protection might be secured by restraining the employé from divulging these secrets or putting them to his own use. He was also entitled not to have his old customers by solicitation or such other means enticed away from him; but freedom from all competition *per se* apart from both these things, however lucrative it might be to him, he was not entitled to be protected against. He must be prepared to encounter that even at the hands of a former employé.

Turning to the facts to ascertain what in fact it was that the appellants here sought protection against, his Lordship mentioned that the plaintiffs were very successful manufacturers of the particular class of machinery he had referred to. They had specialised in it—standardising many parts common to different types of machinery. Though they made some other machinery, this kind constituted three-fourths of their output. In this manufacture they appeared to be the premier firm in England. Their business was very extensive. They had branch offices at London, Manchester, Birmingham, Leeds, Sheffield, Newcastle, Cardiff and Glasgow. They had a traveller in Ireland but no office. Their regular and apparently principal customers, as appeared from the evidence of their managing director, Mr. H. Morris, were the Admiralty, the War Office, the Government Ordnance Factory, numerous foreign and Colonial Governments, railway companies both at home and abroad, and more recently the Aircraft Department and the torpedo factories. No other customers were named. There was nothing to show that Mr. Saxelby ever came into personal relations with any of the officers of these departments or undertakings, or that through his acquaintance or personal influence with any of them he might be able to divert their custom away from the plaintiffs to another firm. In his opinion there was no danger whatever of anything of that kind, and the question of enticing away of customers might be put aside. The appellants, moreover, had thoroughly organised their business, both on the manufacturing and commercial side of it. They had got up and arranged in an elaborate, careful and systematic manner, a large number of charts and drawings called L sheets, comprising tables and indicating the composition and dimensions suitable for particular jobs. Mr. Justice Sargant found that the information there contained was so detailed and minute that it would be impossible for any employé to carry it away in his head. It was claimed, however, by the appellants, that this organisation and general method of business were trade secrets which the defendant was not entitled to divulge to another, or to use his knowledge of them in the service of any persons other than themselves; but he could not get rid of the impressions left upon his mind by his experience on the plaintiffs' works. They were part of himself, and in his Lordship's view he violated no obligation arising from the relation in which he stood to the appellants by using in the service of some person other than they, the knowledge he had acquired of their scheme of organisation and methods of business. Up to the time that the respondent left the service of the appellants in 1913, his whole engineering training was connected with the manufacture of these four special machines. He said he had tried to get employment as a general engineer and had failed, and he was therefore obliged, being unable to live in France, to take service with one of the appellants' rivals.

His Lordship agreed with the view of the Court of Appeal that although the agreement might be of some advantage to the plaintiffs as restraining competition, yet it was not reasonable when viewed from the point of view of the defendant or of the public in general. It was not reasonable to require the defendant to put aside all the skill and experience that he had acquired during the period that he had been in the plaintiffs' employment and to begin life afresh. Accordingly the appeal must be dismissed with costs.

Lord Shaw's judgment, which was read in his absence by Lord Atkinson, was to the same effect. He said that Mr. Morris, the managing director of the plaintiff company, very candidly admitted that the real object of the plaintiff company in imposing the restraint was to preclude competition on behalf of the defendant after he had left the company's employment. The company objected, he said, to skill and knowledge acquired in its service being put to the disposal of any trade rival, and the skill and knowledge he referred to was the general skill and knowledge which an employé of any ability must necessarily obtain as opposed to knowledge of any matter and skill in any process in which the company could be said to have any property at all. He was clearly of opinion that the restraint was in no way required for the plaintiffs' protection, and was therefore unreasonable and bad in law.

Lord Parker of Waddington, in concurring, pointed out that it had been laid down that all restraints on trade of themselves, if there was nothing more, were contrary to public policy, and therefore void. It was not that such restraints must of themselves necessarily operate to the public injury, but that it was against the policy of common law to enforce them, except in cases where there were special circumstances to justify them. The test, he thought, was this: that for the restraint to be reasonable in the interest of the parties it must afford no more than adequate protection to the party in whose favour it was imposed. He agreed that the appeal failed.

In this judgment Lord Sumner expressed his entire concurrence. The appeal was accordingly dismissed, with costs.

Munitions Court Cases.

At the Edinburgh Munitions Tribunal, William Cowie, employed in driving an electric crane for Messrs. Redpath, Brown & Co., Albion Road Steel Works, applied for a clearance certificate on the ground that the work he was engaged on was dangerous. A representative of the firm stated it was an overhead electric crane that Cowie was engaged on and it was a perfectly simple job. The Tribunal refused to grant the certificate, the Chairman advising Cowie to give the work a fair trial.

In a case before the Oldham Tribunal, a labourer employed by a firm of electrical engineers applied for a leaving certificate on the ground that his wages were too small and he had another job offered him. He received 23s. for working 53 hours, and had a wife and children. He now had 30s. offered to do other work in a mill. The firm said the man's average wages during the past four weeks had been £1 8s. 3d. The application was refused, the President holding that the man was fully employed on munitions.

Before Sir Robert Wallace, K.C., sitting at the London and S.E. Division General Munitions Tribunal, a well-known firm of electrical instrument manufacturers were the complainants, and a firm of builders and contractors were the respondents. The Chairman said that the plaintiffs' workmen were clearly engaged in war work, that a number of them left without the consent of their employers, that they had not obtained from the legal tribunal a certificate of discharge, and that they had all been taken into the employment of the respondents. An offence had been committed. The Chairman said that, having heard all the witnesses called by the respondents and the men, they did not want to hear any evidence on behalf of the complainants. In regard to four of the men, the offences against the Act were deliberate and not done in ignorance, for it had been admitted by respondents' manager that when the first man applied for work questions were asked, and the manager was informed that no leaving certificates had been obtained, also that the men had been engaged on war work. A former employé of the complainants was the medium through whom the men were engaged. The Chairman described it as a very bad case indeed, and fined the respondents £15 in each case, and granted 10 guineas costs.

Re Bryant Trading Syndicate, Ltd.

A curious story was told to Mr. Justice Neville in the Companies' (Winding Up) Court, on Tuesday, February 15th, when Mr. Wm. East, a retired brewer living at Wimbledon, applied under Sec. 32 of the Companies' Act, to have his name removed from the register of shareholders in the Bryant Trading Syndicate, Ltd.

Mr. Preston (for the applicant) said the Bryant Trading Syndicate, Ltd., was now in liquidation, and it was alleged that his client was the holder of 50 £ shares, with only £1 paid. Under these circumstances, he made this application, and his case was that the company had no business, and never had any business, to put his name on the register. Mr. East was apparently interested in electric lamps, and in 1908 he heard from a friend that this company was producing a very good lamp. On that account he went with his friend to see it. Apparently there were none for him to see. But he paid £1 for lamps to be sent to his residence that he might test them. He was invited to take shares in the company, and was, indeed, induced to sign an application for 50 shares. But Mr. East stipulated that this application was not to be used until he had tested the lamps. In fact, no lamps were ever sent to him, although he wrote to the company two or three times. Upon that he dismissed the matter from his mind. No notice of allotment was ever sent to him, and until the company went into liquidation, and this demand was made upon him, he only received one communication from the company. That was about four years ago, and as it seemed to indicate that he was being treated as a shareholder, he wrote to the company saying that he was no such thing, and the communication must have been sent to him in error. Apparently there was a resolu-

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tion on April 9th, 1908, allotting the 50 shares. He submitted (1) that Mr. East's application was subject to a condition that had never been satisfied; (2) that even if there had been an unconditional application, the company never communicated the fact of the allotment to Mr. East.

Mr. Walter East went into the witness box to be cross-examined by Mr. Hewitt, K.C., for the liquidator of the company upon the affidavit he had made. He said that when he went to the office of the Bryant Trading Co. in April, 1908, he did not intend to subscribe for shares. But the managing director, Mr. Metcalfe, whose "Geese were all Swans," asked him to take up 500 shares and "practically compelled him" to apply for 50. He said he would not touch them unless the test was satisfactory. But Mr. Metcalfe said the shares were going so fast that he could not guarantee that they would be allotted if the application were deferred, and he made a conditional application accordingly. After the non-delivery of the lamps he did nothing to secure the repayment of his sovereign.

Mr. W. F. Moore, secretary and sales manager of the company from 1908 until 1911, said that he remembered the shares being allotted to Mr. East, but could not remember the notice of allotment being sent out in this particular case. He had no doubt the notice of allotment was sent out.

Mr. James, secretary of the company from 1911 to 1915, said that he first sent out notices to shareholders who had not paid for their shares in full in 1911. About two a year would be sent out afterwards asking for the unpaid balance on the shares. He could not remember any shareholder writing back to deny his liability.

Mr. Hewitt submitted that the memory of Mr. East was not to be relied upon, and that there was ample evidence to show that he had, or should have had, the presence of his name on the register of shareholders brought home to him.

His Lordship, in giving judgment, said this was rather a curious case, which had arisen owing to a peculiarity in the management of a company which he had never come across before, and which he should recommend other companies not to follow, i.e., the company never made any calls on their shares, but occasionally applied to shareholders for something on account of the value of the shares they had taken. Of course they had no right in any of these cases to demand anything from the shareholders, because the liability of shareholders was dependent on the making of calls in the first instance. The question turned on an interview of April 8th, 1908. With regard to that he was not satisfied that Mr. East's application was conditional upon a test of the lamps. Moreover, he had, if he had chosen to read it, received notice over and over again, that he was on the register of shareholders in the company. He was sorry for Mr. East, but saw no reason to rectify the register. The summons would be dismissed, but without costs, because the trouble had been caused by the way in which the company had acted in making no calls, but merely writing round for subscriptions.

Electrical Controller Fingers.

An action by Messrs. Allen West & Co., Ltd., of Lewes Road, Brighton, against the British Westinghouse Electric and Manufacturing Co., Ltd., of Norfolk Street, Strand, claiming an injunction for alleged infringement of a registered design was heard by Mr. Justice Astbury in the Chancery Division on Thursday, February 10th. Plaintiffs said they were the registered proprietors of the copyright in a design of controller fingers for electrical machinery, and the defendants had without their licence or written consent infringed the copyright, and as an instance of the infringement the plaintiffs referred to the supplying by the defendants to the Admiralty of controller fingers for use on machinery installed in a boiler shop in Portsmouth Dockyard in the latter part of 1914 or the beginning of 1915. Defendants denied the alleged infringement, and said the design was invalid, and it was not new or original at the date of registration. They pleaded prior publication and prior general common knowledge. They said the design had been published in this country prior to the plaintiffs' registration by the publication of a drawing by Robert Friedrich Baerlocker, of the Westinghouse Works, Trafford Park, defendants' engineer, in 1909, and by the publication of the drawing by the defendants to their workmen in the ordinary course of their trading between March, 1909, and March, 1910. Defendants also said the design of the plaintiffs had been anticipated by the manufacture and sale by the defendants to the Cargo Fleet Iron Co., Middlesbrough, in 1910, of 17 controllers with controller fingers. Defendants had a motion to expunge the plaintiffs' design from the register of designs.

Mr. Colefax, K.C., and Mr. C. Terrell appeared for the plaintiffs, and Mr. Walter, K.C., and Mr. J. H. Gray for the defendants.

His Lordship gave judgment, and said the encouragement given by the patent laws to new conditions and original designs was primarily to advance our industries and to keep them at a high level, but in administering the provisions of the laws, it was most important to bear in mind that they were not intended, and should not be allowed, to paralyse or impede the natural growth and development of manufactures which they were intended to benefit. He thought that the present case rested upon the question whether the difference in the registered design of the right-angled support finger was or was not sufficient to make it an original design within the meaning of the Act, or whether, on the contrary, it was not an ordinary and natural alteration of the shape of a known article for the purpose of fitting it into a case or apparatus in which it was desired that it should work. He thought that the pattern of the finger in the anticipation could, if it was reasonably adjusted, be made to fit into a space as small for all practical purposes as the finger shown in the original design. The alteration was not sufficient subject matter for a registered design, and the design in question was therefore not valid, and there must be judgment for the defendants in the action and motion, with costs.

A stay of execution was granted on the application of Mr. Terrell.

Price v. Hammersmith Borough Council.

In the King's Bench Division, on Monday, February 14th, Mr. Justice Rowlatt gave judgment in a case that had occupied his attention for some days, in which the plaintiff, Mr. Edward Price, proprietor of the Royal Laundry, Goldhawk Road, Shepherd's Bush, W., sued the Hammersmith Borough Council to recover compensation in respect of a fire that occurred on his premises through, as he contended, the fault of the defendants' electrical installation. The defendants denied liability. After hearing the evidence, Mr. Justice Rowlatt said that in this case the plaintiff sought to recover damages in respect of a fire that broke out in a laundry, and the defendants were sued as a public corporation which supplied the laundry with electricity. It appeared that the fire broke out in the sorting room of the laundry where the service main —which belonged to the defendants and for which they were responsible—entered the fuse-box and meters, which were connected at a point where the plaintiff's own wires began, and for which the defendants were not responsible. The first question was whether the fire broke out in the service main belonging to the defendants on the defendants' side of the fuse-box? On that question, and on that alone, he had been addressed by counsel.

His Lordship concluded his judgment as follows:—"I think it has not been made out that the plaintiff's fire commenced in the defendants' service mains. I do not think that the plaintiff has proved his case. It is a fire which must remain, in my judgment, one of unknown and mysterious origin. It has not been shown to me how it happened. I know quite well where there is apparently no external cause of a fire, and there is electricity in the place, and the service main is found to be burned, that one is apt to say that it must have been the electrical current which started this; but this is only guessing, and I do not think that I am entitled to adopt that intellectual process. The plaintiff has not reasonably convinced me by the evidence that this fire was caused by the electrical main, and I cannot say how the fire began. Under these circumstances, the onus is on the plaintiff, and I must say that he has not proved his case, and, therefore, there must be judgment for the defendants, with costs."

Sub-station Attendants.

In our report of this case on page 170 last week, Mr. Bowden was incorrectly represented as saying that "no special skill was required" for the work in question; the word "no" should have been omitted.

As we go to press, the following has come to hand from Mr. W. Arthur Jones (president of the Association of Electrical Station Engineers), on behalf of the Executive Committee of the Association:—

Referring to your report in last week's issue of the case before the London Munitions Tribunal between Mr. J. H. Bowden, chief engineer of Poplar, and Mr. W. J. Ebben, in which it is stated that a certificate of release was refused, it is only fair to Mr. Ebben to state that the finding of the Tribunal was that—"In view of the facts that Mr. Bowden has now promised to release Mr. Ebben as soon as the improver referred to becomes more proficient, and that overtime would be arranged on munition work, a certificate could not be granted."

We may state that this Association was mentioned by Mr. Bowden in connection with this case, and we would emphatically point out that it was purely a personal matter relating to Mr. Ebben.

As an Association we take great exception to the statement that Mr. Bowden is reputed to have made "that no special skill was required for the class of work referred to." We think that as it was necessary for Mr. Bowden to enlist the services of two of his chief assistants, and also that of Mr. Beauchamp, Chief Engineer of West Ham, at the tribunal to retain the services of Mr. Ebben, the statement to which we take exception is somewhat disproved.

Coal Mines Act Prosecution.

Sheriff Hay Shennan, Hamilton, has given judgment in the case reported in our last issue.

His Lordship finds, in regard to Hutchison, that so far as the cable was concerned, no blame attached to him, and that the course he adopted was not dangerous so long as the workmen observed reasonable precautions. The evidence showed that a course similar to that which Hutchison had taken was frequently followed in the district, and had hitherto led to no mishap if ordinary caution was observed. The plan adopted was to clear away the *débris* from the side of the road furthest away from the cable. As this was done, the soft material kept falling away towards that side, and by the time the men came very near the cable, it should have been possible to lift it by hand and replace it, so as to hang it on the side of the road. Hutchison warned the men that the current was on, so that they might exercise caution. That could not be urged against him as proving that there was danger. There were many unavoidable dangers in coal mining, and it was part of the duty of a careful fireman to keep on warning the men to be cautious. The Sheriff, however, considered that Hutchison, through a misunderstanding of his duty, had failed to comply with the statutory requirement

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in regard to the state of the roof where the fall took place. He ought to have mentioned in his report that the roof was defective there. His Lordship therefore found this part of the charge proved, but dismissed the respondent with an admonition. From the evidence led, he found the charges against Shaw—which had also reference to the cable—not proven.

Workmen's Compensation.

Sheriff Moffatt, Falkirk, on Friday issued judgment in an action raised under the Workmen's Compensation Act by the Scottish Central Electric Power Co. against Wm. Kerr, labourer. While in the employment of the company Kerr met with an accident involving injuries to his head and back, and was paid compensation at the rate of 12s. per week. In consequence of an arrangement, Kerr accepted employment from the Scottish Central Electric Power Co. at his old rate of wages in lieu of further compensation. Proceedings were raised by the company to have it declared that his incapacity had ceased, or at least diminished, and they asked the Court to review the weekly payment of 12s. and to end or diminish the same. Kerr objected to the proceedings, maintaining that, as he had not recovered from the effects of his injuries, no order should be pronounced terminating his right to receive compensation. The Sheriff found in favour of the workman and dismissed the proceedings, finding the employers liable in expenses on the higher scale.

A Belfast Action.

Mr. Justice Gibson, in the King's Bench Division, Dublin, directed notice to be served on defendant's solicitors in reference to an application, on behalf of plaintiff, to have interrogatories administered in the action by Mr. A. B. Farrell, resident superintendent of the central electricity works, Belfast, against Mr. T. W. Bloxam, city electrical engineer, Belfast, for alleged slander, the words complained of dealing with the support and clamping of main feeder cables and with plaintiff's methods of work. The object of the application, it was explained, was to enable defendant to specify the cables, &c. Plaintiff's solicitor had already sent the proposed interrogatories, wishing to avoid application to the Court, but no reply had been received, except that counsel's advice was being sought.

BUSINESS NOTES.

Consular Notes.—JAPAN.—H.M. Consul-General at Kobé (Mr. R. G. E. Forster) reports that one result of the war will be to stimulate the industries of Osaka, the main part of whose foreign trade is done by Kobé. Industries, which were being slowly worked up against the competition of the imported articles, have suddenly been given a free field. To how great an extent they will profit by the occasion to establish themselves firmly against the time when they have again to face competition remains to be seen, but it seems clear that after the war importers of manufactured goods will be faced with greater difficulties than formerly. As to the effect on British trade, it is difficult to speak. The elimination of German and Austro-Hungarian competition would appear at first sight to afford a splendid opportunity, but as far as can be seen at present manufacturers and merchants in the United Kingdom have their hands too full to capture new trade. For the present, therefore, it is rather a question of how much of the old trade in machinery and metals, for instance, can be maintained.

The war has revolutionised zinc refining in Japan. Hitherto the two refining concerns at Amagaski, near Osaka, and Miike, in Kyushiu, have been slowly feeling their way. As a result of the war great activity has been shown in connection with military requirements, considerable extensions have been made, and it is anticipated that when all the works contemplated are in working order they will be in a position to deal with the whole of Japan's output of zinc ore. There was a decline in imports of machinery from £1,697,000 in 1913 to £1,342,000 in 1914. All classes of machinery shared in this decrease, which, speaking generally, was due at first to the Government policy of retrenchment, combined with the general depression, and latterly to the difficulty of obtaining supplies from Europe. The making of machinery in Osaka and Japan generally is increasing yearly. To give a few instances, the demand for oil and gas engines is met largely by locally-made engines; while in machine pumps, water turbines, cranes, dynamos, motors, locomotives, and in many other classes of machinery, imports are feeling the effect of local competition. Since the outbreak of war the difficulty which British firms have experienced in accepting orders for prompt delivery has diverted many orders which might have been expected to go to the United Kingdom.

Bankruptcy Proceedings.—J. Taylor Peddie, described as an engineer, of Aldwych Site, Strand, W.C.—An application was made, last week, to Mr. Registrar Linklater, at the London Bankruptcy Court, for approval to a scheme of arrangement recently entertained by the creditors. Mr. Egerton S. Grey, Official Receiver, reported that proofs of debt amounting to £9,744 had been lodged, and the proposal provided for the payment of a composition of 5s. in the £ on claims of £2,748, and for the absolute release and discharge of liabilities to the amount of £7,472. The Official Receiver opposed the application on the grounds (1) that it was not the actual arrangement which debtor was seeking to make with his creditors; (2) that the assets were not equal in value to 10s. in the £ on the amount of the liabilities; and (3) that he had brought on his insolvency by rash and hazardous speculations. Mr. E W. Hansell, who appeared in support of the application, pointed out that although the releasing creditors represented the majority in value of the debts, they were only a few in number, and were confined to Stock Exchange claims in respect of differences, whilst the creditors who were to receive the composition were 21 in number. His Honour, after hearing evidence, approved the scheme of arrangement, and annulled the order of adjudication.

Alfred Slatter, consulting electrical engineer, Caxton House, Westminster, S.W.—An application for an order of discharge was made, on February 8th, to Mr. Registrar Linklater, at the London Bankruptcy Court. Mr. Egerton S. Grey, Official Receiver, reported that the applicant failed in June, 1912, with provable claims £2,380, and assets valued at £198, but only £10 had been received in respect of the estate. The only offence reported by the Official Receiver was the insufficiency of assets to equal in value 10s. in the £ on the amount of the unsecured liabilities, and his Honour granted a discharge, subject to a nominal suspension of three weeks. Order entered accordingly.

G. E. Bonner, Ashcroft, 103, Fox Lane, Palmer's Green, Middlesex, electrical engineer.—The first meeting of creditors was fixed to be held on February 11th, at 14, Bedford Row, W.C., when the statement of affairs showed liabilities amounting to £210, and assets estimated to realise £63; after deducting preferential claims, the estate disclosed a deficiency of £147. The debtor prior to November, 1914, had for 17 years been engaged as stockbroker's clerk, but on the outbreak of war his salary was considerably reduced, and he took up an agency with a firm of electric lamp manufacturers on commission terms, but did very little business. In November, 1914, the stockbrokers terminated his employment, and from that time until last December his only employment was the agency for the lamp firm. Debtor stated that his failure was due to loss of employment and heavy interest to money-lenders. The matter remains in the hands of the Official Receiver.

Book Notices. — *Sell's Directory of Telegraphic Addresses.* London: Business Directories, Ltd. Price 25s.—The 1916 edition of this useful business directory has just appeared. In the course of its 2,600 pages it gives an alphabetical list of firms in London and the country, with their telegraphic addresses and telephone numbers; an index to telegraphic addresses; a classified trades list of the United Kingdom; cable addresses of British Empire overseas and foreign firms; telegraph tariffs, and other information. All new telegraphic addresses and alterations in postal addresses received from the Postmaster-General up to January 1st this year are included. The classified trades list contains more than 3,400 separate trade headings.

"*Journal* of the Institution of Electrical Engineers." Vol. LIV. No. 256. February 15th, 1916.—This issue contains a paper on "The Principles of Modern Printing Telegraphy," by Mr. H. H. Harrison. There is also a "Sixth List" of 65 members of the Institution serving with H.M. Forces.

"The *Practical Engineer* Electrical Pocket Book and Diary for 1916." London: The Technical Publishing Co. Price, cloth, 1s. 4d., post free. The new edition has been brought up to date, especially in connection with the specifications for copper conductors, particulars of instruments and apparatus, electric furnaces, and standards for electrical machinery; and new sections have been added relating to telephones and to first aid in case of accident. It contains a remarkably varied and comprehensive amount of information.

"Science Abstracts." Sections A and B. Vol. XIX. Part I. January 31st, 1916. Index to Vol. XVIII. Sections A and B. London: E. & F. Spon. Price 1s. 6d. each net.

"Lockwood's Builder's and Contractor's Price Book for 1916." London: Crosby Lockwood & Son. Price 4s.

"Telegraph Engineering." By E. Hausmann. London: Constable & Co., Ltd. Price 12s. 6d. net.

"The Universe and the Atom." By M. Erwin. London: Constable & Co., Ltd. Price 8s. 6d. net.

"Directory of British Manufacturers for Russian Trade." London: Russo-British Trade Exchange, Ltd. Price 5s.—This directory, which has been edited by Mr. R. A. Lenaki, is printed in the Russian language for circulation in Russia. It consists of 400 pages, with trade headings in Russian and English. It has received the support of representative electrical manufacturers, whose advertisements are suitably illustrated and are well produced. We hope it will prove of some assistance to our firms who are trying to gain a hold on the Russian market.

Trade Announcements.—The Electrical Supplies Co. are opening a Manchester office and stores at 40, Victoria Buildings, Victoria Street, Manchester (Telephone No.: "City 5794"). Mr. R. L. Bateson has been appointed manager of the branch, where stocks of lamps, cables, fittings, carbons and accessories will be held.

The Holmquist Electric Co., 1911, Ltd., and the Radio Electric Lamp Co., Ltd., have removed to more commodious premises at 17, Great Chapel Street, Oxford Street, W. Telephone: "4278 Regent."

Messrs. Cave & Higgin, Ltd., of 265, Deansgate, Manchester, have altered their title to Higgin, Ltd., and all communications should be so addressed.

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Liquidations.—Oil-Flame Furnace Co., Ltd.—A meeting will be held at 11, Ironmonger Lane, E.C., on March 14th, to hear an account of the winding up from the liquidator.

Globe Electric Co., Ltd.—Creditors should send the usual particulars to Mr. G. E. Corfield, 119, Finsbury Pavement, E.C., the liquidator, by March 14th.

Patent Restoration.—The Adjustable Cover and Boiler Block Co., Ltd., has applied for the restoration of Patent No. 6,831, of 1911, granted to J. R Hannam, for "Improvements in or relating to side flues and downtakes for boilers."

LIGHTING AND POWER NOTES.

Accrington.—Plant Extensions.—The Electricity and Health Committees have given instructions for a scheme to be prepared and tenders to be obtained for dealing at the minimum of cost with the present difficulties at the destructor and electricity works. The proposal includes the erection of a new chimney and flues and the provision of a new tubular boiler for the destructor, thus releasing two Lancashire boilers for the electricity works. The scheme is estimated to cost between £5,000 and £6,000.

Australia.—Although the Fremantle (W.A.) Council recently decided to reject the Government's offer to supply electricity in bulk from the Perth power station, it is understood that the Fremantle Tramway Board has decided to accept the offer, which includes delivery of energy at the Board's main sub station at East Fremantle, at ·85d. per unit. The agreement is proposed for 50 years; electricity may be resold to other local authorities at not more than 2d. a unit and to the Government at not more than 1½d. per unit. The Tramway Board was influenced in its decision by an expert report by Mr. Curle Smith, showing a profit margin in favour of the Government supply.—*West Australian.*

Mr. Forbes Mackay, reporting on the delay in supplying North Sydney (N.S.W.) with electricity, pointed out that this supply could be available in 10 days after receiving the submarine cables to cross the harbour. It is understood that the cables have been shipped, and it is hoped that the supply will be ready by the end of the month.

Barnes.—The contract for the maintenance of the storage battery having expired, the Tudor Accumulator Co. has asked for a renewal for a further period of 10 years on the same conditions, but no security would be deposited. The matter was adjourned until the next meeting.

It was decided to make arrangements for a supply of electricity to the houses on the Vine Cottage estate as soon as they are ready for occupation.

Bradford.—A small Sub-Committee of the Guardians has been deputed to consider the installation of electricity at the Bowling Park Colony.

Bridlington.—Destructor Scheme.—The L.G.B. has disapproved of the Corporation's scheme for the erection of a refuse destructor at the electricity works.

Brighton.—Suggested Price Increase.—The Electricity Committee has decided to adhere to the proposal to raise the maximum price of electricity to 5½d. per unit, with reductions after the first 1,000 units, but suggests that the charge for power should be raised ½d. per unit on the first 2,000 units. Consumers outside the borough are to be charged 6½d. per unit. It is also proposed for the improvement of the financial position of the electricity undertaking, to transfer to rate account certain annual liabilities on capital expended in plant for street lighting in unremunerative areas.

Chester.—The Waterworks Co. has under consideration the substitution of electric power for steam with a view to reducing the working expenses.

Church Stretton.—Prov. Order.—The local Electricity Co. has applied for a provisional order in respect of the urban district of Church Stretton and the parishes of All Stretton and Little Stretton.

Continental.—Spain.—A joint stock electric supply company, styled the Energica Electrica de Asturias, is being formed at Ujo, in the Province of Asturias. It is intended to utilise certain waterfalls on the Aller River, totalling 6,000 H.P. The scheme is in the hands of the engineer Don Juan Rovira.

Russia.—When the new Moscow central station was constructed in 1898 a three-phase 2,100-volt distribution system was adopted, with transformer pillars where the pressure was stepped down to 120 volts. In 1907 the network was extended to the industrial districts beyond the city, and in 1910 the distribution pressure was increased to 6,500 volts, there being at the present time two 6,500-volt networks and four 2,100-volt networks. Last year the central station and cable network were further modified, with a view to increasing their efficiency.

Dublin.—The report of Mr. P. W. d'Alton, on the Corporation's electricity undertaking, indicates that the administration of the system is unduly complicated owing to the dual control by an engineer who is not a manager, and a secretary who in part manages. The engineer should be given more responsibility for the number and qualifications of people employed, and for the extension of the load and its measurement. The charges for energy, while not unreasonable for public lighting, are unduly high for private supply. Considerable reductions in the number of workmen employed at the Pigeon House are possible. The wages paid under the Department of Public Lighting appear to be out of proportion, amounting to over 16 per cent. of the gross revenue received for that service. The cost of the secretarial department is high; a general gain in economy would follow were canvassers and meter-readers placed on the engineering staff. The salaries and wages paid otherwise than from revenue appear to be unduly heavy. The coal supply seems to have become a monopoly; methods should be adopted in the future to secure competition, and the coal specification issued by the Corporation should be more rigidly drawn. The charges for interest and repayment of moneys borrowed are fair, and are being admirably met. Further capital must be expended at the generating station to provide for the demands of the winter of 1917-18, and a scheme of extension must be prepared, and estimates invited and considered, during the coming year. During the spring and summer of 1916 no efforts must be spared by the engineering staff to get the power house into proper condition to meet its winter load with existing plant. The returns of the units generated at the power house are unreliable on account of the condition of the watt meters, which must be overhauled, repaired, and recalibrated before any reliance can be placed on their readings. The Stewart engines are obsolete and extravagant, and should only be worked in emergency. The Belliss-Morcom engine wants a thorough overhaul by its makers, to render it less extravagant in steam consumption; such an overhaul will probably greatly increase its efficiency. The Richardsons-Westgarth turbine should be in part reconstructed by the makers, to reduce its steam consumption. The Oerlikon turbines are excellent. The condensers of the station, which are now, and have for long been, seriously ineffective, must be put right. The older section of the boiler-house plant should be used only in emergency; it ought not to be worked as it is now on the daily load. The five large Babcock-Wilcox boilers and the Yarrow boiler should be always used for the day in, day out, needs of the station. Such a practice in connection with boilers and engines will produce a saving of the first importance in coal, labour and repairs. The present practice of using obsolete plant for the majority of the working hours of the station, and reserving modern and efficient machinery for intermittent peak and emergency loads, is to be deprecated as most extravagant.

The local Press publishes portions of counter-reports, prepared by Mr. Fred Allan, secretary to the Electricity Supply Committee, Mr. Mark Ruddle, city electrical engineer, and Mr. L. J. Kettle, deputy city electrical engineer. The whole matter will be considered at the next meeting of the Electricity Supply Committee.

The statement of accounts of the electricity undertaking for the year ended March 15th, 1915, shows that the total capital expenditure was £834,757; the total income was £105,440, as against £98,190 in 1914, and the debt charges amounted to £53,579, as against £46,069 in 1914, the surplus on the year being £1,417, as compared with £4,917 in 1914. Together with balances brought forward, the total surplus available was £10,291, from which £2,351 was placed to renewals. The total units sold were 9,519,545, as compared with 8,546,927 in 1914. The maximum demand was 7,486 KW., and the station plant capacity 12,000 KW.

Eccles.—Proposed Extensions.—With reference to the proposed electricity extensions mentioned in this column last week, it is stated that the present engine capacity at the generating station is fully loaded, and the Committee wishes to proceed with the extensions in order to use them as soon as the war is ended. Existing cables would be available for lighting purposes; the three-phase system is necessary for supplying energy to local works.

Ecuador.—The Municipality of Daule has been authorised to install an electrical plant for the public lighting of that town.

Edinburgh.—The Edinburgh Merchants' Association has passed a resolution condemning the Corporation's action in proceeding with the Portobello scheme at the present time.

Epsom.—Increased Prices.—Owing to the extra cost of coal, &c., the U.D.C. is recommended to increase the charges for current by 25 per cent., as from March 31st next. The assessment of the undertaking having been increased from £650 to £1,285, an appeal has been entered.

Glasgow.—War Economy.—Mr. Lackie reports that by deferring meter cleaning and repairs for an extra year £1,500 will be saved; also that £3,000 will be saved by delaying repairs to station plant.

Hastings.—Price Increase, &c.—The T.C. has been refused a loan of £500 for house services. The charges for electricity in respect of the current quarter have been increased by 10 per cent. as a temporary expedient, in addition to the 10 per cent. increase already in force.

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India.—Dissatisfaction is felt in Calcutta at what are claimed to be the high prices charged for electricity to the general public, and the Corporation has adopted a resolution asking for an expert Government investigation of the matter. The public pays 8 annas and 4 annas respectively per unit for lighting and power; the Government pays less than half these rates for its supplies.

Ipswich.—Loan Sanction.—The L.G.B. has sanctioned the borrowing of £3,100 for coal-hauling plant at the generating station.

Kilmarnock.—The Corporation electrical engineer reports that he has adjusted the terms of an agreement with the Cadrington and Auchlochan Collieries, Ltd., for the supply of electricity to Annandale Pit, and that he proposed to run a new 11,000-volt transmission line from the works to the colliery, which could afterwards form part of the scheme for duplicating the supply to Troon and Irvine.

Lincoln.—The T.C. has decided to give an additional supply of current to Messrs. Clayton & Shuttleworth, Ltd.

Llanelly.—Street Lighting.—The Electric Light and Traction Co. has made a rebate of £100 on the account of the T.C. in respect of restricted public lighting. The Council originally demanded a reduction of over £300.

London.—Hampstead.—The Lighting Committee has considered a report of the chief electrical engineer, with reference to the breakdown of the 1,000-kw. Westinghouse turbo-alternator on December 15th; the Committee found that the switchboard was of an obsolete pattern and incapable of dealing with the present loads, and it has authorised the engineer to issue specifications and obtain tenders for a modern switchboard. The B.C. has agreed to apply to the L.C.C. for sanction to the borrowing of £4,000 for the above purpose.

Fulham.—After the current quarter the prices for electricity for private lighting, power and public lighting are to be increased to 4d., 1½d. and 1½d. per unit respectively, with no discount.

Shoreditch.—As from the March meter readings the price of electricity for all purposes is to be increased by 15 per cent. Owing to the increased cost of coal, &c., there will probably be a deficiency of £4,000-£5 000 on the year's working.

Stepney.—The Finance Committee of the B.C. has approved an estimate of £19,000 for two new boilers; the Council has machinery sanctions representing £16,000 in hand, and it is proposed to interview the L.C.C. with a view to utilising this sum and borrowing a further £3,000.

Hammersmith.—The electricity works are at present insured against fire and aircraft risks to the amount of £45,588; the Electricity Committee has authorised an extension of the policy against aircraft for a further £45 588, representing an insurance against fire of £45,588 and against aircraft of £91,177.

Sheerness.—The U.D.C. has agreed to the proposal of the Sheerness E.P. Co. to increase the charge for the supply of energy at the sewage works by 15 per cent.

Market Drayton.—The Salop C.C. has withdrawn its objections to the Electricity Co. erecting overhead lines, subject to the usual B. of T. regulations being complied with.

Masham.—The Council has intimated to the local company that no tender will be required for public lighting under present conditions.

Middlesbrough.—The Cleveland and Durham Power Co. has granted the T.C. further privileges respecting the maximum load taken, and the engineer reports that it is not now necessary to consider the question of bringing the battery up to date; he suggested that a gas engine plant be installed for emergency use, and this was agreed to. It was stated that the alterations would cost £1,000, and effect an annual saving of £500 or so, besides deferring for several years a further expenditure of some thousands. The engineer reported that, owing to the new arrangements, the services of a chief assistant would not now be required.

Monaghan.—Street Lighting.—The Council has now given permission to a company to proceed with the erection of poles and wires for the introduction of public electric lighting.

Newport (Mon.).—Loan Sanctions.—The L.G.B. has sanctioned the borrowing of £780 in respect of an electric substation at Mill Parade. The Board has also sanctioned the raising of £3,004 for mains and £500 for services, and has advised the Corporation that it has deducted £375 to be paid by the contractors in respect of the laying of cables from Pill sub-station. With regard to the proposed loan for the provision of power to the factory at Maesglas, the Board asks to be furnished with details showing how the revised estimate of £3,872 is made up.

Sheffield.—A recent issue of the *Sheffield Daily Telegraph* contained a reference to the phenomenal state of hustle which characterises the city electric supply department. It appears that the generating capacity of the department has been doubled since the war started, and is now being quadrupled. Our contemporary's pen-picture of the E.L. Committee running away from the "slow-going" Council, and of the efforts of chairman and manager to out-distance the Committee, depicts a refreshing atmosphere of alertness not usually associated with municipal control in peace time. We understand that the Council will shortly be called on to sanction a further £137,000 expenditure on electricity extensions.

Stafford.—Proposed Loan.—The T.C. has decided to apply to the L.G.B. for sanction to the borrowing of £12,000 for extensions to the electricity works.

Tasmania.—Hydro-electric Works.—Mr. Butters, the chief engineer, has submitted an estimate of £48 750 as the probable cost of completing the hydro-electric works. The total cost of the works, including the above amount, is placed at £338 996, exclusive of submerged land at the Great Lake, estimated eventually to extend over 5,000 acres and to cost £7.000 and of the cost of extension to North West Bay. Mr. Parry's estimate of the total cost of the first part of the scheme was £295 572, and the excess is attributed partly to payments in excess of preliminary valuation to the Complex Ores Co. and partly to generally increased cost of plant. It is announced that as soon as the annual consumption for domestic lighting in Hobart reaches a million units the price will be reduced to 4d. per unit.

Wadebridge.—Cottage Lighting.—The Electric Supply Co. has under consideration a scheme to supply electric light to the tenants of small cottages, at a weekly rate, which will compare favourably with the cost of oil or other means of lighting.

Walsall.—Motor Hire Scheme.—The electrical engineer has been authorised to negotiate a working arrangement with motor manufacturers, whereby they will supply motors on a three or five years' hire-purchase basis, through the sales department, without the department incurring any financial liability.

TRAMWAY and RAILWAY NOTES.

Argentina.—The first section of the Metropolitan electric railway, under construction at Buenos Ayres, was inaugurated on December 1st. The concession holder is the Anglo-Argentine Co. Three new tunnels will shortly be constructed to connect with the section inaugurated. The working day is 20 hours, and a three to five-minutes' service is given. On the opening day 100,000 passengers were carried.—*Industria e Invenciones.*

Continental.—Denmark.—At a recent meeting of the Danish Ingeniørforening, a discussion was initiated on the "Eventual introduction of electric driving on the boulevard tramways in Copenhagen and on the neighbouring tramway system."

Spain.—An application has been made by the Sociedad Minera y Metalurgica de Panarroya for a concession to construct and work a narrow-gauge electric railway between Conquidor and Puertollano.

Switzerland.—The General Management and the Standing Committee of the Swiss Federal Railways have just submitted a report to the Council of Administration in regard to the projected conversion of the Erstfeld Bellinzona section of the St. Gothard railway. It is first pointed out that the three-phase system would be unsuitable for the purpose in view, whilst the advocates of the direct-current method base their contentions on experience with lighter trains and pressures far below 3,000 volts. The single-phase system, which is already employed on the Lötschberg railway, can now be recommended for adoption without reserve. No other electric railway system exists which can be placed on an equality in regard to the varied nature of the service, the number of locomotives, length of the track, and extent of services rendered, with that of the New York, New Haven and Hartford Railway. At the same time this railway is the first which from the system used has proved itself to be extensible at will and capable of being accommodated to all kinds of services. In the case of the Lötschberg railway the interruptions in working were attributed chiefly to the difficult circumstances under which the electrical equipment had to be provided. The report also discusses the problem of uniformity in the form of current and periodicity, which it is sought to attain in the distribution of energy throughout Switzerland. The Amsteg and Ritom power stations, which are proposed for the working of the Erstfeld-Bellinzona section, will be able to furnish energy not only for this section but also for the whole line from Lucerne to Chiasso, the conversion of which will not be long deferred.

Darlington.—The T.C. has agreed to certain increases of wages in the tramway department, which will entail extra expenditure amounting to £135 a year.

Dudley.—On Friday last, Timothy Parkes, the conductor concerned in the recent tramway accident, was charged with manslaughter at the Dudley Police Court, and committed to the next Worcestershire Assizes.

The inquest in connection with the second death resulting from the recent tramway accident, was resumed on Monday, the jury finding that Turner died as a result of the accidental overturning of the car, which was caused by the negligence of the conductor, Parkes; the jury added that they did not consider this culpable or criminal negligence and addressed certain recommendations to the tramway company.

Dundee.—Mr. Fisher, the tramway manager, has drawn attention to the necessity of renewing the overhead equipment in the centre of the city, which work will shortly be carried out by the electricity department.

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Ecuador.—A decree has been published authorising the construction of a railway, with electric traction if convenient, between Quito and Esmeraldas. The line will pass, by preference, through the towns of Cayambe and Otavalo; the first section to be constructed will be from Quito to Ibarra. Should it be decided to employ electric traction, the erection of a power station would be undertaken at the same time.

Glasgow.—War Economy.—Mr. Dalrymple has reported that there will be no expenditure on capital account this year, and that owing to depleted staffs ordinary expenditure will be reduced, but the saving will be counterbalanced by increased wages and war allowances. The T.C. has decided to purchase Thornliebank Gas Works, and ground is to be given up for road widening, the Tramways Committee contributing £500 towards the price.

Hindley.—The U.D.C. has approved a draft agreement with the Wigan Corporation for the lowering of the road under the bridge at Wigan Road, Hindley, to allow of the passage of double-deck tramcars, subject to the surveyor endeavouring to get the lowering tailed out to make the gradient not more than 1 in 80.

Jarrow.—The Town Improvement Committee has decided to communicate with the Tramway Co. regarding the condition of the tramway track.

Luton.—Tramway Extension.—The T.C. has been recommended to make application to the B. of T. for an order prolonging the period for the completion of the remainder of the tramway track for another two years from August 11th next.

Loan Sanctions.—The L.G.B. has approved of the borrowing of sums amounting to £30,327 for electricity purposes, by the T.C.

North London Railway Electrification.—It is stated that the work of electrifying the North London Railway to Richmond will shortly be commenced, and that a much improved service will be the result.—*Pall Mall Gazette.*

Southport.—It has been decided that horse haulage at the Corporation gas works shall be superseded by electric haulage in the near future; the rails already in use will be retained, and the Electricity Committee will supply the overhead equipment and the necessary vehicle.

West Lancashire.—The L. and Y. Railway Co. proposes to construct a light railway from the existing railway at Hightown round by Formby Point, rejoining the existing railway at Ainsdale, a distance of about six miles. The Light Railway Commissioners have been asked to issue an order authorising the work

TELEGRAPH and TELEPHONE NOTES.

Air Raids.—In order to keep the lines free for official messages on the occurrence of air raids, the Postmaster-General has issued an appeal to the public to use the telephone as little as possible on such occasions, and on no account to call up the police or other public officials.

Australia.—It is hoped that the new telephone rates, which came into force on December 10th, will bring in an additional revenue of £180,000 a year. Increases in the postal and telegraphic rates will be made this year, in order to avoid a repetition of the deficit of over £600,000.

Canada.—On Monday last telephonic communication was effected between Montreal and Vancouver, a distance of 2,300 miles. Montreal was also connected with San Francisco.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—March 8th. Electrical goods, for the Powell-Duffryn Steam Coal Co. Stores Manager, Aberaman offices.

March 11th. U.D.C. Electrical stores for 12 months. See "Official Notices" to-day.

Australia.—Sydney. May 1st. Two 300-kw. turbo-alternators, condensers, switchboard, &c., for the pumping station at Ryde, for the Metropolitan Board of Water Supply and Sewerage at Sydney.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-kw. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.*

Birkenhead.—March 6th. Corporation. Cable and two rotary converters with switchgear. See "Official Notices" February 1st.

Bolton.—March 2nd. Electricity Committee. Stores, including some electrical items. See "Official Notices" Feb. 11th.

Bootle.—February 23rd. Corporation. Stores, including lamps, meters, fuse boxes, &c. Electrical Engineer.

Dewsbury.—Electricity Department. Two second-hand 250-kw. generator panels, oil separator, piping, cables, &c. See "Official Notices" February 11th.

Dublin.—March 1st. Battery materials for carriage lighting, for the G.N. Railway Co. (Ireland). See "Official Notices" to-day.

Dundee.—February 28th. Corporation. Stores for the Tramways Committee. Mr. P. Fisher, General Manager.

France.—Paris.—February 24th. The State Railway Service requires 3,500 copper rail bonds of 400 mm². section, and 9,900 of 200 mm². section. Bureaux du Service Electrique (3e division), 72, Rue de Rome, Paris (8e), Tuesdays and Fridays, 3 to 5 p.m.

Keighley.—30-h.p. electric motor installation for pump driving, for the Fleece Mills Co., Ltd. See "Official Notices" to-day.

London.—Battersea.—February 21st. B.C. Stores for the Electricity Department. See "Official Notices" Feb. 4th.

New Zealand.—Dunedin.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.*

Plymouth.—March 2nd. Corporation. Converter with starter. See "Official Notices" to-day.

Pontypridd.—March 13th. U.D.C. Twelvemonths' supply of electrical stores for the Electric Light and Tramways Department. See "Official Notices" to-day.

Swansea.—March 6th. Education Committee. Electric lighting installation at Brynmill and Cwmbwrla Council Schools. See "Official Notices" to-day.

West Ham.—March 22nd. B. of G. Three months' supply of electric fittings. Clerk, Union Road, Leytonstone.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Glasgow.—Tramways Committee.

Traction lamps.—General Electric Co., Ltd., and Edison & Swan Co.
Lighting conduit and fittings.—Simplex Conduits, Ltd.

Messrs. W. Lucy & Co. asked the Electricity Committee for an increase of 10 per cent. on their contract prices for the supply of c.i. branch boxes, in consequence of the phenomenal rise in the price of pig-iron and foundry coke. The engineer reported that the other contractors for similar material had not applied for any increase, and the Sub-committee agreed to recommend that the increase be not granted.

Hampstead.—B.C. British Thomson-Houston Co., Ltd., for H.T. switchboard, £3,886.

London.—St. Marylebone. B.C.

British Westinghouse Co., Ltd.—Spare armature for rotary converter, at £1,018.
Ferranti, Ltd.—200 prepayment meters.

Bermondsey.—The Electricity Committee has given instructions for existing contractors to be asked to continue their contracts for supplies for a further 12 months on the same terms. The Committee has accepted a tender of the Glenboig Union Fireclay Co., Ltd., for 3,000 firebricks and one ton of fireclay in bags, for £28; and it proposes to renew for a further period of 10 years, upon the same terms, the agreement with the Tudor Accumulator Co. for the maintenance of the battery.

Newport (Mon.).—The contract for the supply of cables having expired, the electrical engineer proposes for the present to order supplies as required.

Park Prewett.—The tender of Messrs. Hill, Upton and Co. has been accepted by the Hants County Council, at £2 599. for telephones, fire-alarms, tell-tale clocks and bells, at the Park Prewett Asylum. This firm has the contract for installing the electrical plant.

Slough.—Messrs. Chamberlain & Hookham, Ltd., have received the contract for electricity meters for this year.

Sunderland.—Tender accepted by Electricity Committee:—Willans & Robinson, Ltd., blading for Willans turbine.

Walsall.—Electricity Committee. Accepted tender: Belliss & Morcom, for a 3,750-kw. turbo-alternator (in place of one sold to the Government) for £13,227.

West Bromwich.—The tender of the New Conveyor Co. for extensions to the coal conveyor at the Council's electricity works has been accepted.

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FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, February 18th. At 6 p.m. At 61, George Street, Westminster, S.W. Annual General Meeting. Paper on "Chisels," by Mr. H. Fowler.

Greenock Electrical Society.—Friday, February 18th. At 7.45 p.m. At the Temperance Institute, 19, West Stewart Street. Paper on "Electro-Plating," by Mr. S. V. Thorp.

Royal Institution of Great Britain.—Friday, February 18th. At 5.30 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Polarised Light and its Applications to Engineering," by Prof. E. G. Coker.

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, February 22nd. At 7.30 p.m. At the Engineers' Club, 17, Albert Square. Paper on "Continuous-current Railway Motors," by Mr. E. V. Pannell.

(Birmingham Local Section).—Wednesday, February 23rd. At 7 p.m. At the University, Edmund Street. Kelvin Lecture on "Terrestrial Magnetism," by Dr. C. Chree, F.R.S.

Illuminating Engineering Society.—Tuesday, February 22nd. At 8 p.m. At the Royal Society of Arts, John Street, Adelphi. Discussion on "Some Future Possibilities in the Design of Instruments for Measuring Illumination."

Liverpool Engineering Society.—Wednesday, February 23rd. At the Royal Institution, Colquitt Street. Paper on "Efficiency of Projectors and Reflectors," by Mr. H. T. Harrison.

Leeds Association of Engineers.—Thursday, February 24th. At 8 p.m. At 5, Park Lane. Paper on "Stamp Forgings," by Mr. B. Saunders.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, February 25th. At 7.30 p.m. At the Bolbec Hall, Newcastle-on-Tyne. General meeting.

Manchester Association of Engineers.—Saturday, February 26th. At the Grand Hotel, Aytoun Street. Paper on "Cast Steel as a Material of Construction," by Mr. E. F. Lange.

Battersea Polytechnic, Battersea, S.W.—Saturday, February 26th. At 7 p.m. Annual conversazione and inspection of students' work.

TRADE STATISTICS OF NEWFOUNDLAND.

The following figures, showing the imports into Newfoundland during 1913-14 of goods which are of interest to electrical contractors, are extracted from the recently-issued trade statistics. The figures for 1912-13 are added for purposes of comparison, and notes are given of any increases or decreases.

	1912-13. Dols.	1913-14. Dols.	Inc. or dec. Dols.
Belting.—			
From United Kingdom ...	4,000	5,000	+ 1,000
,, Canada	6,000	3,000	- 3,000
,, United States ...	11,000	12,000	+ 1,000
Total	21,000	20,000	- 1,000
Gutta-percha manufactures.—			
From United Kingdom ...	21,000	26,000	+ 5,000
,, Canada	48,000	46,000	- 2,000
,, United States ...	66,000	79,000	+ 13,000
Total	135,000	151,000	+ 16,000
Iron and steel railway bars and fittings.—			
From United Kingdom ...	—	1,000	+ 1,000
,, Canada	5,000	1,000	- 4,000
,, United States ...	3,000	2,000	- 1,000
,, Other countries ...	1,000	—	- 1,000
Total	9,000	4,000	- 5,000
Radiators, electric light material, etc.—			
From United Kingdom ...	31,000	4,000	- 27,000
,, Canada	8,000	8,000	—
,, United States ...	64,000	40,000	- 24,000
,, Germany	1,000	1,000	—
,, Other countries ...	1,000	1,000	—
Total	105,000	54,000	- 51,000
Machinery for mining purposes.—			
From United Kingdom ...	34,000	42,000	+ 8,000
,, Canada	267,000	140,000	- 127,000
,, United States ...	92,000	56,000	- 36,000
Total	393,000	238,000	- 155,000
Machinery for local industries.—			
From United Kingdom ...	3,000	2,000	- 1,000
,, Germany	4,000	3,000	- 1,000
,, Canada	2,000	1,000	- 1,000
,, United States ...	8,000	20,000	+ 12,000
*Total	17,000	26,000	+ 9,000

*Not including $53,000 value of material and machinery for pulp paper and saw mills, of which $38,000 came from the United States, $10,000 from Canada, and $4,000 from the United Kingdom.

	1912-13. Dols.	1913-14. Dols.	Inc. or dec. Dols.
Oils, lubricating.—			
From United Kingdom ...	2,000	3,000	+ 1,000
,, Canada	7,000	7,000	—
,, United States ...	21,000	27,000	+ 6,000
Total	30,000	37,000	+ 7,000
Materials for Western Union Telegraph Co.—			
From United Kingdom ...	4,000	33,000	+ 29,000
,, United States ...	1,000	3,000	+ 2,000
Total	5,000	36,000	+ 31,000
Goods for Anglo-American Telegraph Co.—			
From United Kingdom ...	3,000	51,000	+ 48,000
,, United States ...	1,000	1,500	+ 500
,, Canada	—	1,000	+ 1,000
Total	4,000	53,500	+ 49,500
Scientific instruments.—			
From United Kingdom ...	500	500	—
,, United States ...	1,000	500	- 500
,, Other countries ...	—	1,000	+ 1,000
Total	1,500	2,000	+ 500
Materials for wireless telegraphy.—			
From United Kingdom ...	1,000	1,500	+ 500
,, United States ...	2,000	1,500	- 500
Total	3,000	3,000	—

Dollar = 4s. 2d.

REVIEWS.

Electric Arc Phenomena. By Ewald Rasch. Translated by K. Tornberg. London: Constable & Co. Price 8s. 6d. net.

Before proceeding to deal with the electric arc, the author of this book devotes a dozen pages of introduction to calling attention to certain "facts, which, with exceptional force, should caution us to discreet tolerance and independence of thought on scientific subjects." The "facts" appear to be that, while as late as 1874, Kelvin, Tait, and Von Helmholtz thought to dispose of Newton-Weber's corpuscular theory of light by demanding to be shown a "light corpuscle," and made "unconditional, dogmatic surrender to Maxwell's theory of light," it was unanimously agreed at Salzburg, in 1909, by the highest authorities in theoretical physics (Einstein, Planck, Born-Minowski, A. Sommerfeld, and others) that Maxwell's theory of the universe and his ether hypothesis "must plainly be considered as obsolete." We agree with the author that scientific dogmatism is deserving of whole-hearted condemnation; we also agree that Maxwell's theory, while true for electromagnetic waves of great length, is inapplicable to the shorter waves which constitute the visible spectrum; and we fully appreciate the ingenious Planck-Einstein "Licht-quanten Hypothese" and Minkowski's time-co-ordinates. But there is surely a great gulf fixed between Newton's corpuscles and Einstein's light units; and there are surely *some* authorities in theoretical physics outside of Germany! It must be remembered that Sir J. J. Thomson, whose work on the electron in England ranks with that of any scientist, has alternatives even to Einstein's theory; and Dr. Wood of Baltimore, whose researches in physical optics give some weight to his opinion, remarks that "we may eventually be driven to a compromise between the old corpuscular theory and the wave theory." In fact, there is no unanimity among the world's scientists concerning the Planck-Einstein theory, and the consignment to oblivion of Maxwell's theory by the learned diet of Salzburg and the unanimity of *their* opinions does not convince us that Maxwell, Kelvin, Tait, and Von Helmholtz were the dogmatic blockheads that the author would lead us to suppose.

The author states that "the development of our mental pictures of a civilised world and of a physico-technical universe has been hindered, with more dire results, from the point of view of political economy, than were ever caused by the most bitter religious strife." The ideal of a physico-technical universe does not appear to us to be entirely desirable, but even supposing such a state *has* been postponed by this combat between rival theories, we decline to believe that men of the calibre of Kelvin and Tait have had any part or lot in the matter. The fact that even Goethe has devoted "several volumes of the sharpest kind of controversy against Newton, without making it clear to himself, or to us, what he is driving at," does not alter our opinion concerning the honesty of purpose of the great physicists of the nineteenth century.

The treatment of the electric arc is exceptionally complete—probably the most exhaustive monograph on the subject yet published.

The first chapter deals with the history of the electric arc, and rightly attributes the pioneer work to Davy. Some well-illustrated sections are devoted to the formation, starting, and

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adjustments of arcs and the various types of arcs, D.C., A.C., and enclosed. In the third chapter electrode materials and their physical properties are described very fully. In this section the author points out the lack of experimental knowledge concerning emissive powers of substances at high temperatures, remarking that it is in this direction that the illuminating engineer will have to seek guidance for progress towards perfection of illuminants by the selection of efficient electrode materials.

There are short chapters on the theory of electrical discharges and spark discharges in which the excellent work of Steinmetz, Earhart, and Russell is briefly referred to; but the main portion of the book is devoted to the study of the voltage and current conditions, and the distribution of energy in the arc. In the former of these subjects the classical work of Mrs. Ayrton is made the basis of the treatment. Her study of the carbon arc is undoubtedly the most exhaustive yet made, and although the author modifies his equations to suit the results of the more recent experiments of Grau and Toepler, he relies on the Ayrton results and the Ayrton-Thompson equations for the greater portion of his treatment of the carbon arc. Perhaps the most important criticism that Rasch makes of Hertha Ayrton's experiments is in connection with her method of measuring the arc-length. Usually, like Hertha Ayrton, one denotes and measures the length of the arc as the axial distance between the edge of the anode crater and the point of the cathode. In reality, however, the true length of the arc., *i.e.*, the length of the current-carrying gas column, is longer by the depth of the crater, a depth which is not entirely independent of the arc length and the current. The introduction of this true arc-length results in the correction and simplification of Ayrton's equation from

$$e = g + al + (\gamma + \delta l)/\imath \qquad (1)$$

to

$$e = m + l\,(a + \delta/\imath) \qquad (2)$$

where e, l, and $\imath$ are volts, millimetres and amperes respectively and the constants are in (1) $g = 38.88$; $a = 2.074$; $\gamma = 11.66$ and $\delta = 10.54$; while in (2) $m = 36.59$; $a = 2.074$, and $= 10.54$.

Extending the theory to metallic electrodes, it is found that the value of δ is a linear function of the specific heat, and on page 97 a diagram is given indicating this relationship. Unfortunately, the linear law derived is quite wrong, and should read $\delta = 23 - 62c$ instead of $\delta = 23 \times 4\ (1 - 2.7c)$.

Very little attention is given to mercury vapour lamps and hematite arcs, but the ordinary commercial types of arc are fully dealt with and valuable efficiency data are given.

On the whole, the German of Rasch is done into very fair English by the translator (Tornberg), but occasional obscurities and inaccuracies mar the translation. The German construction, in which the verb is eventually brought to heel near the end of the sentence, is occasionally met with, and the punctuation is erratic.

While the present work is a useful monograph on the subject, we do not think that it is by any means the last word on the electric arc, at any rate, so far as physicists and electrical engineers in this country are concerned.—P. H. S. K.

An Introduction to Applied Mechanics. By E. S. ANDREWS, B.Sc. Cambridge: University Press. Price 4s. 6d. net.

A preliminary survey of the pages of this book is sufficient to convince us that Mr. Andrews has had experience of the difficulties met with by students of mechanics, and that he is no novice in the art of text-book writing. A closer study deepens the conviction that the prefatory remarks are not the idle platitudes that we are accustomed to look for in prefaces, but are the sober truths concerning the present methods of teaching applied mechanics.

The author's experience leads him to the conclusion that the chief difficulties encountered by both teachers and students in applied mechanics are due to the treatment in the older form of text-book being too much that of applied mathematics—a kind of exercise ground for algebraic manipulation—and that in attempting to remedy this, the modern books have given too much engineering application of the principles of mechanics without sufficient explanation of those principles. Practical teachers of mechanics will recognise that Mr. Andrews has thus effectively summarised the defects that have rendered most class-books of mechanics useless for the instruction of engineering apprentices and the younger students in engineering colleges.

But the author has not only accurately diagnosed the weakness of the ordinary text-book; he has, in the 300 pages of this volume, prescribed a valuable remedy. He has avoided making his book into a course of mathematical gymnastics; at the same time, he has not gone to the other extreme and crowded out the adequate explanation of principles by practical examples and applications. The book before us is, in fact, a well-balanced treatise, in which a true view is kept of the relations between principle and practice, theory and experiment.

The order of treatment is somewhat unusual. Chapter I deals with Vectors, followed by Moments and Leverage, and Work, Power and Energy—subjects usually treated *after* the application of vectors to velocity, relative velocity and accelerations. Machines and Efficiency are dealt with in Chapter IV, and then the usual treatment of vectors is resumed, followed by chapters on Energy, Momentum, and Newton's Laws. The book does not appear to suffer on account of this deviation from the usual order of treatment, and even the subject of Work, Power and Energy is successfully negotiated in spite of the postponement of the velocity and acceleration section. There are very obvious advantages in the introduction of moments and leverage and machines at an early stage, and, since the ideas of velocity and force are commonplace ideas which scarcely need definition, there appears to be no reason why the old order should not give place to the new.

There are excellent chapters on Stress and Strain, Riveted Joints, Frames, Beams, and Girders. Chapter XIII is a somewhat belated treatment of Centres of Gravity, a subject that might well have made an earlier appearance in the book; and another section that seems somewhat out of place is a chapter on curvilinear motion inserted between "Friction and Lubrication" and "Mechanisms and Gearing." All these subjects are, however, treated with remarkable clearness and practical insight.

The book is well illustrated; worked examples and descriptions of laboratory experiments are frequent, and every chapter is carefully summarised; and there are sets of well-chosen exercises following every one of the 17 chapters. An appendix includes trigonometrical tables, weights and measures, and some useful constants. The book is well bound and printed, and is in every way likely to fulfil the hope of its author "that it may be found of value as a class-book in the junior classes of engineering colleges and in public schools that have an engineering side."—P. H. S. K.

Continuous and Alternating-current Machinery Problems. By W. T. RYAN. London: Chapman & Hall, Ltd. Price 2s. 6d. net.

The average technical student is apt to find general principles and mathematical theory rather vague, and to enable him to get a genuine grasp of a subject—particularly a subject like electrical engineering—considerable practice with numerical examples is essential. This small volume, emanating from America, has been designed for administering a short elementary course of such examples.

On the whole, the problems are well chosen, and bear a resemblance to those with which an engineer meets in practical work. They cover a wide ground, and occasionally notes and hints for their solution are given. By people trained in this country, problems involving "circular mils per ampere" will probably be ignored.

The answers are not given—thus making the book of little use to a private student—and considering that the total number of pages is only 37, the price appears to be on the high side.—H. G. S.

NOTES.

Electrical Machinery for China Stopped.—With reference to the proceedings before the Prize Court in London, reported on page 748 of our issue of December 10th, we have received a communication which makes it necessary to state that the concern for which Mr. Dunlop asked for the release of certain electrical machinery was the Peking Electric Co. and not the Peking Chinese Electric Light and Power Co., Ltd. We have also received a copy of the *Peking Gazette*, in which a letter appears amplifying the explanation which we have just given. Mr. A. O. Buckingham, engineer-in-chief to the Peking Chinese Electric Light and Power Co., Ltd., there writes as follows:—

> In case there should be any misconception as to which is the Peking Electric Co., and which is the Peking Chinese Electric Light and Power Co., Ltd., I would point out that the former has an order, which it enjoys in common with the Peking Chinese Electric Light and Power Co., Ltd., to supply in the Legation Quarters, and in no other part of Peking, whereas the Peking Chinese Electric Light and Power Co., Ltd., has power to supply over the whole of Peking including the Legation Quarters.
>
> It will, therefore, be clear that the function of the Peking Electric Co. is more specific than general, and such terms as "Chinese Public Lighting Installation," and "Electric Light Co. of Peking," could only in their common acceptation be taken to refer to the Peking Chinese Electric Light and Power Co., Ltd.
>
> The reason I am compelled to deal with this matter is, that my company's business is being seriously handicapped, owing to its being confused with the Peking Electric Co.

Mr. Buckingham's company has placed in England considerable orders for goods of which it is in great need. These goods are already very much overdue, and any doubt as to the identity of his company would cause the goods to be further delayed.

Fatality.—SHEFFIELD.—An inquest has just been held on a 16-year-old boy named C. H. Roper, who met his death from electric shock while having a bath. His brother John had fixed an electric lamp in the bathroom with flexible wire secured by tacks. Owing to the blind falling, John endeavoured to remove the lamp bulb (on account of the lighting regulations), but it was too hot to hold, and fell, with the wire attached, into the bath. The lad in the bath got so severe an electric shock that he died almost immediately. The pressure was 200 volts.

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The Future of Electric Steel.—An article in the *Ironmonger* states that the number of electric furnaces in the United States has increased during the past 12 months by 32 to a total of 73, and the American total now exceeds by 20 that of Germany, which had previously occupied the first place in this branch of industry. Of the German furnaces 16 are melting ferro-manganese, and, consequently, are not a factor in the steel trade. The American development of electric melting has been mainly in the production of steel castings of ordinary analysis, but more solid and free from blowholes than can be obtained by the baby Bessemer or the open-hearth process, and of alloy steels ranging from the high-priced "quality" steels used for aeroplane and automobile construction up to tool steel itself.

Even in Sheffield electric melting is making rapid headway; 15 furnaces were installed last year, of which eight are employed in melting high-speed steel. There is great scope for the electric furnace outside the manufacture of tool steel. New kinds of steel are in demand which can be successfully made only in that furnace, and the call of the aeroplane, automobile, and other progressive industries for steels of higher quality is compelling recourse to the same system. Statistics indicate that progress is chiefly with the arc type of furnace, which is making rapid strides everywhere. In the United States there are 68 against two of the induction type, and in other countries the number is 179 against only 35 induction furnaces.

According to the *Iron Age*, the total number of furnaces in operation for electric melting of steel has increased from 213 to 303. Germany now takes second place with 53, an increase of only six. Progress was greater in England than in any other European country, our number of furnaces having gone up from 16 to 46, and there is every probability of the same rate of increase being maintained in the near future. A considerable number of contracts for new installations have been placed or are under consideration, and many more will be needed if steelmakers in the country lay themselves out (as is highly probable) to capture a share of the huge trade in small steel castings which in the past has been left largely in the hands of Continental firms. There is a decided opening for a small electric furnace of moderate first cost and simple design, both for the production of small castings and special steels for various purposes.

During the year Sheffield has installed or contracted for electric furnaces as follows:—Hadfields, Ltd., 5; Vickers, Ltd., Thos. Firth and Sons, Ltd., John Brown & Co., Ltd., and Brown, Bayley's Steelworks, Ltd., two each; Arthur Balfour & Co., Ltd., S. Osborn and Co., Ltd., and the University of Sheffield, one each. The whole of these furnaces are of the Héroult type, and range in capacity from 3 to 10 tons. Eight of them are producing tool steel and the remainder castings and war material. The following British firms have also installed or are installing electric furnaces: London Foundry Co., Ltd., Brimsdown; Daimler Motor Co., Ltd., Coventry; Thwaites Bros., Ltd., Bradford; and T. Summerson and Sons, Ltd., Darlington.

As regards types, the Héroult furnace stands first with a world total of 115 out of 303, induction furnaces ranking second with 38, the Rennerfelt third with 35, and the Grönwall next with 15. The number of Héroult furnaces in the United States has increased from 19 to 43. Other figures for the same country are Snyder 14, Wile 7, and Rennerfelt 2. There are also 4 Rennerfelt installations in England at the following works:—Edgar Allen & Co. Ltd, Sheffield; A. Kenrick & Sons, Ltd. Birmingham; Steel Castings, Ltd., Birmingham; and Electro Flex Steel Co., Ltd., Dunston. There are 11 electric furnaces in Russia, 23 in Sweden, and 6 in Norway. In Canada the manufacture of steel by electric melting is carried on by Electric Steel and Metals, Ltd., Ontario; Armstrong, Whitworth, of Canada, Quebec; Thomas Davidson Manufacturing Co., Montreal; and the Canadian Brake and Shoe Co., Quebec, these firms having 8 furnaces among them.

In the foregoing extracts it is not made clear whether the considerable number of electric steel furnaces installed by Messrs. Electrometals, Ltd., in Sheffield and other English towns are included. These furnaces were described in our issue of October 8th, 1915.

Institution and Lecture Notes.—Insurance Institute of London.—On Monday afternoon last Mr. Alfred Hands, delivered the first of two lectures on "Storms, Lightning, and Lightning Conductors," at Gresham College, E.C. The second lecture will be given on Monday, February 28th, in the Hall of the Insurance Institute at 11 Queen Street, E.C.

Institution of Electrical Engineers.—A special general meeting of the corporate members of the Institution will be held on Wednesday, March 1st, at 5 p.m., for the purpose of considering and, if thought fit, of passing the following resolution as an extraordinary resolution with the view to its subsequent confirmation as a special resolution:—

"That the following words be added to Article 41 of the Articles of Association, namely:—(*a*) In the event of a state of war arising between the United Kingdom of Great Britain and Ireland and any other country or State, any member of any class who at any time during such war shall be a subject of such enemy country or State shall forthwith cease to be a member of the Institution, and in the case of the European War of 1914 all such members shall cease to be members of the Institution on and after the 16th day March, 1916."

Should the above resolution be passed by the requisite majority, a further special general meeting will be held on March 16th, when the said resolution will be submitted for confirmation as a special resolution.

The Committee of the Privy Council for Scientific and Industrial Research has made the following grants to the Institution for one year's research work:—Heating of buried cables, £810; properties of insulating oils, £250.

The provisional programme of the Birmingham Local Section for the second half of this Session includes the following:—

February 23rd.—Dr. C. Chree—Kelvin Lecture on "Terrestrial Magnetism."
March 15th.—Mr. N. W. Storer—"The Possibilities in the Design of Continuous-Current Traction Motors."
April 11th.—To be arranged.

Mr. C. P. Sparks, president, accompanied by Mr. P. F. Rowell, secretary, was present at a meeting of the Newcastle Local Section on the 15th inst. Mr. P. V. Hunter presided, and there was a very good attendance, including many of the principal electrical engineers in the district, who offered the visitors a hearty welcome. The President addressed the meeting on the work of the Institution, and afterwards a paper, with lantern illustrations, was given by Mr. R. W. Gregory, dealing with the Roman Wall. The arrangements were admirably carried out by Mr. J. R. Andrews, the local secretary.

Birmingham Electric Club.—On Saturday last a paper was read by Mr. H. W. Wolton on "Electric Welding."

Electrolytic Copper in Germany.—According to *Industria e Invenciones*, a new factory is to be started in Germany for the refining of copper by electrolysis, at Bitterfeld, the owners being the Hüttenwerke, of Niederschöneweide. The energy required will be 2,000,000 KW.-hours yearly, which will be supplied by the power station at Golpa Jessenitz. This will make the third electrolytic copper works in the German Empire.

Electricity at Dublin Quays.—In the High Court, Dublin, Mr. Justice Pim made a consent a rule of Court in a case by the Corporation against the Port and Docks Board and the Steam Packet Co., in regard to the opening-up of the quays for the laying of electric wires from the pathway. The settlement provides for notice of intention to open, the city engineer to require defendants to guard against the interruption of the city electricity supply and other utilities.

Volunteer Notes.—Engineering Institutions' Volunteer Engineer Corps.—Orders for week commencing February 21st, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commandant.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, February 21st.—Sections 1 and 2, Technical; Sections 3 and 4, Lashings and Trestle Bridging, Signalling Class and Recruits.

Tuesday, February 22nd.—School of Arms, 6 to 7 p.m.

Thursday, February 24th.—Shooting for Sections 1 and 2, and Signalling Class.

Friday, February 25th.—Sections 3 and 4, Technical; Sections 1 and 2, Lashings and Trestle Bridging; Signalling Class and Recruits.

Saturday, February 26th.—Uniform Parade, 2.45 p.m.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, February 17th, 1916:—

Week-end Parades.—Saturday.—The Battalion will parade at Wembley Park at 3.15 p.m. for drill under Company Officers. "Derby" recruits are invited to attend.

Sunday.—The Battalion will parade at Liverpool Street Station (low-level entrance, G.E.R.) at 9.30 a.m., and proceed by train for Entrenching duties. Members will carry their own lunch. The Battalion will return to town about 6 p.m.

Winter Quarters.—The Fatigue Party, under Corporal Manning will parade, as usual, at Wembley Park, on Saturday and Sunday next.

Musketry.—There will be a Shooting Match at Bisley on Saturday next, the 19th inst. Parade in uniform at Waterloo Station, No. 9 Platform, at 12.45 p.m.

A. G. Joiner, *Major and Adjutant*, O.B.C.

For Sale.—The Stoke-on-Trent Electric Supply Committee has for disposal two Belliss and four Raworth engines, D.C. and A.C. generators. See our advertisement pages to-day.

Rock Drills.—Replying to the discussion on a paper on "Compressed Air for Coal-Cutters," which he read at a meeting of the Mining Institute of Scotland, in Edinburgh, on Saturday, Mr. Sam Mavor said the complaint that a satisfactory electric rock drill had not been produced was a valid one, but he now believed that the days of the compressed-air rock drill were numbered. He had recently seen in operation a rock drill constructed in accordance with a novel system of power transmission, which absorbed only one-fifth of the power required by a compressed-air drill, and could be used in association with any electrical plant. The system had features which differentiated it from any other attempts to compete with the compressed-air drill, and he believed it was destined to revolutionise all branches of civil engineering and mining which were based upon rock drilling.

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Flood-lighting—a Contrast.—We reproduce herewith from the *Electrical World* a view of the "matchless Tower of Jewels" at the San Francisco Exposition, as it appeared at night. This will interest readers in this country, especially residents in

the city of ——, and will assist their imaginations to conjure up some idea of what might be there were it not otherwise ordained. After the war, perhaps—

Farm Supply in Eastern Pennsylvania.—A recent issue of the *General Electric Review* contains an article by Mr. J. W. Price on the subject of rural development of transmission lines which details more particularly the experience of two companies in the supply of electricity to farms. The first company has acquired its rural consumers incidentally, but having been led to investigate matters is establishing a definite policy for acquiring farm consumers. It has at present 135 such consumers, and has put up 12 miles of special lines in quarter to half mile lengths, the majority of the farms being connected to lines put up for other purposes.

Of the 125 farmers mentioned, 30 are power consumers, and all are users of light. The 95 consumers using only light give an average revenue of £3 15s. a year; the average revenue per farm power consumer (including lighting) is £16 18s. a year. The supply is charged at 6½d. per unit for lighting, less 20 per cent. discount, and 2½d. per unit for power, less 10 per cent. discount, with a monthly minimum bill of 4s.

The total farm power load is 412 H.P., or 307·35 KW., and the total farm load (including lighting) 432·35 KW., representing 3·46 KW. per consumer, and a demand of 55,000 units, rather more than half being lighting units.

The second company adjoins the one just referred to, and has 32 miles of lines, much of which, however, is used jointly for telephone and power wires. Current is being supplied for street lighting, but the principal load consists of farms, to whom a special tariff is offered, one of the conditions of contract being that where the prospective load is not such as to warrant an extension at the company's expense, the extension will be installed if the consumer agrees to guarantee revenue within two years to cover the cost of the extension. The customer pays for and maintains his transformer and main switch, with the idea that he will switch off his transformer when not in use, and save core loss.

The lighting rate is 6½d. per unit, less 10 per cent., with minimum charges; cooking, heating, battery charging and motor service above 1 H.P. are classed as power, and supplied on a sliding scale varying from 4d. to 2½d. per unit, with 10 per cent. discount and minimum charges.

There are 40 farm customers, and 30 use both light and power, the total motor load being 325 H.P., of which 228 H.P. is distributed amongst the 30 consumers referred to, giving an average of 7½ H.P. each. The company has now adopted a standard 10-H.P. motor for its consumers.

Six consumers, representative of the whole, show an average yearly revenue for power and lighting of £15; for 40 farms the total is taken at £578. Three of the farms have their motors mounted on trucks, and it may be noted that vacuum cleaners, washing machines, sewing machines, irons, &c., have been adopted in considerable numbers.

It is mentioned that the tendency is to keep the H.P. rating down with a view to distributing the load throughout the day; also that experience shows that it is only a short time before the lighting consumer adopts electric power appliances.

None of the consumers above mentioned employ irrigation pumping.

Italian Progress in Electrochemistry.—The prizes awarded yearly by the Brambilla Foundation for inventions or processes calculated to be of advantage to the population of Lombardy, have, for 1915, been awarded, as regards the first prize, to the Società Anonima Ferriere di Voltri, of Voltri and Darfo, for alloys of iron produced in the electric furnace, &c., and for the impulse it has given to electrometallurgical production in Italy. The second prize is awarded to the Società Elettrica e Elettrochimica del Caffaro, of Milan and Brescia, for an electrolytic substance styled "Pasta Caffaro," for the prevention and combat of the vine disease termed peronospora.

Electricity Works as "Controlled Establishments."—The Glasgow Electricity Committee has appointed a Special Sub-Committee to confer with representatives of the Gas Committee as to the question of making application to have the electricity department declared a "controlled establishment."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—At the Electricity Works, Stamford, Mr. F. H. BRANDRETH, the resident engineer (Lieutenant, 67th Provisional Territorial Force), was presented by the staff with a pair of silver candlesticks on the occasion of his marriage. Mr. J. E. Edmundson made the presentation.

Mr. T. K. RICHARDSON, station superintendent at the Marylebone B.C. electricity works, who was granted three months' leave of absence on November 4th, owing to illness, has been granted a further three months' leave.

Mr. R. PARKER has retired from the position of foreman at the Bristol T.C. electricity works after 22 years' service, and Mr. J. STAPLETON has been appointed his successor at a salary of £169 per annum. Mr. Parker's health has broken down, and at the Council meeting the question of a pension was raised. Alderman Pearson replied that there was no scheme in existence under which Corporation workmen could receive a pension, the Council having refused to listen to his own proposals on the matter. Mr. Parker was entitled to every consideration. The Committee is to report upon his case. One member proposed that he be granted a year's salary.

The St. Marylebone B.C. has increased the salaries of the following members of the electricity supply staff:—Mr. W. HARPER, assistant accountant; Mr. W. H. SHORTER, chief assistant, sales department; and Mr. C. H. CAPE, shift engineer.

Mr. E. J. WALSH, chief assistant engineer to Kilmarnock Corporation, where he has been for the past four years, has been appointed resident engineer by the Musselburgh and District Electric Light & Traction Co., Ltd.

Petty Officer S. HANN, attached to the *Hawke* Battalion, R.N. Division (borough electrical engineer, Stoke Newington), received special mention in a dispatch by General Sir Ian Hamilton on September 22nd, 1915.

Mr. J. LEWIS, assistant engineer at the Sleaford Urban Council electricity works, has resigned.

General.—At a complimentary dinner, given on Saturday, 5th inst., at the Princess Restaurant, Newcastle-on-Tyne, Mr. J. SPENCE was presented, on the anniversary of his 21 years as district manager of the General Electric Co., Ltd., with a silver rose bowl by the staff.

The Committee of the Privy Council for Scientific and Industrial Research has appointed the Hon. Sir C. A. PARSONS, F.R.S., to be a member of the Advisory Council, in place of Prof. Bertram Hopkinson, F.R.S., who has been forced to resign by the pressure of duties connected with the war; and Prof. J. F. THORPE, F.R.S., to fill the vacancy caused by the death of Prof. R. Meldola, F.R.S.

Mr. T. G. TRAVIS has resigned his position as general sales manager with the Electrical Apparatus Co., Ltd., in order to join the sales organisation of the British Westinghouse Co., Ltd., at Trafford Park, and will commence his new duties on the 17th inst. Mr. Travis was previously with the British Westinghouse Co. for some years, subsequently joining the Electrical Apparatus Co. as Manchester representative.

The Illuminating Engineering Society (U.S.A.), on February 10th, gave a banquet in New York in honour of Mr. T. A. EDISON, who was made an honorary member.

Private M. F. BELLIVEAU, electrical engineer, of the 55th Canadian Infantry, was married last week at the Catholic Church of St. Lawrence, Petersfield, to Miss Ruth Maude Gibbins.

Roll of Honour.—Trooper JOSEPH WM. ODELL, of the Berkshire Yeomanry, who was on the staff of the Pulsometer Engineering Co., Ltd., of Reading, and had served with the regiment in Egypt, has died from consumption.

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The D.C.M. has been awarded to Sergeant COLIN MORRELL, of the 2/1st West Riding (Sheffield) Royal Engineers, who was, before enlistment, underground electrician at the Hickleton Main Colliery.

Private DAVID QUINN, of the 7th Battalion Lancashire Fusiliers, formerly employed by Messrs. W. T. Glover & Co., Ltd., at Trafford Park, has been wounded, and is in hospital at Cairo.

The D.C.M. has been awarded to Private F. MOTTERSHEAD, of the 7th Battalion Lancashire Fusiliers, formerly employed by the British Westinghouse Works, Trafford Park.

We are sure that our readers will join with us in congratulations to the President of the Institution of Electrical Engineers, Mr. C. P. SPARKS, upon the honours gained by two of his sons who are with the Forces. Reference was made to the matter at last week's meeting of the Institution. The facts are these:—Lieutenant A. C. SPARKS, R.E., received the Ribbon of the Military Cross from his Corps Commander in France on February 5th. This was awarded him following the night attack on January 11th-12th, 1916. Captain HARRY SPARKS, Suffolk Regiment, was decorated by the King at the Investiture on January 15th, 1916, with the Military Cross, awarded February, 1915.

Obituary.—SIR C. RIVERS WILSON.—We regret to record the death, which occurred on February 9th in London, at the age of 85 years, of Sir Chas. Rivers Wilson. The deceased gentleman was for some years chairman of the British Electric Traction Co., Ltd., also of the Rand Central Electric Works, Ltd., which was taken over by the Victoria Falls Power Co.

MR. HERBERT KINGSFORD.—Mr. Herbert Kingsford, whose death was announced here last week, was chief of the staff of the Central and South American and Mexican Telegraph Companies. Mr. Kingsford began his career with the Telegraph Construction & Maintenance Co., and took part in some of the Atlantic cable-laying expeditions of the *Great Eastern*. He afterwards joined the Commercial Cable Co., and sailed in the ill-fated *Minia*, but later was for many years in Peru with the companies first named. He was patentee of a bell-ringing grapnel used by cable-laying concerns.

MR. BELVEDERE BROOKS.—The *Daily News* reports the death of Mr. Belvedere Brooks, of the Western Union Telegraph Co., who began as a messenger boy in 1870 and worked his way up to the top.

MR. JOHN WOOD.—We regret to record the death, in his 65th year, of Mr. John Wood, which ocucrred on 14th inst. at his residence at Forest Hill. The deceased gentleman was senior partner in the firm of Mosses & Mitchell, of Chiswell Works, Golden Lane, E.C., and a director of several London firms.

NEW COMPANIES REGISTERED.

Scott Electrical Co., Ltd. (142,870).—Registered February 9th, by Pepper, Tangye & Winterton, 34, Waterloo Street, Birmingham. Capital, £100,000 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in lighting sets and starting apparatus, lamps, dynamos, magnetos, and electrical and other apparatus, and accessories of all kinds, and parts thereof, for use in connection with motor vehicles, airships, aeroplanes, seaplanes, boats and ships, manufacturers of and dealers in such vehicles, and cycles, carriages and other conveyances for use on the road, in the air, or on the sea, electrical, mechanical, hydraulic, automobile and general engineers, etc., and to adopt agreements with the Efandem Co., Ltd., and Jesse Varley. The subscribers (with one share each) are: J. Varley, Elmsdale, Wightwick, Wolverhampton, accountant; R. H. Johnston, 49, Queen Street, Wolverhampton, chartered accountant; P. Smith, Ravensholt, Sunnetfield, Wolverhampton, secretary; F. H. Pepper, 34, Waterloo Street, Birmingham, solicitor; H. Walker, 117, Poplar Avenue, Edgbaston, Birmingham, managing clerk; J. E. Smith, 78, Springfield Road, King's Heath, Birmingham, cashier; J. W. Harvey, 28, Algernon Road, Birmingham, accountant. Minimum cash subscription, 25,000 shares. The first directors (to number not less than three or more than ten) are: J. Varley; E. J. Hardy, Alverstone, Park Road, Coventry; and G. R. Cornwallis, Roseland, Albemarle Road, Norwich. Until otherwise determined the said directors shall form a committee of management of the board of directors. The Efandem Co., Ltd., shall for a period of ten years have the right to nominate a director, so long as they hold 500 shares. Qualification (except such nominee), £500. Remuneration (except managing director), £50 each per annum (chairman £100). Each member of the management committee of the board shall receive a further £200 per annum as remuneration. Registered office: National Provincial Bank Chambers, Queen's Square, Wolverhampton.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Bullers, Ltd. (62,020).—Capital, £400,000 in £10 shares (20,000 pref.). Return dated December 29th, 1915. 15,000 ord. and 15,000 pref. shares taken up; £10 per share called up on 7 ord. and 15,000 pref.; £150,070 paid; £149,930 considered as paid on 14,993 ord. shares. Mortgages and charges: Nil.

Gambrell Bros., Ltd.—Land Registry Charge on the company's "Electrical Laboratories" in Merton Road, Southfields, dated January 12th, 1916, to secure all moneys due or to become due from company to National Provincial Bank of England, Ltd., 153, High Street, Putney, S.W.

Osram-Robertson Lamp Works, Ltd. (formerly Osram Lamp Works, Ltd.) (95,312).—Capital, £250,000 in 7,500 "A" and 2,500 "B" shares of £10 each, and 150,000 pref. shares of £1 each. Return dated December 9th, 1915 (filed January 7th, 1916). 7,500 "A," 2,500 "B," and 128,250 pref. shares taken up; £10 per share called up on 5,000 "A"; £50,000 paid; £178,250 considered as paid on 2,500 "A," 2,500 "B," and 128,250 pref. shares. Mortgages and charges: £24,000.

Kingolite Co., Ltd.—A memorandum of satisfaction to the extent of £50 on January 9th, 1916, of debenture dated July 9th, 1914, securing £400, has been filed.

John Spencer, Ltd. (56,764).—Capital, £75,000 in £5 shares (10,000 pref.). Return dated December 21st, 1915 (filed January 5th, 1916). 10,000 pref. and 1,027 ord. shares taken up; £55,135 considered as paid on 11,027 shares. Mortgages and charges: £25,000.

Robert W. Blackwell and Co., Ltd.—Capital, £250,000 in £1 shares. Return dated January 14th, 1916 (filed January 27th). All shares taken up; £1 per share called up on 100,007; £100,007 paid; £149,993 considered as paid on 149,993 shares. Mortgages and charges: Nil.

Aluminium Foil Co., Ltd.—Mortgage dated December 8th, 1914, to secure £1,500, charged on the Bridge Road Engineering Works, Harlesden. Holders: International Foil Co., Ltd., 195, Strand, W.C. (Registered February 2nd, 1916, pursuant to Order of Court).

Pernambuco Tramways and Power Co., Ltd.—Issue on January 11th, 1916, of £100,000 debentures, part of a series of which particulars have already been filed.

Enfield Electric Cable Manufacturing Co., Ltd.—Deed of further charge on certain hereditaments and premises dated January 27th, 1916 (supplemental to mortgage dated November 5th, 1914), to secure £2,750. Holders: Viscount Grimston, The Camp, St. Albans; G. J. Andrews, 180, West Campbell Street, Glasgow; and F. Plutte, Fountainbleau, Dacres Road, Forest Hill, S.E.

Bourne End Electric Installation Co., Ltd. (98,428).—Capital, £5,000 in £1 shares. Return dated December 30th, 1915. 1,000 shares taken up; £7 paid; £993 considered as paid. Mortgages and charges: £2,000.

Westinghouse Cooper Hewitt Co., Ltd. (89,947).—Capital, £30,000 in £1 shares. Return dated December 17th, 1915. All shares taken up; 9s. 6d. per share called up; £14,250 paid. Mortgages and charges: Nil.

CITY NOTES.

St. James' and Pall Mall Electric Light Co., Ltd.

Mr. WALTER LEAF, presiding at the annual meeting on Tuesday, said that they had to recognise that their industry had yet to suffer for an indefinite time under conditions which were wholly adverse and brought no war profits. Last year they set aside £4,500 to be used this year for the equalisation of dividends, hoping to maintain the rate at 10 per cent., but conditions had been worse than they anticipated. Their estimate of reduced revenue was correct, but expenses had exceeded the estimate by £3,000. The loss of profit due to the war was, therefore, about £12,000 additional, and they were only able to pay 8 per cent. The increased expenditure showed itself chiefly in the accounts of the Central Co., on which they relied more and more for their supply. The cost of the unit for electricity purchased had risen materially, and it had been thought desirable by the two companies concerned that, in order to keep down the cost, the Central Co. should not declare a dividend for 1915; they would thus be that amount short in next year's revenue. They had had to renovate the plant at Grove Road Works, and had added a large new turbo-generator and boiler plant. A large reserve of coal had had to be held. These two causes involved considerable capital expenditure, which must be provided by the companies until it could be made up out of the large provision for depreciation. For this reason they were proposing to extend the borrowing powers. They had entered into an arrangement with their neighbours, the Marylebone Borough, for mutual support in the event of certain emergencies. 64 of their men had joined the Colours, and six had been killed. Theirs was accepted as a public utility undertaking, and a number of their skilled staff were to receive war service badges. Their investments, which cost just over £55,000, stood at £45,716 at December last. They were not ear-marked for any special purpose, and, unless some unforeseen necessity arose they intended to hold them until the liquidation of the business. If at that time there was depreciation, it would be a capital depreciation, and would have to be met out of the capital reserve fund. It was not a depreciation that must be made good out of revenue. In regard to the future, if the war stopped tomorrow they would at once step back into their previous prosperity, but while the war continued profits could not improve. The revenue showed unexpected elasticity in the second half of 1915, and there was a real growth due to extended electrical power and heating business, and to somewhat increased charges to consumers. That increase had been well received, and they would profit more by it in 1916 than in 1915, but it was not a resource upon which they could largely depend. There came a point at which any increase of charge simply meant that the demand was cut down. They looked to increased heating and power demand to make up for the shop lighting loss. The report was adopted, and a resolution increasing the borrowing powers to the extent of £50,000 was also carried.

Westminster Electric Supply Corporation, Ltd.

Lamps, motors, &c., connected increased during 1915 from 41,201 KW. to 42,355 KW. Out of profits £2,000 has been set aside, together with £500 received for founders' shares cancelled in 1897, to the reserve fund; these sums more than cover the loss on investments realised during 1915. After allowing for depreciation, sinking fund and other charges, and paying 8 per cent. final on the ordinary shares, making 7 per cent. for the year, £1,518 is carried forward. Units sold 22,485,878 (including A.C. supply of 1,267,258); used on works 325,690. Annual meeting: February 23rd.

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National Electric Supply Co., Ltd.

Mr. John Booth, at the annual meeting on February 9th, said that the company had had to face the loss of many reliable men, increasing expenses for fuel, rates and taxes, and for the greater part of the year a falling revenue; but new consumers had enabled them to end the year with a record output for December. They had had to pay more for loans, and had now raised the rate of interest to 4½ per cent. and 5 per cent. Older machinery had been taken out, allowing for the installation of one of the latest and most efficient turbine sets, by which substantial saving would be effected in the fuel account. The balance on the net revenue was £13,358, against £15,240 a year ago. With an increased output and new machinery, the company was in an excellent position.

Davis and Timmins, Ltd.

The net profit for 1915, including £15,334 brought forward, after allowing for depreciation and manager's commission, was £61,555. After putting £5,000 to general reserve, to income-tax account £2,600, to depreciation on investments £452, paying 6 per cent. on the preference shares, and 8 per cent. on the ordinary, plus a bonus of 15 per cent. free of tax, £39,092 is carried forward subject to the special taxation of the year, the amount of which is at present unascertained. For 1914 the dividend was 8 per cent. and the bonus 15 per cent. Annual meeting: February 24th.

Electrical Distribution of Yorkshire, Ltd.

The net profit for 1915 was £3,634 (1914, £2,964; 1913, £2,569). Steady progress is again reported, and in view of the increased expenditure, the lighting restrictions, and other difficulties occasioned by the war, the results are very satisfactory. After including £602 brought forward, £1,000 is put to reserve, 6 per cent. is paid on the ordinary shares, and £1,031 is carried forward subject to directors' remuneration. The company's strong position is largely due to its close association with the Yorkshire Electric Power Co., and to the benefits of agreements with that company for bulk supply and management. These have enabled the year's difficulties to be met in a manner and at a cost which would not have been possible with separate generating stations and a separate organisation. The Selby and Stanley Provisional Orders have been granted, but they will not come into force until after the war, nor will further applications be considered by the Board of Trade during the war, save under exceptional circumstances. Annual meeting: February 29th.

Smithfield Markets Electric Supply Co., Ltd.—The gross profit for 1915 was £4,250 (£4,576 for 1914), and the net profit £2,816 (£3,139 for 1914). £400 has been put to debenture stock redemption, and £1,250 to depreciation. After paying the dividend of 2 per cent., £1,296 is carried forward. The output was maintained, but costs increased. Matters in dispute *re* existing oil plant have been settled on favourable terms and the cost charged to capital. An improved design oil generating set, to replace the last remaining steam set, will be ready for working in the early spring.

Cambridge Electric Supply Co., Ltd.—During 1915, 99 additional consumers were connected and 1,067,081 units were supplied, an increase of 55,246. The profit was £9,359, plus £2,647 brought forward. Debenture and other interest absorbed £1,793, £3,000 is put to depreciation fund, and, after paying 5 per cent. for the year on the ordinary shares, £2,753 is to be carried forward. The 1914 dividend was 6 per cent. Annual meeting: February 23rd.

Crossley Bros., Ltd.—Final dividend 3 per cent., making 5 per cent. for the year. The amount to credit of revenue account for 1915 was £99,015. £20,000 has been placed to reserve and £30,330 is being carried forward. Capt. Eric Crossley has been elected to the board in place of the late Mr. Brian Crossley (killed in action).

Central London Railway Co.—A dividend of 1½ per cent. is declared on the undivided stock for the past half-year, making 3 per cent. for the year; one of 2 per cent. on the preferred ordinary, making 4 per cent. for the year; and one of 2 per cent. for the year on the deferred ordinary, carrying forward £16,685.

Metropolitan District Railway Co.—After paying the dividend on the 4 per cent. guaranteed stock, and 4½ per cent. on the 4½ pref. stock, a dividend of 1½ per cent. is paid for the last half-year on the 5 per cent. second pref. stock, making 3 per cent. for the year, carrying forward £13,952.

Chelsea Electricity Supply Co., Ltd.—For the last half of 1915 the ordinary dividend is to be at the rate of 4 per cent. per annum, making 4 per cent. for the year; carrying forward about £3,260. The dividend for 1914 was 5 per cent.

London Electric Railway Co.—After paying the full dividend on the 5 per cent. pref. stock, a final dividend of ¾ per cent is to be paid on the ordinary shares, making 1½ per cent. for the year, carrying forward £12,303.

Telegraph Construction and Maintenance Co., Ltd.—In addition to the interim dividend of 5 per cent. a further dividend of 10 per cent., together with a bonus of 12s. per share, are now announced. The 1914 distribution was at the same rate.

National Boiler and General Insurance Co., Ltd.—Total dividend for 1915, 30 per cent., less tax.

Underground Electric Railways Co. of London, Ltd.—After paying the full interest on the 6th per cent. first cumulative income debenture stock, and on the 6 per cent. income bonds, £38,500 is to be carried forward.

Liverpool Overhead Railway Co.—For 1915 the gross receipts were £95,232, and the working expenses, including appropriation to reserve funds, were £64,435. Passengers carried 15,082,502, as against 13,361,944 in 1914. After paying 5 per cent. on both classes of preference, and 3¼ per cent. on the ordinary shares for the year, £6,873 is carried forward. Annual meeting: February 22nd.

London Electric Wire Co. and Smiths, Ltd.—Distribution on the ordinary shares for 1915: 12½ per cent. (7½ per cent. dividend and 2s. 6d. bonus). £50,000 is put to reserve and £28,559 is carried forward. For 1914 the dividend was 10 per cent.

Mather and Platt, Ltd.—Ordinary share dividend for 1915; 12½ per cent., less tax.

Fredk. Braby and Co., Ltd.—Interim dividend on the ordinary shares: 5s. per share, free of tax.

STOCKS AND SHARES.

Tuesday Evening.

Alteration in the form of this Stock and Shares article and price lists is rendered necessary, of course, by the Government's action with regard to the supply of paper. Journals have to make the best of it they can, without raising unnecessary fuss; and so, so far as this particular section of the Electrical Review is concerned, we say no more than to hope that the excision of various quotations from our lists of securities will not be a matter of noticeable inconvenience to any of our readers. From time to time, it is proposed to add to the accompanying tables others of securities such as these which we are taking out this week; and, as it has been said on former occasions, if there are prices which friends of ours find it difficult to obtain, we shall be always very pleased to do our best to get them.

Round the Stock Exchange markets are generally hard. There is a slight yielding in the prices of Consols and some of the other gilt-edged stocks, thanks to the permission just given by the Treasury to the French holder of British stocks and shares that he may sell in London markets, under stated restrictions. This has dislodged a certain amount of stock which was held on French account, seeking opportunity for some time past to be allowed to sell. Moreover, the shadow of the next War Loan once more drags across the investment markets. It was driven away in the early winter by the issue of Exchequer Bonds; but its advent cannot be delayed much longer, and the probable date assigned to it at present is somewhere in April.

The electric lighting markets are somewhat inclined to heaviness. Chelseas eased off to 3¾ on the reduction in the dividend from 5 per cent. to 4 per cent., but otherwise the list of West End shares is unchanged. South Londons maintain their rise of 3½, thanks to the repetition of the 5 per cent. dividend. There is a little doing in Westminsters, the price keeping hard at £6; while in the preference also there is an occasional bargain marked in the neighbourhood of £4.

City of London ordinary slipped back to 12, and the preference to 10¾, showing falls of 5s. in each case. The declines were associated with fears as to the ability of the company to continue the dividend of 9 per cent. paid a year ago on the ordinary shares. Counties are keeping very steady, and at 10 the price is full of dividend, showing a yield, therefore, of over 7 per cent. on the money, provided the distribution of last year is repeated.

Smithfield Markets Electric Supply Co. shows a net profit of £2,816—a decline of £323 as compared with last year. The dividend is maintained at 2 per cent. The shares have not changed hands since last October, when a bargain was marked at 17s. 1½d. For 1913, by the way, the dividend was 2½ per cent.

British Westinghouse preference have eased off to 44s. 6d. British Aluminium fell sixpence to 22s.; there are some 6 per cent. preference on offer about 18s., which are cheap as compared with a good many other of the £1 preference shares so popular at the present time. Why there should be a run after this particular class of shares it is difficult to see, but, in point of fact, the preference issue of any sound industrial company is readily taken nowadays, and at a price which looks extravagant when it is compared with the quotations for trustee securities.

The Home Railway market is quiet, with Underground Electric incomes once more the principal feature of strength. The price has risen another ¼ upon the declaration of the full £3 per cent. interest on the bonds. The other dividends from the Associated Electric Railway companies are in accordance with general expectation, but it must be confessed, now that the dividend is out, that none too much certainty was felt about the before-mentioned coupon for £3 being paid in full next month, although the odds were strongly in favour of it. Metropolitan ordinary stock is a dull market at 24, at which

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price it still looks too high. Districts loiter about 15, and there is no alteration in Central London stocks.

Brazil Tractions have risen to 51½, thanks to a recovery in the Rio exchange to 1s., a subsequent reaction to 11 15/16d. being regarded as negligible. The rally wipes out the greater part of last week's fall. Anglo-Argentine Trams are wanted, and most of the other securities associated with the Argentine Republic have come into request, from the National bonds downwards. Mexicans are very weak. No quotable changes are marked in the prices, but the feeling of disappointment deepens—disappointment mainly concerned with the failure of the United States to take any real steps towards the settlement of the country.

The Telegraph market is scarcely so firm. Eastern ordinary has recovered 10s., after its fall of last week; but the Anglo-American group is a little easier, and Globe preference went back to their par value of 10. West India and Panama shares are 1/16 lower. New York Telephone bonds keep at 101½, the Government price. More business in Marconis has resulted in the quotation improving to 1 31/32; but the subsidiaries are dullish in tone, Americans, for instance, being 16s. 3d. and Canadians about 6s. 6d.

Telegraph Constructions, in the manufacturing group, are £1 up at 37; and at 10¾ British Insulated ordinary show a 5s. rise. Babcock & Wilcox keep steady. The armament group is dull, though the Webley & Scott Co. shows its profits quadrupled, as compared with those of a year ago. The rubber market is active and strong, the raw material having risen to 3s. 7d. per lb., which brought in a fresh accession of buyers for all the popular shares.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Feb 15, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.				
Brompton Ordinary	10	7½	—	£3 18 4
Charing Cross Ordinary	5	2½	—	7 2 10
do. do. 4½ Pref.	4½	3½	—	6 0 0
Chelsea	5	3½	—	6 13 4
City of London	9	12	— ¼	7 10 0
do. do. 6 per cent. Pref.	6	10½	— ¼	5 11 7
County of London	7	10	—	7 0 0
do. do. 6 per cent. Pref.	6	10½	—	5 17 8
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	1⅝	—	8 8 4
do. do. 6 per cent. Pref.	6	4½	—	7 1 2
Metropolitan	8½	2½	—	7 15 7
do. 4½ per cent. Pref.	4½	3	—	7 10 0
St. James' and Pall Mall	10	6	—	8 6 8
South London	5	3¼	—	8 6 8
South Metropolitan Pref.	7	1⅞	—	6 14 0
Westminster Ordinary	9	6	—	7 10 0
Telegraphs and Telephones.				
Anglo-Am. Tel. Pref.	6	103½	—1	5 19 0
do. Def.	33/6	21½	—	7 14 8
Chile Telephone	8	6¼	—	6 10 8
Cuba Sub. Ord.	5	7⅜	—	6 9 0
Eastern Extension	7	19½	—	*6 5 0
Eastern Tel. Ord.	7	127	+ ⅛	*6 5 6
Globe Tel. and T. Ord.	6	10½	—	*6 12 6
do. Pref.	6	10	— ¼	6 0 0
Gt. Northern Tel.	22	34	—	6 8 6
Indo-European	18	49	—	6 15 4
Marconi	5	13½	+ 1/32	6 8 1
New York Tel. 4%	4½	101¼	—	4 8 4
Oriental Telephone Ord.	10	1½	—	5 18 6
United R. Plate Tel.		5¾	—	*7 19 0
West India and Pan.	1	1 7/16	— 1/32	9 10 6
Western Telegraph	7	12⅛	—	*6 4 6
Home Rails.				
Central London, Ord. Assented	4	60	—	5 16 0
Metropolitan	1½	24	— ¼	5 8 6
do. District	Nil	15	—	Nil
Underground Electric Ordinary	Nil	1⅛	—	Nil
do. do. "A"	Nil	6/-	— 6d.	Nil
do. do. Income	6	84⅞	+ ⅛	*8 2 0
Foreign Trams, &c.				
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	44	—	6 18 6
do. 2nd Pref.	5½	34	—	7 17 2
do. 5 Deb.	5	79½	—	6 5 6
Brazil Tractions	4	51½ xd	+1⅛	7 17 0
Bombay Electric Pref.	6	10 xd	—	6 0 0
British Columbia Elec. Ry. Pfds.	5	55	—	9 1 10
do. do. Preferred	—	37	—	Nil
do. do. Deferred	—	34	—	Nil
do. do. Deb.	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	42	—	Nil
do. 5 per cent. Bonds	—	37	—	Nil
Mexican Light Common	Nil	29	—	Nil
do. Pref.	Nil	28	—	Nil
do. 1st Bonds	—	42	—	—
Manufacturing Companies.				
Babcock & Wilcox	14	2⅜	—	5 6 8
British Aluminium Ord.	5	23/-	— 6d.	4 17 0
British Insulated Ord.	15	10¾	+ ¼	6 19 6
British Westinghouse Pref.	7⅛	44 6	- 6d.	6 14 4
Callenders	15	11½	+ ⅛	6 10 5
do. 5 Pref.	5	4¼	—	5 17 8
Castner-Kellner	20	59	—	6 8 0
Edison & Swan, £8 pd.	Nil	7/-	—	Nil
do. do. fully paid	Nil	1½	—	Nil
do. do. 5% Deb.	5	80	—	6 6 8
Electric Construction	6	15/-	—	8 0 0
Gen. Elec. Pref.	6	6⅞	+ ⅛	6 4 8
Henley	20	14	+ ¼	*8 8 0
do. 4½ Pref.	4½	4¼	—	5 6 0
India-Rubber	10	9¼	—	*11 19 0
Telegraph Con.	30	37	+1	*7 8 6

*Allowance made for dividends being paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, February 16th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	..	..
a " Nitric	"	..	..
a " Oxalic	per lb.	1/4	..
a " Sulphuric	per cwt.	..	..
a Ammoniac Sal	"	£70	..
a Ammonia, Muriate (large crystal)	per ton	£54	..
a Bleaching powder	"	..	..
a Bisulphide of Carbon	"	£28	..
a Borax	"	£25	..
a Copper Sulphate	"	£45	..
a Lead, Nitrate	"	..	..
a " White Sugar	"	..	..
a " Peroxide	"	..	..
a Methylated Spirit	per gal.	..	..
a Potassium, Bichromate, in casks	per lb.	..	..
a Potash, Caustic (98/99 %)	per ton	..	..
a " Chlorate	per lb.	1/8	..
a " Perchlorate	"	1/6	..
a Potassium, Cyanide (98/100 %) (for mining purposes only)	"	Nom.	..
a Shellac	per cwt.	75/-	..
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	"	£18	30/- inc.
a " Recovered	"	..	..
a " Lump	"	£9	..
a Soda, Caustic (white 70/72 %)	"	..	..
a " Chlorate	per lb.	1/4½	..
a " Crystals	per ton	60/-	..
a Sodium Bichromate, casks	per lb.	9d.	½d. inc.
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	..	..
b " Wire, in ton lots (1 to 14 S.W.G.)	"	..	..
b " Sheet, in ton lots	"	..	..
a Babbitt's metal ingots	"	..	..
c Brass (rolled metal 2" to 12" basis)	per lb.	1/3½ to 1/4½	1½d. inc.
c " Tubes (solid drawn)	"	1/4½ to 1/5	1d. inc.
c " Wire, basis	"	1/4½ to 1/4¾	1½d. inc.
c Copper Tubes (solid drawn)	"	1/6½ to 1/6¾	1½d. inc.
a " Bars (best selected)	per ton	£143	£13 inc.
a " Sheet	"	£148	£12 inc.
a " Rod	"	£143	£13 inc.
d " (Electrolytic) Bars	"	£155	£12 inc.
d " " Sheets	"	£153	£12 inc.
d " " Rods	"	£142	£ 2 inc.
d " " H.C. Wire	per lb.	1/4½	1½d. inc.
f Ebonite Rod	"	8/-	..
f " Sheet	"	2/6	..
a German Silver Wire	"	2 2	..
b Gutta-percha, fine	"	6/10	..
b India-rubber, Para fine	"	3/2½	½d. inc.
f Iron Pig (Cleveland warrants)	per ton	94/5	8/8 inc.
f " Wire, galv. No. 8, P.O. qual.	"	£20	..
g Lead, English Pig	"	£32 15	10/- inc.
g Mercury	per bot.	£16 12 6 to £16 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e " " " medium	"	8/6 to 6/-	..
e " " " large	"	7/6 to 14/- & up.	..
e Nickel, sheet, wire, &c.	"	Nom.	..
g Phosphor Bronze, plain castings	"	..	..
g " " rolled bars & rods	"	..	..
g " " rolled strip & sheet	"	..	..
e Platinum	per oz.	..	..
d Silicium Bronze Wire	per lb.	1/6	..
c Steel, Magnet, in bars	per ton	£85	..
g Tin, Block (English)	"	£184	£2 10 inc.
a " Wire, Nos. 1 to 16	per lb.	2/9	..
g White Anti-friction Metals	per ton	..	..
k Zinc, Sh't (Vieille Montagne bnd.)	"	Nom.	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m P. Ormiston & Sons.
n Johnson, Matthey & Co., Ltd.
o
r W. F. Dennis & Co.

City and South London Railway Co.—Final dividend 2½ per cent., making 5 per cent. for the year on the 5 per cent. pref. stocks, carrying forward £9,027.

Kensington and Knightsbridge Electric Lighting Co., Ltd.—Final dividend on the ordinary shares 4 per cent., making 7 per cent. for 1915, as compared with 9 per cent. for 1914.

Newcastle and District Electric Lighting Co., Ltd.—Owing to war conditions no dividend is recommended for 1915. For 1914 3 per cent. was paid.

London Electric Supply Corporation, Ltd.—Dividend on the ordinary shares 3 per cent. for 1915, as compared with 4 per cent. for 1914.

Tottenham District Light, Heat and Power Co.—The electricity department receipts for 1915 were £574, and the expenditure was £547; balance £27.

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NOTES ON ELECTRIC WELDING PRACTICE.

(*Concluded from page* 184.)

As a final example, fig. 27 shows the Clarkson system of building up steel wheels for automobiles by butt welding. Radial bosses on the drop-forged nave A are drilled and machined externally to form a short tubular section of diameter and area equal to that of the tubular spoke B, which is then welded in place. At the outer end a rim attachment, consisting of a tubular section (equal to that of the spoke) expanding in the form of an elliptical "bell" to the curved flange plate, is welded to the spoke, and the rim is then shrunk on after machining the periphery of the attachment plates. An exceptionally strong and neat construction results.

"*After-working.*"—After completing an electric weld, and usually whilst the metal is still hot, a thermal or mechanical treatment may be given with a view to relieving possible internal stresses, hardening or softening, or to remove or re-fashion extruded material. In arc welding the arc may be "played" by a skilled workman so as to prevent severe contraction stresses being set up, and it is common to hammer the joint by hand whilst it is cooling. Percussive welding does not heat the work appreciably; no thermal after-treatment is required, and the only mechanical finishing necessary is to grind off the fin which is quite thin but usually sharp.

If it is required to anneal a butt welded joint, it is only necessary to increase the jaw separation somewhat and pass a gradually decreasing current (considerably less than the welding current) through the joint. If the material has to be hardened it can be heated to any desired degree electrically and then quenched. Opening and closing the switch so as to pass the full welding current intermittently is a possible means of causing moderate heating, but is not recommended for regular practice. Incidentally, it may be noted that "resistance heating" in a butt or spot welder can often be used very advantageously to heat parts for bending, forging, hardening or annealing, whether or not welding is actually performed. Annealing is essential at welded joints in high carbon and certain other alloy steels. On the other hand, a weld in copper is soft, so that if the joint is in wire which has to be redrawn, the whole should be annealed.

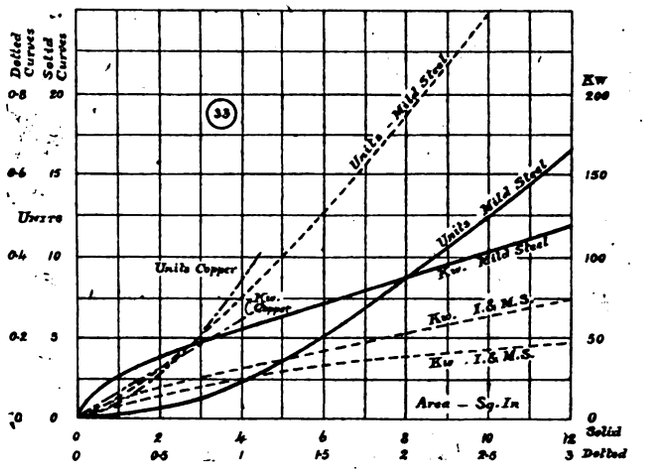
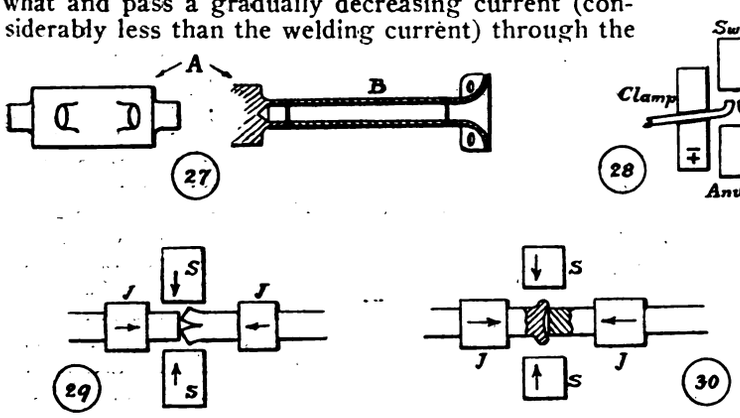


FIG. 33.

Often it is desired to leave a welded joint of the same size as stock in which it is made. This is practically the case if sheets are chamfered and arc welded, but in butt-welding a burr is necessarily formed, which may be swaged down by hand or automatically by hammering or pressure. Fig. 28 shows in principle a means of overcoming the difficulty of true edge-to-edge butt welding between thin sheets and also of reducing and smoothing the burr formed.



FIGS. 27–30.

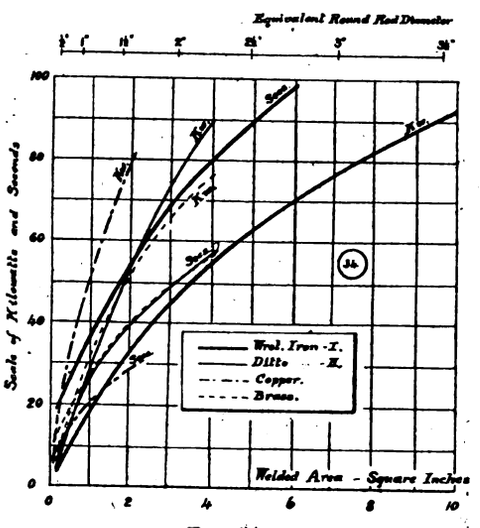
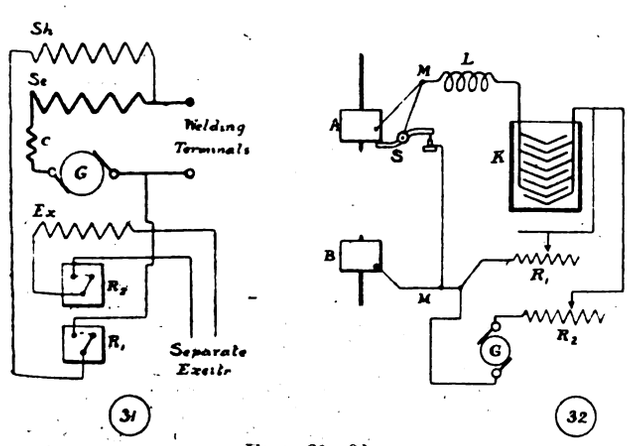


FIG. 34.

To form a smooth joint between two bars the end of one may be split and splayed as in fig. 29, or shaped as in fig. 30, so that when welding heat is reached, and the jaws JJ and swaging blocks SS are all moved inwards, practically a cylindrical joint remains. There is obviously a risk that full welding heat will not be reached all over the section and that foreign material may be included in the joint. For most purposes a plain butt joint is simplest and best, the burr being ground off if necessary. The object of the special arrangements shown in figs. 29 and 30 is not so much to avoid a burr (which could be ground off) as to prevent shortening the stock whilst still permitting that displacement of metal at the moment of welding which is necessary for satisfactory union. A method serving the same end and tending to greater reliability in the body of the weld is to force in a "filling" pellet or strip of metal at the joint, subsequently grinding off surplus material.



FIGS. 31–32.

Current Supply, Regulation and Consumption.—Generally welding equipments are sold complete and installed under expert supervision so that arrangements for current supply are generally suited to the

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work to be done. Though well known to every electrical engineer, it is not so generally appreciated amongst those using or interested in welders that only 50 or 60 volts is needed or can be used effectively by a carbon arc (less by metal arcs), so that a low voltage motor generator is generally good business. A constant current generator overcomes much of the difficulty of drawing a steady arc of suitable intensity on the work itself. Connections for the Kramer constant current, commutating pole dynamo are shown in fig. 31, where C represents the commutating pole winding, *se* a differential series field winding, *sh* a shunt field system, and Ex a separately excited fine wire field winding. By adjusting the regulator R1, the dynamo voltage is controlled whilst the regulator R2 adjusts the welding current. Once adjusted, the latter remains constant over a considerable range of weld resistance (*e.g.*, 150 amps. from 0 to 0.5 ohm weld resistance, falling to 100 amps. at 1.1 ohms). Since a single arc welder is rarely employed, and since some hundreds of amperes each is a reasonable average, supply has to be taken from power or traction mains, and this renders a low voltage set commercially essential. The latter should be used with a switchboard containing voltmeter and ammeters, controllers for the motor and compound generator, and an automatic short circuiting switch. Alternating current is not suitable for arc welding.

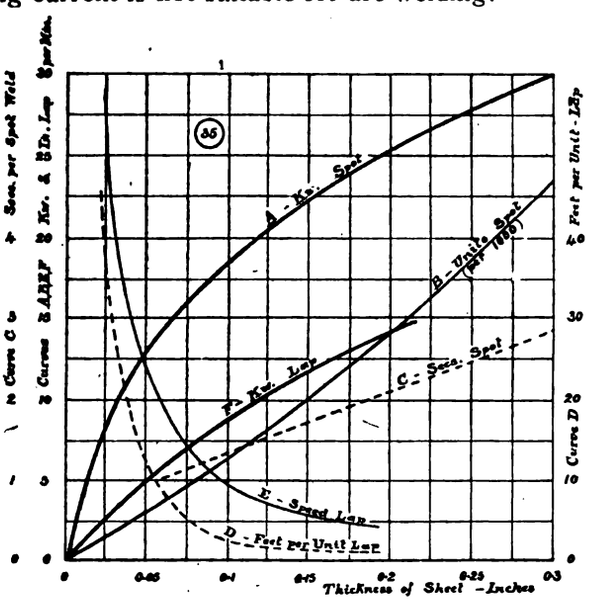

Fig. 35.

Percussive welding needs only a large electrolytic condenser and charging motor generator, the general arrangement of the circuit being as in fig. 32, where G is a C.C. dynamo charging a discharge circuit R1, K, L through a variable high resistance R2. The switch S short circuits the lines MM whilst work is being inserted in the welding jaws AB. By a suitable mechanical device, the switch S is opened (permitting K to become charged), and the falling jaw A is released practically simultaneously. The welding action which occurs directly the piece A reaches B has been described already.

The current consumption in a butt weld is reckoned by thousands or ten thousands of amperes, though the p.d. required across the weld is only a few volts. Obviously alternating current supply is the only practicable solution, primary supply at 100 to 500 volts, single phase, 50 cycles being convenient. Regulation of the secondary current may be by reactance in the primary, by varying the primary turns or by varying the supply generator excitation if a special generator be used. Varying the effective primary turns, say to 75%, 50%, and 25% maximum, by a plug switch (this eliminating the risk of short-circuiting turns), gives coarse control which can be amplified by finer sub-division, by reactance, or, to some extent, by varying contact pressure between the pieces heated. The circuit is naturally opened in the primary to save damage to switches, jaws or work, by attempting to interrupt the heavy secondary current directly. If considered necessary, a choker with rising and falling core can be used to smooth out the current demand. All but very heavy welders can be run unbalanced on one phase of a 3-phase power network.

As regards actual energy consumption, this has formed the subject of a number of special papers and articles, and really demands detailed treatment since the mechanical form of the work modifies considerably the energy consumption for a weld of given area (an extreme case, for example, being the difference in consumption for a weld between two bars and a weld in a small ring of the same sectional area). Within comparatively wide limits, and particularly in the case of butt welding, a satisfactory joint can be made with a certain current for a certain time, or with a less current for a longer time. Naturally the energy consumption is greater in the second case, owing to the greater heat losses, and for every piece of work there is a best all-round current and time. The permissible range of current is much greater with wrought iron or mild steel than with brass or aluminium.

A collection of curves based on data from a variety of sources is presented graphically in figs. 33-35; figs. 33 and 34, referring to butt welding, and fig. 35 to spot and lap welds: the curves can only be accepted as a general guide, since the number of variables is great and their effect complicated. Somewhere about ⅔ cb. in. of metal per KW.-hour can be filled into blow-holes, etc., using a metal electrode arc process, and from 10 to 20 ft. per hour of seam can be arc welded in steel plate according as the latter is ¼ to ⅛ in. thick. On repetition work surprising outputs can be attained in butt and spot welding machines, though the actual figures depend largely on the exact mechanical form of the work. Hoops and tires from 2 to 9 inches in width can be welded at the rate of 10—15 per hour; 600 to 1,000 or more spot welds, each equivalent to at least one rivet, can easily be made per hour, and chain links can be welded at a similar rate.

An immense variety of electric machines are now available to meet practically any needs. One or other of the basic systems, arc, resistance or percussive welding, is employed in each case, the distinction between the innumerable machines operating on each system lying in such important mechanical details as jaw opening and closing gear, upsetting mechanism, contact cooling, and general arrangement of controls. The art and science of electric welding have been brought to such perfection that there are few metal-using industries in which electric welding does not or could not find very advantageous application.

BRITISH TRADE AFTER THE WAR.

(*Concluded from page* 165.)

On the subject of trade exhibitions, the Sub-Committee says:—

Trade Exhibitions.

"It was the general opinion that the organisation by private enterprise of exhibitions for financial profit, including and encouraging retail stalls, entertainments and side shows, is of no substantial benefit to traders; on the other hand, the highest appreciation was expressed of the British Industries Fair organised by the Board of Trade, and it was urged upon us that the Fair should be repeated and, if possible, made an annual institution. Emphasis was laid on the necessity of maintaining the Board of Trade control, and of stringently enforcing the rules as to exhibition by manufacturers only, and the exclusion of the general public. It was also suggested that the longest possible notice should be given, so as to give over-sea buyers ample opportunity to attend. The B.E.A.M.A. represented that in their opinion the expenditure of Government money on British participation in recent international exhibitions abroad had not greatly benefited British industry."

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The Committee recommends that the following broad principles should be adopted in respect of future trade exhibitions:—

(*a*) Trade exhibitions should be held under the control of the Board of Trade.

(*b*) Exhibitions should be exhibitions of manufacturers' wares for traders, and should not be organised with a view to attracting the general public.

(*c*) Exhibitions should not be too general in scope, but should be for a limited number of branches of industry at a time, according to the importance and dimensions of each particular industry in this country.

(*d*) At least one year's notice of the intention to hold any particular exhibition should be given to manufacturers.

Trade Marks.

As regards the Merchandise Marks Act, practically all the witnesses urged that the provisions of the Act should be strengthened so as to require compulsory marking indicative of foreign origin, that such marking should be on every imported article to which the requirement extends, and that mere marking of the wrapper or other packing should not be sufficient. In the case of glassware it was suggested that the marking should be in the glass itself. A number of witnesses expressed strongly the opinion that goods of enemy origin should be marked distinctly with the name of the country of manufacture, and not with some less definite indication, such as "foreign made" or "not British."

"Some of the witnesses urged that the Customs should prevent the entry into this country of goods which bear infringing trade marks, but it would appear that the existing arrangements in this respect are not fully known or understood. We understand that the Customs have at present a system of registration of trade marks, the property of manufacturers, dealers, or traders in this country. Under this system a manufacturer who has reason to believe that his name or trade mark is one not unlikely to be imitated so as to constitute a forgery may apply for registration for his name or mark. On such registration being completed the Customs officers are apprised, and in the event of any goods bearing such name or trade mark being observed by them in the course of their examinations, the firms registering are immediately informed, and on their statement that the marks are infringements, the detention of the goods is continued. A bond is entered into by the firm to cover this detention, and unless some satisfactory arrangement is concluded between the importer and the possessor of the infringed mark the goods are in due course confiscated."

The Committee received various representations respecting the protection of British trade marks abroad. Its recommendations are as follow:—

(*a*) All German and Austrian goods imported into the United Kingdom should be required to be marked with an indelible mark "Made in Germany," or "Made in Austria-Hungary," and goods imported from other foreign countries should be similarly marked either with the country of origin or with the words "Foreign made" or "Not British." Such marking should be in all cases on the actual goods, and not merely on the package.

(*b*) Alien firms and alien-owned companies should be prohibited from registering in the United Kingdom trade marks containing English words.

(*c*) The Government of India should be urged to reconsider the question of the establishment of trade mark registration in India.

(*d*) As regards the entry into this country of goods bearing infringing trade marks, there seems nothing to complain of in the Customs practice set out in the above quotation, as a public department cannot be called upon to undertake actions for the protection of private rights, and we endorse it, but there is an additional requirement which should be put into force, viz.:—

"As a part of the information to the firm affected by the infringement, there should be supplied as a matter of course, the names of the consignor and consignee, which have hitherto been withheld on the ground that the Customs have no power to give the required information, which is in many cases actually in their possession. In cases where shippers, or brokers, are alone concerned in the importation, the Customs should be enabled to require full information as to the original consignor, and the actual consignee, as a condition of entry of the goods, and this should be effected by legislation, or by regulation, as may be found necessary. In support of this view it is only necessary to point out that the first step in any action for infringement is to ascertain the identity of the infringer, and that this should be withheld by a British department, when in its possession, is wrong as a question of policy, and really amounts to a screening of the offending foreigner, and the confederate recipient in this country, who is often a mere agent of the consignor, occupying a small office. The Customs should, therefore, in our opinion, be furnished with necessary powers and required to use them when granted."

"His Majesty's Consular Officers should be directed, so far as practicable, to watch for, and report immediately with the fullest details obtainable, cases of the apparent infringement of British trade marks, or attempts to pass off foreign-made goods as British."

A Ministry of Commerce.

The B.E.A.M.A. and the Paper Makers' Association made suggestions on this subject. The Committee says that the suggestion is believed to be due "to a feeling in trade circles that the great variety of duties which the Board of Trade has to discharge unavoidably prevent that concentration of attention on commercial and trade matters which is desirable." The B.E.A.M.A. further urged that it should be the duty of the Ministry of Commerce not only to promote trade but "to champion its cause against any other Department which seeks to impose restrictive conditions." The Association's witnesses took exception to the connection of a Ministry concerned in the development of trade with a Department which issues "regulations as to public safety and all the numerous regulations which emanate from the Board of Trade."

On this point the Committee recommends:—

"H.M. Government should be urged to consider anew the advisability of establishing a separate Ministry charged solely with the safeguarding and extension of British industry and trade, and freed from the regulative duties in respect of Railways, Shipping, and Harbours, and the duties in respect of Labour, which at present devolve upon the Board of Trade."

Trade Commissioners and Consuls.

It was suggested to the Committee that the system of Trade Commissionerships under the Board of Trade, which has proved so successful in the Self-Governing Dominions, should be extended to the principal foreign countries. "We heard a certain amount of criticism of the Consular Service. Whilst no doubt there has been justification in the past for some of the complaints as to the inattention of Consular Officers to commercial matters, and their inexperience in regard to them, and weak spots are still to be found in the existing organisation, we think that the general level of the Consular Service in this respect has risen appreciably in recent years. We are of opinion that more weight should be attached to commercial knowledge and experience in the appointment of Consular Officers, though we recognise that other considerations must be taken into account; but in regard to both Trade Commissioners and Consular Officers we may point out that we are informed by the Board of Trade that numerous complaints are received from both classes of officials that British traders and their travelling representatives do not make sufficient use of them, and that the officials are thereby deprived of the opportunities which they desire to have of obtaining at first hand practical information as to the particular ways in which they might be of service to British manufacturers and merchants."

The Committee recommends on these points:—

"The appointment of Trade Commissioners responsible, and reporting directly, to the Board of Trade, should be extended to the principal foreign countries."

"The organisation of the Consular Service should be dealt with so soon as possible after the completion of the Report of the Royal Commission on the Civil Service, with a view to the increase of its commercial utility."

The Metric System.

The B.E.A.M.A. urged that a Government inquiry should be instituted into the desirability of adopting decimal coinage and the metric system both for this country and in the Dominions. "The use of the metric system is, of course, already permissible; as to any Government action beyond that we are aware that opinion is divided; and we content ourselves with recording these suggestions."

Travellers and Catalogues.

The Committee recommends:—"Representations should be made to the Governments of the Self-Governing Dominions and of the Colonies with a view to the preferential treatment of British commercial travellers in respect of licence fees."

"Representations should be made to the Governments of such British possessions as levy import duties on imported catalogues and trade circulars, with a view to the substantial reduction of such duties in respect of the catalogues and circulars of British manufacturers."

Techuical Training.

The Committee refers briefly to the "insufficient importance attached in this country to technical training, in spite of the progress made in some directions, and the advantages which the manufacturers of Germany have derived from the more developed and systematic schemes in operation there. Suggestions as to the failure by employers and employed alike to appreciate the full importance of technical training were made in several instances. "We were glad to learn, however, that in the glass industry there are signs of a marked improvement in this respect."

Those Continental Tours.

We can almost hear the smile of some of our readers as they remember some electrical excursions which may not have been in the mind of the Committee when it penned the following:—

"The other matter to which we would direct attention is the attraction which Continental buying exercises upon British distributing houses. The periodical visit to the Continent, combining a business tour with a pleasant holiday, and the entertainment provided by German manufacturers, presents strong attractions to the representatives of British distributing firms, and is not likely to be given up by them unless there are very strong motives for such action. The cumulative effect of this particular consideration on a large number of firms in leading them to prefer to deal with Continental makers, even when British firms are offering goods of similar quality at competitive prices is, we think, very considerable."

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Tariff Protection.

The Committee says that the preceding matters were, in the representations made to it, of secondary importance in comparision with the question of the possibility or otherwise of tariff protection after the war. Practically all the representative firms and associations consulted asked for a measure of Protection. The reasons advanced were as follow:—

"There is a general fear that, immediately after the war, this country will be flooded with German and Austro-Hungarian goods, sold at almost any price, and that the competition in price which was going on before the war will be accentuated, with resultant serious difficulty to all manufacturers of goods of kinds exposed to this competition, and positive disaster to those manufacturers who have been encouraged to extend their operations, or engage in new branches of industry, with a view to capturing trade hitherto carried on by enemy countries.

"The causes of the ability of German firms in the past to undersell their British competitors, on which most emphasis has been laid in the representations made to us, are:—

"(*a*) The low railway rates charged in Germany on goods for export, and other transport advantages.

"(*b*) The industrial combinations in Germany, which, with a large home market secured to them by the tariff, were able to produce on a large scale and to dispose of their surplus product abroad at very low prices.

"(*c*) The low rates of wages prevailing in certain industries in Germany.

"In some cases it was admitted that lower wages are not the cause of the lower prices at which German goods are offered. Thus we were informed as regards paper-making that 'the labour bill, for the same class of output, is much the same in Germany as in Bury'; that in the electrical industries 'in 1913 hours of labour were slightly longer in Germany than in England, wages were about the same in the two countries, and the standard of labour was better in Germany.'

"The conviction that the prices at which German goods will be offered in the British and neutral markets after the war will be even lower than the pre-war quotations is based on two assumptions—first, that in some branches of industry at least Germany has been accumulating large stocks during the war, and secondly, that immediately upon the conclusion of peace she will make every effort to recover her position in the world's markets, and to crush nascent competition, and that in carrying out that policy cheapness will be a potent weapon. Whatever may be the truth as to the accumulation of stocks, we do not think the validity of this second assumption is open to doubt."

Magnetos.

The Committee directs special attention to magnetos:—

Prior to the outbreak of the war the trade in magnetos, which are of great importance for all forms of motor-cars and aircraft, as well as for other purposes, was virtually monopolised by the Bosch Co., of Stuttgart, a very powerful organisation with great resources. The result was that at the sudden commencement of the war there were no manufacturers in this country, where the normal demand was about 5,000 magnetos per week; since then it has substantially increased, especially for military and naval purposes. A number of British firms took up the manufacture, and with the assistance of Sheffield in respect of the production of magnet steel, they have succeeded in making magnetos which have passed the Government tests and are asserted to be as good as the Bosch products. The firms are receiving large Government contracts, and there seems to be no doubt that in this instance (which is specially important as being one of a "key" industry) a considerable British manufacture could be built up which, *inter alia*, would guard against a repetition of the serious difficulties caused in the early stages of the war by our dependence on foreign supplies. The one obstacle is the reluctance of the firms concerned to commit themselves to further capital outlay, and the unwillingness of outside capital to come to their assistance, unless assured of some security against the strenuous efforts which the powerful Bosch concern will undoubtedly make after the war to break down the new British enterprise. The representatives of this industry asked that Government assistance might be afforded them in the shape of (1) an undertaking that the Government Departments concerned in motor transport and the air services would undertake to make use only of British magnetos made (so far as practicable) only of British parts—such undertaking to be for a term of years after the conclusion of the war; and (2) the extension to all magnetos of the import duty of 33⅓ per cent. imposed upon magnetos imported as parts of motor cars. We reported to the President of the Board of Trade that, in view of the importance of the manufacture of magnetos for military and naval purposes, its position as a "key industry," the efforts which the manufacturers have made, and the undoubtedly severe competition from the powerful Bosch interests which they will have to encounter after the war, we were unanimously of opinion that Government assistance might be given in the two forms desired by the industry.

The amount of the tariff duties which it was suggested should be imposed naturally varied with the different branches of industry.

The B.E.A.M.A. Protection Proposals.

The following resolution, recently passed by the Council of the British Electrical and Allied Manufacturers' Association, was communicated to the Committee:—

"Resolved, that it is the considered opinion of the Council of this Association that the Government should, as soon as possible, proceed to formulate a tariff scheme, embodying:—

1. An Imperial Customs Union between Great Britain and her overseas Colonies, Dominions and Dependencies, with a view to the adoption at some later period of free trade within the British Empire.
2. A tariff on all goods imported into this country which are such as can be efficiently and economically manufactured in British workshops.
3. That a substantial preference should be given to all goods, whether manufactured or otherwise, imported from any portion of our overseas Empire.
4. That a smaller preference than the foregoing be given to those countries which are now allied with us in defending the right of national existence against the dominating influence of the Central European Powers.
5. That such preference as may be possible, having in view the balance of trade between nations, be given to neutral countries.
6. That the duty imposed on goods of Austrian and German manufacture should be of a highly protective character, not only in Great Britain, but also in the overseas parts of the Empire."

Some other suggestions were put forward for the protection of British manufacturers in other ways. These are:—

(*a*) The confiscation of, or imposition of a substantial duty on, imported goods unaccompanied by a British Consular certificate to the effect that the goods are not invoiced to this country at a lower price than would be obtained for them in the domestic market of the country of manufacture (*i.e.*, "anti-dumping" legislation).

(*b*) Restriction of British Government contracts to British goods, or a preference to such goods in respect of price. The reasonableness of this claim was strongly urged upon us by representatives of the new magneto industry, and also in the case of table glassware.

The British Science Guild reported that a large number of educational institutions and authorities had already undertaken not to purchase any chemical glassware of foreign manufacture for a period of three years after the war, provided that an adequate supply of British manufacture is forthcoming.

(*c*) That in respect of the raising of loans or the levying of taxes by municipalities or public bodies for carrying out works of public utility, it should be a condition imposed by the Central Government that preference be given to British manufacturers. Such preference might, it was suggested, be limited to 10 per cent., as a check upon trade combines.

The Committee Recommends Import Duties.

On this matter the Committee recommends:—

"*Tariff Protection.*—Where the national supply of certain manufactured articles, which are of vital importance to the national safety, or are essential to other industries, has fallen into the hands of manufacturers and traders outside this country, British manufacturers ready to undertake the manufacture of such articles in this country should be afforded sufficient tariff protection to enable them to maintain such production after the war. With reference to the strongly-expressed opinion of many of the witnesses that the enactment of protective duties on the industries other than those referred to in the preceding paragraph, which have formed the subject of our inquiry, is essential to their maintenance, we wish to report that in view of the following considerations:—

(*a*) That there exists a strong desire to respond to the feeling in our Dominions in favour of an Imperial preference in trade, and that there is also a strong desire to arrange preferential trading with those who are our Allies in the present war, and

(*b*) That the present high direct taxation tends to raise the rate of interest on money, and cheap and abundant capital for the employment of their labour is of the greatest importance to the working classes,

it will be necessary to impose some widely-spread import duties, and we are therefore prepared to recommend that a larger proportion of the revenue should be raised by reasonable import duties. We are of opinion that such import duties would go a long way towards satisfying the requests for special protective treatment for the industries which we have had under consideration. We would only add that in view of the threatened dumping of stocks which may be accumulated in enemy countries, the Government should take such steps as would prevent the position of industries, likely to be affected, being endangered after the war or during the period required for a wider consideration of the whole question."

Cold Water and a Reservation.

The recommendations of the Committee are subject to this consideration:—

"We are fully conscious of the limited range of the inquiry, and that the particular branches . . . cannot well be singled out for special Government action; our investigations have been devoted only to a comparatively small portion of the immense field of British industry, and the conclusions at which we have arrived might consequently be modified in some respects were the range of inquiry to be extended."

The signatories to the report are:—Algernon F. Firth; A. J. Hobson; Stanley Machin; E. Parkes; and Albert Spicer. (Percy Ashley, Secretary.)

Sir Albert Spicer adds a reservation in respect to the immediate enactment of protective duties, which concludes as follows:—

In view of these recommendations, which are all protective in effect, and of the fact that during the continuance of the war manufacturers are automatically protected, and that for some years after the war protection, equivalent to import duties, is likely to be afforded by the prejudice against German and Austrian goods, I feel that the consideration of a tariff for these special industries should wait until after the war, unless it can be undertaken earlier, when the whole issue can be again considered in the light of what, I hope, will be an agreed policy with our Dominions overseas and our present Allies.

Electrolytic Disinfectant.—Our contemporary, *Nature*, in a note on new antiseptics refers to the use of electrolysed sea-water for the disinfection of hospital ships, remarking that though the production of hypochlorite by the electrolysis of salt solution for bleaching purposes, and the powerful antiseptic properties of hypochlorite so produced, have long been known, the idea of electrolysing sea-water on the vessel which is to be disinfected is a novel one. It is due to Dr. H D Dakin, whose apparatus consists of an electrolytic cell, which, with a current of 65-75 amperes at 110 volts, yields a solution of two parts per 1,000 of hypochlorite at a cost of about 3d. per 100 gallons. This solution, diluted with an equal volume of sea-water, is sufficiently strong to sterilise floors, decks, latrines, &c. It has been used on the *Aquitania* on her last two voyages, with excellent results.

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THE ELECTRIC ARC IN VAPOURS AND GASES AT REDUCED PRESSURES.*

By W. A. DARRAH.

A study of the light efficiency of an arc from a chemical standpoint, shows that there is a certain rather limited class of substances which, when introduced into the arc in small quantities, produce a very great increase in luminosity. Thus the addition of small quantities of cerium or calcium compounds to the carbon arc may increase its efficiency over 300 per cent., and the addition of titanium (preferably as an oxide) to the magnetite arc similarly produces an increased luminosity without a corresponding increase in energy consumption.

A study of these facts led to the conception that perhaps an arc could be maintained in a closed vessel and supplied with these light-producing elements in the vapour form. Titanium, tungsten, and other elements which increase the luminous efficiency of an arc, may readily be secured in the form of volatile liquids.

Preliminary tests having indicated the possibilities, as well as the difficulties to be overcome, lamps were constructed and a detailed study was made of the effects of the various available electrode materials, the different vapours, and different designs of lamp. A hard glass was employed, which allowed of the sealing of tungsten wires and rods directly into the globe with the aid of a flux of potassium nitrate and borax. This enabled heavy seals to be used. Figs. 1 and 2 show designs which were found fairly satisfactory.

The lamp consists essentially of a chamber at the centre of which an arc is drawn between tungsten electrodes about $\frac{3}{16}$ in.

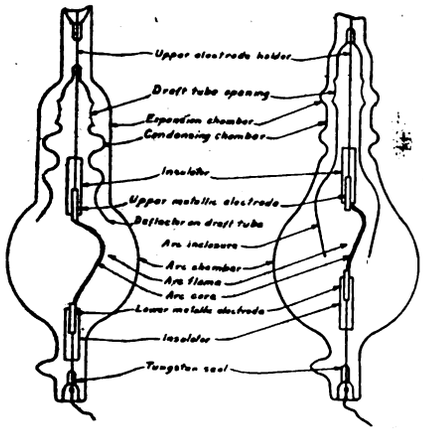

Fig. 1.

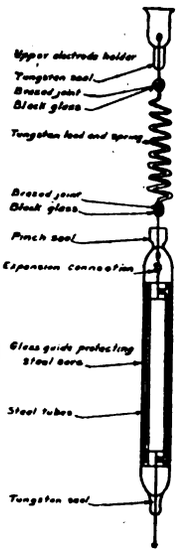

Fig. 2.

Fig. 3.

in diameter. The electrodes are partly surrounded with a refractory insulator, intended to keep the arc from moving far from the ends of the electrodes, as this allows the arc to extend and ultimately to rupture. The refractory insulator, also assists in keeping the electrodes at a high temperature, thus increasing the efficiency of the lamp and the stability of the arc.

The upper electrode is fastened by means of a tungsten rod to an iron core, which is surrounded by a glass shell to protect the iron from corrosion, as the vapours used readily attack nearly all metal except tungsten, platinum, gold, and a few other inert materials. A flexible tungsten spiral serves to conduct the current from the upper movable electrode to the upper seal, fig. 3.

It was found, after a number of trials, that a certain combination of gases gave a minimum amount of decomposition products, which gradually collected upon the globe, thus reducing the amount of light radiated. In order to overcome this difficulty, the arc chamber was extended above the upper electrode, thus forming a condensing chamber in which the soot could collect, allowing the walls to remain clean. A draught tube was placed around the upper electrode in such a position that the heated gases from the arc would pass upward through the draught tube out into the condensing chamber, and then back downward into the arc chamber for use again. The corrugations shown on the draught tube and condensing chamber were found to aid the condensation of the suspended matter.

The search for a satisfactory electrode material showed that carbon was unsatisfactory. Tungsten proved to be practically inert, even at a white heat, in the presence of the various vapours used. The tungsten terminals, moreover, did not melt or evaporate in the arc except at a very slow rate, which seemed to be comparable to the evaporation of the filament in an incandescent lamp.

The arc in this lamp is quite different from that of other commercial arc lamps (see fig. 4). It is usually very stable, about $\frac{1}{4}$ in. in diameter, tubular in form, and varies from 2 to 5 in. in length with 110 volts direct current, the variations being due to differences in pressure, nature of the gases supplied, &c. A high pressure increases the intrinsic brilliancy of the arc, but makes it necessary to operate at a shorter length, as the gas currents due to temperature differences and arc reaction are correspondingly more violent. The diameter of the central luminous tube is also reduced with an increase in pressure.

The general appearance is that of a thick intensely white incandescent filament slightly bent at the upper end. With some of the vapours, as, for example, the metaloid halogen compounds, antimony, phosphorus, and arsenic chlorides, the central tubular portion is surrounded by a ragged flame, which is light pink in the case of arsenic and pale green in the case of phosphorus.

The flame portion acts somewhat as an absorbing screen, thus reducing the total useful radiation. It is a curious fact that this flame may exist for a short but appreciable time after the circuit has been interrupted, thus indicating that it probably does not have a part in the conduction of electricity through the vapour, but appears to be a zone in which the vapours, after being dissociated by the heat and electrical effects of the arc, recombine. The spectrum of the flame is usually quite different from the arc spectrum, and is characteristic of the elements involved, while the spectrum of the arc independent of the ends of the electrodes (which, of course, give a hot-body spectrum) is usually a band spectrum, and is practically continuous except for a few absorption lines.

The electrical characteristics of the antimony pentachloride lamp are shown in fig. 5, plotted between arc length and voltage. The curve indicates that a 4-in. arc at 10 amperes requires no more voltage than a 1-in. arc at 2 amperes. A 10-ampere arc is four times as long as a 2-ampere arc, and its intrinsic brilliancy is

Fig. 4.

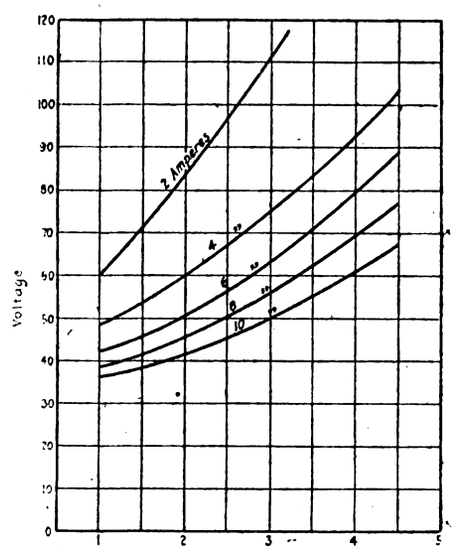

Fig. 5.

about five times as great; accordingly, the light emitted by it under these conditions is 20 times, and the efficiency approximately four times that of the 2-ampere arc.

The efficiency ranges from 1 watt per mean spherical candlepower to less than one-quarter of the value. This performance may be secured with a white light which closely resembles afternoon daylight (north sky).

While the results set forth in the paper offer considerable promise from a practical standpoint, they are not presented for consideration as representing a finished device, but merely a research in what seems to be a new and interesting field.

* Abstract of a paper read before the American Electrochemical Society, in joint session with the Illuminating Engineering Society, on November 11th, 1915.

Science and Industry.—On January 5th a conference was held in Melbourne to consider the Federal Government's proposal for the establishment of a national laboratory. The Prime Minister has stated that the Government intends to secure the services of the best scientific men available, and that the resources of Australia are to be systematically developed on scientific lines.

X-Ray Dangers.—Although the dangers attending the irradiation by X-rays are now generally recognised, risks are often taken unnecessarily, through want of thought or knowledge of danger on the part of operators. The rapidly increasing number of radiographic laboratories and installations have brought into the field many workers of limited experience, and there is fear that in the near future cases of X-ray dermatitis may develop among operators, nurses, and those working with X-rays generally, that would have been avoided by taking proper precautions. The Council of the Röntgen Society has, therefore, formulated an excellent card set of recommendations which, if followed, will give a large measure of protection from the known dangers attending the use of X rays, and it is suggested that the card, which is now ready, should be affixed in a prominent place in all departments where X-rays are generated.

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FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

BRITISH DOMINIONS AND POSSESSIONS.—A Supplement to the *Board of Trade Journal* of January 13th contains lists of prohibited exports, classified under their respective headings in alphabetical order, from British India, the Self-Governing Dominions (other than Australian), Egypt, and certain other British Possessions. The information in the present Supplement supersedes that given in the Supplement dated October 14th last, and the lists have been amplified by the inclusion of particulars for Malta, Mauritius, Jamaica, Barbados, and British Guiana. Copies of the Supplement may be obtained, price 3d., from the usual sale agents for Government publications.

FRANCE.—In virtue of a Decree of the French Minister of Finance, dated December 10th, certain goods whose exportation and re-exportation had been prohibited by a Presidential Decree dated December 7th, are allowed to be exported or re-exported from France, without special authorisation, when consigned to the United Kingdom, the British Dominions, Colonies, and Protectorates, Belgium, Japan, Montenegro, Russia, Serbia, or American countries. The list of articles includes the following:—Accumulators and accumulator plates; manufactures of aluminium and oxides; antifriction metal; copper, pure or alloyed, in all forms; electrodes, electric batteries and their elements; tin, pure or alloyed, in all forms; engine and boiler packing, including slag wool; manganese (metal) in all forms; mercury (compounds and preparations of); molybdenum (salts of); worked mica; nickel, pure or alloyed, in all forms; salts of copper, chromium, tin and mercury; silicon; sulphates of soda and zinc; titanium (salts); tungsten (metal) in all forms; vanadium salts; zinc manufactures.

BRITISH INDIA.—The exportation of mica has been prohibited from British India to all countries except the United Kingdom and British Possessions, as from November 19th last. The prohibition does not, however, apply to goods shipped by or for the use of the Crown.

SOUTH AFRICA.—Customs decisions have recently been issued in the Union of South Africa and also in Southern Rhodesia in virtue of which the rate of import duty on concentrated accumulator acid (consolidated sulphuric acid) is to be 20 per cent. *ad valorem* under the general tariff. In the Union of South Africa the rebate allowed to the product of the United Kingdom or of reciprocating British Possessions is 3 per cent. *ad valorem;* in Southern Rhodesia, however, the rebate is fixed at 9 per cent. *ad valorem,* and is allowed to all British Possessions, whether reciprocating or not.

By a further decision of the Union of South Africa Customs Authorities the duty leviable on commercial silica under the general tariff is 20 per cent. *ad valorem,* with a rebate of 3 per cent. *ad valorem* to the product of the United Kingdom or reciprocating British Possessions.

NETHERLANDS.—A Dutch Royal Decree dated December 10th prohibits the exportation of graphite and articles made therefrom, whether as raw material or manufactured, unless forming parts of manufactured articles of which graphite is not the main component part.

FRENCH COLONIES.—A French decree dated December 27th provides that mica in sheets or leaves, and micanite (the exportation of which was prohibited by a decree of December 9th) may be exported and re-exported, without special authorisation, when consigned to the United Kingdom, the British Dominions, &c., Belgium, Japan, Montenegro, Russia, Serbia, or American countries.

SWITZERLAND.—By a Swiss Federal decree of December 30th, the exportation from Switzerland of asbestos, mica and micanite—in sheets, even if combined with tissues; and in pipes and other specially-shaped articles, even if combined with other materials—is prohibited as from January 3rd.

STATE OF BRUNEI.—Revised import and export duties have recently been announced in the State of Brunei, among which may be noted an export duty on Para and other cultivated rubbers of 2½ per cent. *ad valorem.* Formerly, rubber was not specifically tariffed.

PORTUGAL.—A Portuguese decree dated December 27th prohibits, as from the date of the decree, the exportation of certain articles from Portugal and the adjacent islands. By way of exception, the Minister of Finance may permit, in certain circumstances, the exportation of these articles on payment of special export surtaxes in addition to the ordinary export duty. Among the articles included in this restriction are the following:—

	Rate of surtax.
Tin or tin ore	1½ per cent. *ad valorem.*
Copper ore or cement	1 per cent. *ad valorem.*
Wolfram	30 escudos per metric ton.
Other ores not specified	1½ per cent. *ad valorem.*
Articles of copper, brass and tin	8½ per cent. *ad valorem.*

SPAIN.—An export duty on zinc in bars, lumps, cake, and scrap of 100 pesetas per 100 kilogs. net came into force in Spain on January 3rd, in virtue of a Spanish Royal Order.

EAST AFRICA PROTECTORATE.—New regulations dated November 10th, 1915, have been issued in the East Africa Protectorate amending the requirements as to Certificates of Origin for goods imported from certain foreign countries. Certificates in the prescribed form must be presented to the Chief of Customs in respect of all goods imported into the Protectorate in trade with any foreign port, other than British ports, with the exception of those of Russia, Belgium, France, Italy, Spain, and Portugal, provided, however, that in respect of goods transhipped in the United Kingdom a duplicate of the "Specification for Foreign and Colonial Merchandise" (Form 30) or the Shipping Bill (Form 64), signed and stamped by the proper Officers of Customs in the United Kingdom, may be accepted in lieu of the Certificate of Origin. For the present, however, such Certificates will not be required in respect of individual consignments not exceeding £25.

BRITISH GUIANA.—The "Customs Duties Ordinance, 1916," provides for the imposition of duties on goods imported into and exported from British Guiana, with effect to December 31st, 1916, unless otherwise enacted. The rates of duty leviable under the new Ordinance are practically the same as those previously in operation.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

1,469. "Electrical selectors or impulse responders." L. C. Brcraye and Relay Automatic Telephone Co. January 31st.

1,472. "Cells or boxes for secondary batteries." E. J. Clark & Hart Accumulator Co. January 31st.

1,475. "Miners' electric safety lamps." O. Oldham. January 31st.

1,481. "Make-and-break switches." E. Girardeau. January 31st. (France, January 29th, 1915.)

1,483. "Electro-magnetic release or cut-out." A. Fantini. January 31st.

1,502. "Testing arrangements for machine telephone switching systems." Western Electric Co. (Western Electric Co.). February 1st.

1,526. "Electric motor pump." S. Kawakami. February 1st. (Japan February 5th, 1915.)

1,540. "Impulse senders." Relay Automatic Telephone Co. February 1st.

1,550. "Protective gear for alternating-current feeders and circuits." A. E. McColl. February 2nd.

1,595. "Transmission of wireless signals." Galletti's Wireless Telegraph and Telephone Co. & R. C. Galletti. February 2nd.

1,596. "Electric heat radiators." A. F. Berry. February 2nd.

1,597. "Radio-telegraphy." J. Bethenod & E. Girardeau. February 2nd. (France, February 2nd, 1915.)

1,609. "Electrically-operated ordnance, machine guns, &c." J. M. Echavarria & W. G. Grattan. February 2nd.

1,617. "Mercury contact and short-circuiting devices for electrical measuring instruments." A. L. Davis. February 3rd.

1,620. "Means of equalising or balancing electric currents, applicable to rotary converters." C. C. Garrard & A. H. Railing. February 3rd.

1,628. "Electrolytic apparatus for laundry, &c., purposes." E. Reubs & V. Roberts. February 3rd.

1,635. "Electric joint." G. H. Scholes. February 3rd.

1,698. "Electric batteries." H. F. Joel. February 4th.

1,705. "Means for controlling alternating currents." British Thomson-Houston Co. (General Electric Co., U.S.A.). February 4th.

1,707. "Electric heat-regulating switch." J. Kiell. February 4th.

1,724. "Electrical resistances." Clarke, Chapman & Co. and R. C. Harris. February 4th.

1,748. "Electro-plating tubes." J. D. Carlmark (trading as Electric Engineering & Plating Co.). February 5th.

PUBLISHED SPECIFICATIONS.

1914.

24,098. Aerials for Wireless Signalling. Marconi's Wireless Telegraph Co. & C. S. Franklin. December 15th.

1915.

677. Electric Cable Sockets. C. Pressland. January 15th.

1,212. Thermostatic Electric Switches. W. T. Pritchard. January 25th.

1,214. Electric Generators and Motors. M. M. Cardellino. January 25th.

1,234. Stranded Electrical Conductors for Overhead Power Transmission. M. Höchstädter. January 26th. (Convention date not granted.)

1,284. Electrical Controlling Apparatus for the Tool Carriers of Metal-working Machines. "Vulkan" Maschinenfabriks Akt. Ges. January 26th. (February 2nd, 1914.)

5,883. Method of obtaining a Sparkless Break of an Inductive Electrical Circuit. T. F. Wall. April 20th. (Cognate application 6,253/15.)

8,524. Electric Vulcaniser. O. C. Dennis. June 9th.

10,901. Manufacture of Electric Apparatus comprising Insulating Parts made by Moulding. M. Segre. July 27th.

10,902. Method of Screw Threading Articles made of Horn or Analogous Substances of Fibrous Structure. M. Segre. July 27th.

11,660. Arc Lamp with Enclosed Voltaic Arc. Allgemeine Elektricitäts Ges. August 12th. (August 13th, 1914.)

12,143. Electrical Switchgear. E. A. Graham. August 23rd.

12,924. Electric Heating Apparatus. G. Pate & A. R. Wood. September 9th.

15,369. Telephonic Receivers. E. A. Graham. November 1st.

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ELECTRICAL REVIEW.

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NOTICE.

IN view of the recent Increase in the Postal Charges, our Subscription Rates for Great Britain and Canada will until further notice be increased to £1 1s. 8d. and £1 3s. 10d. respectively.

THE DEMAND THAT WILL FOLLOW.

A NUMBER of our manufacturers are at present making laudable efforts to secure a share in the large electrical trade that will be done with Russia after the war. Their immediate ability to meet the requirements of the market is restricted for various reasons, but for those who are not pre-occupied with other concerns the market presents great opportunities for them to assist our Ally. Everybody electrical now knows that Russia's electrical manufacturing capacity has been very small indeed, and nobody has known it better than German firms, who have done their best to keep it so. Russia has been in the past far too dependent upon those who wished to add Imperial domination to commercial conquest, and her statesmen and her business people too must recognise by now that, if the way had been less easy for that commercial success, the possibilities of the present lamentable state of war ever occurring would have been much reduced. With a manufacturing capacity and a modernised industrial organisation such as her national position and wealth called for, there might have been no shortage of munitions last year giving the enemy an opportunity to demonstrate the superiority of her industrial facilities. The same thing applies in regard to other countries as well, and there may be much heart-searching on this point in all of them before the conditions of a permanent peace are laid down.

It is a serious question of the first magnitude as affecting the entire future relations between great nations as to how far one nation is to so develop its industrial resources as to make them a constant war menace for the rest of the world. The matter is of the utmost importance now that experience has shown us all that war in the twentieth century is so largely a series of engineering operations. The nation with the most extensive engineering works, and with the largest number of trained people earning their livelihood therein, given the facility for securing ample supplies of necessary raw material, may be so prepared for war emergencies as to be able to dictate the policy of other nations. Germany's works of this character are at present practically intact; whether or not they will remain so at the end of the war is quite another question. But whatever happens in that connection the lesson has been learned, and as one consequence we may reasonably suppose that after the war international trade between Germany and Russia will not be resumed on the old basis. Russia, in order to be independent of German electrical manufacturing in the future, must either increase her own productive capacity or she must import increasingly from Great Britain, America, Japan, Sweden, etc. The former of these alternatives has exercised the minds of Russian electrical and other industrial authorities a good deal, and we may expect to see increased manufacturing capacity on Russian soil as time goes on; but as things stand, and until a new and industrial Russia emerges, importation must be relied upon. Leaving our Allies and neutral manufacturing countries out of consideration at present, let us ask what will be the position of British electrical manufacturers in relation to the coming Russian

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demand. Some of her writers are blaming us for our past indifference to the market, and are seeking the reasons therefor and drawing their own conclusions as to what may be expected in the future. Granted that a good deal must depend upon Russian national policy in regard to import trade, and the possibility of that policy favouring British traders, we have to remember that British electrical manufacturers are faced with many other problems in regard to the future which are somewhat closely related to the question of their activity in Russia. They are eager to secure the Home market to themselves, also to meet the needs of the Colonies and dependencies, while France and Belgium and Italy desire their assistance, or will do for a time, and there will further be no disposition to reduce their hold on foreign markets in which they already have desirable connections. They may distribute their attentions over all these markets, Russia included, without meeting any of them to the full, but the question that is naturally being asked in some of these other countries is, how far it will be possible for them to depend upon British industry if they make plans for trying to prevent enemy trading within their borders. Will the character of British products be adjusted to meet their requirements? Will British manufacturing or productive capacity be increased to any large extent? We believe that to both of these questions the answer is emphatically in the affirmative, but will the capacity be sufficient to justify other nations in basing international trading policy upon possibilities in this direction? As our deliberations on after-the-war trade policy proceed we may expect such questions to be more and more searchingly asked and discussed by our Allies, and it is as well that we should consider the matter as calmly and carefully as we can in readiness. We may be as anti-German in sentiment as the horrors of this war compel us to be, but the fact will remain that, if in any country whatsoever other nations cannot suitably meet the requirements of purchasers, the trade will go to those who are in a position to do it, and who are not merely in that position from a manufacturing capacity point of view, but are eager to employ every possible means of adaptation and enterprise within their power to attain that end.

We have been led to make these remarks more particularly by an article which has appeared in *Elektrichestvo*, of Petrograd, on the prospects of future electrical business between Russia and England. There is so much of interest in this article that we quote from it fairly fully elsewhere in this issue. The author is Engineer P. Gurevitch. We suggest that his contribution might well be made the basis of a very serviceable discussion. It is well that we should see ourselves as we appear in the eyes of a friend, but he offers certain criticisms to which we are sure our manufacturers could effectively reply. He suggests that British electrical manufacturers will lose certain markets because Germany, being out of favour elsewhere, will concentrate her energies remorselessly upon those markets, fighting us with the old weapons of low prices and long credit until she succeeds. Taking this, we think too readily, as accomplished, M. Gurevitch uses it as an argument why we should display our utmost enterprise in seeking new markets—especially in Russia. We do not believe that British electrical and engineering firms need much more urging at this particular moment to display enterprise in Russia. The war has roused many of our trading interests from their former lethargy, and the future will be different from the past in that respect or we are greatly mistaken. It will be different for our enemies also. The condition of affairs in Germany at this moment, and the more serious position that is inevitable, do not, in our opinion, suggest that we shall be defeated in the future by the long credit given by Teutonic firms. Further, if we are to meet the demand we must be to some extent assured concerning the inducements. Our electrical confrères in Russia should see to it that their arms are not so wide open to German electrical firms in the future, and that German financiers and electrical organisations are not so privileged in the facilities granted to them. They should also bear in mind that there are other difficulties beside that of the language and demands for long credit that have led some British traders to be disinclined to operate in Russia. M. Gurevitch has something to say regarding the bad reputation of some Russian business people. Much is to be gained by the promotion of a spirit of confidence and trust between the trading communities of our two great nations. The war has brought about a better understanding between us, and the mutual sacrifice that we are making in the cause of world civilisation will, we trust, be followed by mutually satisfactory fair and square commercial dealings which shall be uninterrupted for a generation. Electrically we shall play our part up to the limit of our enlarged capacity. Labour problems, especially the prospects of "dilution" being continued after the war, the employment of women, and the abandonment for ever of limitation of output, have much to do with this question of future capacity. Assuredly the worker requires educating as to the importance of the effect of these matters upon the future trade of the Empire, and of the promotion of desirable commercial relations with our Allies. Of course, our manufacturers will weigh up in good time the question of that capacity, and we hope that they will accommodate themselves to all the coming markets of the world according to the developments in the situation. But we hardly think that they will be inclined to relax their hold upon a market where they can do good business, and where the possibilities are immense, until they are assured of success in another that is offered to them. However much they may welcome good desires and believe in anti-German sentiments, they will require to know more about the Russian Government's policy for excluding German electrical manufactures. On the other hand, the Russian Government is not likely to deprive German traders of facilities if by so doing it is going to affect adversely Russian developments; therefore, it is not unlikely that it will want to know something about British, Allied, and neutral manufacturing capacity. The situation is not an easy one to deal with, but the details will inevitably hang very largely upon the broad principles which are adopted by the Trade Conference of the Allies—if the war position is such as to enable any definite conclusions to be reached when that conference takes place.

Lead. **The lead market has preserved a wonderfully steady tone, and there was hardly any change in values even when it became necessary to sell some fair quantities of lead which had been loaded for Russia many weeks ago, the vessels containing which had not left British ports. The demand continues distinctly active on account of the home trade, but there has not been much doing generally in connection with the export markets, although within the last few days a few inquiries have been met with from Russia for April-May shipment. At the present time the White Sea is frozen up, and no more shipments are likely to be made to Archangel until the route is pretty free from ice. A good deal of lead has been imported lately, and thanks to this there is a plentiful supply of metal for early delivery, but demands have been good enough all along to absorb everything reaching here.**

The position depends very largely, no doubt, upon shipping conditions which have become abominably muddled. The monstrous charges and hopeless muddle at ports, combine to put out of effective operation all economic factors tending to relieve the position, and it seems to be

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nobody's business to direct matters with the smallest degree of commercial intelligence. Probably things have about reached their limit now, and there seems to be a faint hope entertained in some quarters that "something will be done." It is absurd to look for any change for the better until a little common sense is brought into play, until the vessels lying rotting on account of ineptitude are made use of, until steps are taken to control the extravagance and waste in connection with official chartering, and until arrangements are made for discharging vessels when they do arrive. So far the promises of improvement which have been made have been entirely illusory, but if conditions were changed in this respect there would soon be an end of the extravagant prices everywhere demanded for commodities, and the sooner the situation is handled with a few grains of common sense the better for the nation at large.

The advices coming to hand from Mexico suggest a distinct improvement in the mining position there, and this is all to the good, for, as Messrs. James Forster & Co. point out, Mexico produces in normal times 120,000 tons a year, or about 10 per cent. of the world's lead production.

Fatality in the Bath.

The fatal accident recorded in our last issue affords a grave warning of the danger of a little knowledge in connection with electrical affairs. It is very well for the young tyro to experiment with electric bells and pocket lamps, or anything else that can be fed from primary cells, but when he tampers with conductors connected with the public mains he is embarking upon an enterprise which may have disastrous results. This is well understood in the case of gas and water supplies, which have been with us so many years that the public thoroughly understands its position with regard to them and the dangers which follow ignorant and unskilful tampering with the pipes and fittings; electricity, however, is comparatively a newcomer, and has not yet acquired the respect of the ambitious schoolboy anxious to demonstrate his cleverness.

It is true that in the case in question the combination of circumstances happened to be exceptionally favourable to the prospects of disaster, and was probably unique—may it remain so. In ordinary circumstances the lamp might have remained in use for years without mishap. But the flexible cord was held in place only by tacks, and when the boy, in haste to extinguish the light, seized the hot bulb instead of the switch, apparently in dropping the lamp he jerked the flexible off its frail supports.

The moral to be drawn is that on no account should any unqualified person be permitted to meddle with the wiring of electric lighting installations. The bathroom especially is the very last place in which foolhardy experiments should be allowed.

Tapping Blast Furnaces.—At the Edgar Thompson works of the United States Steel Corporation, blast furnaces are tapped by a method devised by the engineering department of the Westinghouse Electric and Manufacturing Co.

An electric arc is drawn between an electrode and the chilled metal in the tap hole; the heat of the arc burns through the chilled metal, until the fluid contents of the furnace are reached. If during the opening operation non-conducting material is encountered, it is necessary to stop the arc and drive a steel bar through this mass. The process of melting is then continued, the arc following this bar of metal.

A 250 volt circuit is used, the pressure being reduced by means of a water rheostat. A current of from 800 amp. to 1,000 amp. is ample for the operation. The apparatus required consists of a special electrode holder, electrodes, cable, a resistance, and a head shield or protector for the operator. The electrode holder consists of an iron pipe 4 ft. or 5 ft. long, in one end of which the electrode material is placed and clamped by means of a ring; the end of the pipe is split in order to give a clamping effect when the ring is forced down towards the end of the pipe. In the other end of the pipe a wooden pole is placed, the cable connection being made to the iron pipe. The entire length of the electrode and its holder is about 12 ft.

INCREASING THE TRAFFIC CAPACITY OF TELEGRAPH LINES BY ACOUSTIC TUNING.

The usual connections for D.C. telegraphy with Morse sounders are subject to the disadvantage that with closed-circuit or with open-circuit working, so long as communication is in progress between two stations, all intermediate stations must remain idle. On a line with many intermediate stations, this naturally involves great delay, particularly during busy hours, and a line which is ample for the average daily traffic may be hopelessly inadequate during the rush hours. The two main methods by which the traffic capacity of a telegraph network may be increased are (1) by increasing the average capacity of the transmitting and receiving instruments; (2) by increasing the message capacity of the line—*i.e.*, by using high-speed instruments and multiplex working respectively. High-speed instruments are generally fairly complex, and must be served by a crew of skilled operators, so that they are chiefly limited to long-distance main lines, with high traffic density during a large fraction of each day. Multiplex working also shows to best advantage only when traffic is dense, but the apparatus used is little more complex than for ordinary one-direction working, and no special preparation of messages is required. Combined high-speed and multiplex working is particularly adapted to the interchange of messages between two large towns, and offers nothing to the solution of the problem of maintaining free intercommunication between all possible pairs of stations on a line dealing principally with local traffic of this nature.

A system facilitating such intercommunication must be

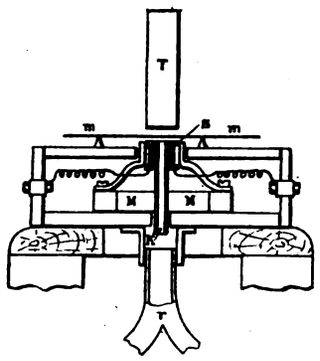

Fig. 1.

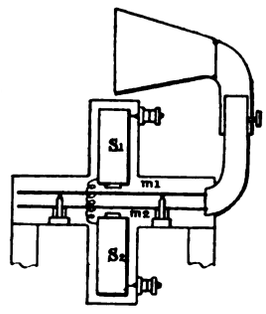

Fig. 2.

infinitely flexible, *i.e.*, permit simultaneous communication between any pair of the series of stations served, and it must involve only apparatus which is reasonably cheap to install and quite simple to operate. Recent advances in the use of alternating currents for signalling purposes suggest that the principle of variable-frequency tuning might be used to advantage in developing simultaneous signalling without interference over a single line. Dr. Oscar Srnka, of Brunn, has recently devised a multiplex system on this principle, using alternating currents of different frequencies on the same line and passing through all stations on the latter, but each frequency affecting only that receiver tuned for its reception. The sender, receiver and auxiliary apparatus at each station are connected in series with each other and with the line, and each station is allotted, for reception purposes, a definite A.C. frequency. Giving suitable arrangements for sending signalling current of appropriate frequency into the line, this system eliminates waiting (except where a station is already engaged), and gives each station access to all the others at all times by a single line.

For reasons given later, it is convenient to keep the frequencies used between, say, 600 and 1,100 cycles per second. With a difference of 50 cycles (*i.e.*, 600, 650, &c.) 11 stations per line are possible between these limits, and if this be not sufficient, 14 stations can be operated by reducing the difference in frequencies to 40 cycles. A smaller difference is not desirable, since 40 cycles at 1,120 cycles represents only 4 per cent. difference, and this is as low as it is safe to go without endangering accuracy in selective working. If more than 14 stations should be desired on

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one line, the best solution is to extend the frequency range above 1,000, or below 600 cycles. To prevent confusion by harmonics, the even progression of frequencies should be broken, say, by the use of 1,250 instead of 1,200 cycles (which would probably confuse with the 600-cycle messages); 1,350 instead of 1,300 cycles (which = 2 × 650 cycles), and so on. This also provides a greater percentage difference between the several frequencies, and makes working safer in consequence.

The apparatus employed consists of a "mono-telephone," or tuned A.C. telephone (fig. 1) for reception, and an adjustable, variable-frequency "singing telephone" for transmission purposes. The mono-telephone responds vigorously to alternating current of the frequency for which it is tuned, but is practically unaffected by alternating currents of other frequencies. In the sketch, which is based on a drawing in *Elektrotechnik*, a steel membrane *m* (1 or 2 mm. in thickness) rests on three fine points set 120° apart round the nodal line of the fundamental wave—*i.e.*, on a circle of diameter = 0·68 × the diameter of the membrane. A powerful magnet M has an iron core K carrying a fine wire winding *s* of 200 to 400 ohms resistance. The core K is hollow, and to it is connected a forked tube *r* leading to the telegraphist's head-piece receivers. Both the operator's hands are left free; the monophone is protected by a glass bell jar.

An ordinary telephone receiver with rim-fixed membrane responds to all frequencies, but a membrane supported as in fig. 1 responds freely only to a frequency identical with its own natural frequency. The latter depends on the

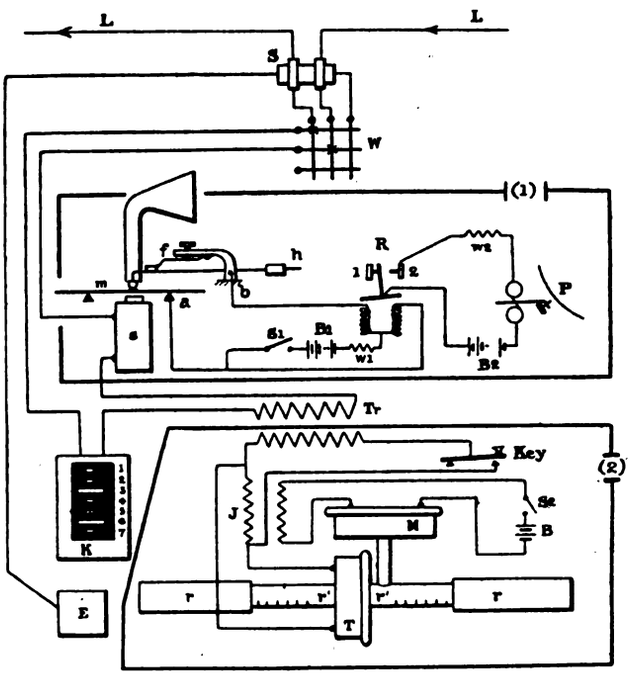

Fig. 3.

diameter of the membrane, and it is thus possible to make monophones to respond to any desired frequency, this frequency being constant throughout the life of the instrument, *i.e.*, *no frequency adjustment being required in ordinary working*. Though, in practice, the monophone membrane *will* respond to others than its exact natural frequency, it does so very weakly, and the difficulty is not to pick out the loud signals intended for the station concerned, but to read the faintly-reproduced signals belonging to other stations, even supposing one wished to do so. By placing a closed resonance tube T over the centre of the membrane, the fundamental note is rendered yet more pronounced, and there is no possibility of mistaking it. For frequencies of 1,100 and 600 cycles per second the wavelength of sound = velocity/frequency = 33,300/1,100 or 600 = 30·3 or 55·5 cm.; and the length of the tube T (closed at upper end) = wave length/4 = 7·6 to 13·9 cm., which is quite a convenient range of dimensions.

It should be noted that the tuning of the receiver is entirely mechanical and accoustical—there are *no tuned circuits*, involving complex construction and needing more or less skilled manipulation. Once built, the monophone should need no further adjustment.

To eliminate the necessity for a head-piece receiver, a loud-speaking monophone may be built on the principle illustrated in fig. 2, using two membranes actuated by two magnets and supported respectively on cork and on steel points, the lower membrane being drilled to admit the pins carrying the upper membrane. A horn with telescope tube for acoustic tuning, and a thin elastic diaphragm for dust-exclusion, complete the apparatus. Where a permanent record of messages is required, a mono-frequency relay, in combination with a differential relay, operates a printer, the arrangement being as shown inside rectangle (1), fig. 3. In this diagram, *m* represents a monophone membrane (as in fig. 1), actuated by the relay coil *s*. A nickel-silver contact-plate at the centre of *m* makes contact with a rounded contact piece on a light and delicately pivoted lever *h*. The latter is counterweighted, so that it has a frequency of swing slightly lower than that of *m*, but does not affect the natural frequency of the latter. During idle periods the adjustable spring *f* (fitted with a felt pad) holds the lever *h* lightly on to *m*, so that a closed circuit is maintained between the points *a b*, and the differential relay R keeps the position shown. When, however, a signal sets *m* swinging, the lever *h* is not able to keep exactly in step, its contact with *m* becomes imperfect, and the relay R, therefore, closes contact 2, and so completes the local printer circuit B_2 w_2, and the signal is printed on P. Adjustment is effected by a screw setting the position of *s*, or by shunting the coils of the latter; the relays are placed under a dust-tight cover, and mounted on a rubber block to absorb external vibrations. By adding a resonance tube the monophone relay can be adapted for audible reception as well as, or instead of, giving a printed record; when receiving by sound the printer is stopped, and the switch S_1 opened.

So far only incidental mention has been made of the apparatus used to produce the frequency required for signalling to a selected station. Each station must be able to produce with ease and certainty A.C., at all the frequencies required by the $(n - 1)$ other stations on the line. The apparatus used for this purpose must be reasonably cheap and compact, and it must be reliable and simple to manipulate. Tuned buzzers might be used, but a battery of them to supply ten or a dozen definite frequencies would be costly, take up a good deal of room, and need more skilled attention than can be counted on in a country telegraph office. Toothed-wheel high-frequency alternators run at variable speed offer another solution, but the difficulty is to provide means for maintaining speed constant at the desired value, particularly where there is no ordinary electricity supply available to serve a driving motor. The Larsen acoustic, variable-frequency A.C. generator offers a simple, inexpensive and technically satisfactory way out of the difficulty. The generator yields a nearly sinusoidal current, and therefore sets up clear musical tones in air. In the rectangle (2), fig. 3, a singing telephone T is provided back and front with tubes r^1, over which slide tuning tubes *r*; the telephone is coupled electromagnetically to a microphone M by the induction coil J. By varying the setting of the tubes, the frequency of the A.C. is controlled; for any particular setting, the frequency of the current delivered by the secondary of the induction coil is constant within a fraction of 1 per cent., and falls normally between the limits 600 and 1,100 cycles per second, but can be made higher if there is a specially large number of stations on the line. The positions of the tubes *r* corresponding to predetermined frequencies are naturally determined once for all, and marked on the tubes themselves.

Fig 3, as a whole, shows the complete lay-out for an intermediate station. The through-line L is connected, *viâ* the lightning protector S, to the change-switch W and the station apparatus. The receiver gear (in rectangle (1)), is adapted to audible or printing reception, and by connecting a second monofrequency relay to the terminals *a b* (or possibly just by using a second membrane beneath *s*), the second relay or membrane being tuned to the same (special) frequency in each station, provision may be made for simultaneous reception throughout the system of time signals, weather reports and other official intelligence. The transmitter, in rectangle (2), is connected to the line through a transformer T_r and

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frequency meter K of the vibrating reed type. This meter indicates whether a station with which it is proposed to communicate is already engaged; in the case depicted, the meter shows stations 3 and 6 already engaged. The whole equipment is compact, simple to operate, and not unduly expensive. For use under average conditions on lines with 10 to 15 intermediate stations, it seems to be of distinct interest.

MODERN PRINTING TELEGRAPHY.

Discussion at Edinburgh.

The paper on "Modern Printing Telegraphy," by Mr H. H. Harrison, was read before a meeting of the Scottish Local Section of the Institution of Electrical Engineers at Edinburgh, on Tuesday last week. The meeting was largely attended by members of the telegraph staff of the General Post Office in Edinburgh.

Replying to Mr Turnbull (Edinburgh), who asked if anything had been done to connect electrically two typewriters, so that the operator at one end could work with his vis-à-vis at the other, Mr. Harrison explained that the London and Manchester circuit had not less than hundreds which were controlled when transmitting with one operating line wire. Mr. M'Gregor (Edinburgh) cited a case where a civilian telegraphic staff had been very considerably reduced—*i.e.*, in the *Scotsman* office in Edinburgh. He explained that there they had had three wires, but that now they worked with the Creed system upon one line. The saving in cost of maintenance, &c., would be great. There were now two or three operators against five or six. The apparatus was bought outright at a cost which would in three or four years be covered by the amount saved in the wages of the operators who had been dispensed with. Mr. Dankes (Edinburgh) agreed entirely with the author that Morse signalling could not go out of use, as the present war had shown that there was no system to approach the Morse. In the commercial world, however, the Murray-Baudot had points to commend it.

In the course of his reply, Mr. Harrison, in answer to Mr. M'Gregor, said he took it that in the case he had cited the Creed wire was not always running, and that occasionally there were corrections and service instructions to be sent. While it was possible to work with Creed on the staff as Mr. M'Gregor had suggested, and with no knowledge of Morse, it would be awkward if any mishaps occurred. He imagined, therefore, that a Morse operator would still be needed in an establishment with a Creed installation only. As to driving, his opinion was that the weight-driven transmitter was a very good form if they made the motor large enough; he imagined that many, including those in post offices, were on the small side. He was inclined to think that transmitters and reproducers on the Creed system should be driven by the phonic wheel.

Discussion at Manchester.

Mr. Harrison's paper was also read and discussed by the Manchester Local Section on January 25th.

Mr. W. J. Medlyn said that in Manchester the Murray and Western Electric Co.'s printing systems were used, whilst Liverpool used the Siemens and the Baudot systems. The Wheatstone automatic and the Creed reperforator and printer were also used at both the above centres. On the Murray and Western Electric apparatus in Manchester, operators had no difficulty in typing at the rate of about 50 words per minute, and thus keeping well ahead of the automatic transmitter running at 40 words per minute. In Manchester, specially prepared ink rollers were used, and the printed tape or page print was afterwards run through a copying machine in order to produce a duplicate for departmental purposes. The printing of a duplicate by the telegraph apparatus itself would, if possible, effect a considerable saving. The high-speed one-channel automatic printer appeared to have a disadvantage in the delay experienced in obtaining repetitions or correcting errors of transmission. Questions had first to be perforated on one of the sets and then wait their turn for passing through the common transmitter. The required reply suffered delay at the distant end through the same reasons.

Mr. A. Brooker said the printing telegraph practice of the future was apparently to be based chiefly upon the work of Hughes and Baudot. The valuable work of the Post Office engineers had to be recognised, particularly in duplexing printing telegraphs. It was not fully appreciated even now that a differentially wound instrument, although balanced to a steady current, was not necessarily so to transient currents; in fact, an instrument could hardly be made truly differential to transient currents of different duration and voltage. The author had issued a warning to inventors who tried to produce signals by varying current strength; if he held the opinion that even with perfectly insulated lines variable-current methods were not going to succeed, it would be well if the warning was more definite and reasons given.

Mr. T. E. Herbert said, regarding the author's statement that the typewriter class of printer would survive, that Murray constructed a special typewriter with a very short type-bar and ball bearings, with a view to increasing the rapidity of the machine. The final result was a speed of about 200 words per minute. The recent telegraph of Siemens claimed a rather higher speed with the aid of the type-wheel. He was not convinced that the type-bar would eventually survive the type-wheel. In designing his own machine the author had adopted a type-wheel. There was a simple form of type-printing telegraph (constructed by Siemens) in extensive use in Germany, and it would be remembered that in this country the Steljes admittedly failed, because it was badly constructed; had the construction been better, it would have been in extensive use to-day, and, as things stood, there was nothing to replace it for short-distance work.

Mr. T. Plummer said that in Birmingham the duplicating of messages had been abandoned. Only one copy was prepared, which was passed on to the public, but certain particulars embodying number of words, address, times, &c., were recorded on a portion of the message form, which could be detached and retained. The old method of taking carbon copies had apparently been abandoned, in which case one of the great difficulties of inventors of printing telegraphs had been removed. Birmingham had two sextuple duplex Baudot sets working to London in place of four quadruple and four duplex sounder circuits. The Birmingham-London cable was underground, paper-insulated, and the four quadruple sets were worked on loops, *i.e.*, without any earth connection, and on the top of the loops the four earthed duplex circuits were superimposed. The old arrangement gave 12 channels working in either direction between the two cities, and these 12 channels, which formerly took up eight wires, were now being provided by the two Baudot septuple duplex sets, taking up only four wires. The new arrangement released lines for extension to other towns. A trial was made recently to find what the Baudot sets could do, and the record, Birmingham to London, was 849 messages finished and disposed of in an hour. Since this traffic did not keep the instrument fully employed, the figure could not be taken as the maximum possible.

Mr. G. C. Morris said that when contrasting the single-channel high-speed with the multiplex low-speed instrument, a point to be borne in mind was the speed at which the printed tape could be gummed on message forms and checked. Gummers and checkers all worked in one group with the high-speed instrument, and there was only one tape to be gummed; the work could, therefore, be easily distributed amongst the group, and the size of the group varied according to the speed. With a multiplex, however, one gummer was required for each channel. The transmitter also had to be considered, and the speed of the channel had to be adjusted to give both ends suitable loads. An electrical combiner consisting only of relays coupled with a rotating type-wheel offered the best solution of many mechanical difficulties. Regarding the use of perforated tape as a reservoir of signals, although this had been employed for many years it was far from satisfactory. The difficulty in making punches to work rapidly and accurately was surprising, and worn punches and dies were often a source of stoppage. Paper of variable thickness also contributed to the faults. With Col. Squier's sine-wave method of telegraphy, all fine printing signals might be sent simultaneously on one segment, and suitably sorted out at the receiving end, using tuned circuits. If so, the speed of circuits would be enormously increased.

Mr. F. D. Latimer drew attention to the invaluable pioneer work of the late Mr. Fred. Higgins, of the Exchange Telegraph Co., and said that the relays of the Exchange Telegraph Co. were not situated at the receiving end, nor were they polarised; they were sufficiently sensitive, however, to respond to the current impulses at the rate of about 2,000 per minute. In practice it had been found that in a transmitter running at 100 revs. a minute, the electromagnets had an "apparent" ohmic resistance of approximately nine times the actual ohmic resistance, consequently the operating current was only one-ninth of that under steady current conditions. Some years ago the Exchange Telegraph Co. maintained about 700 financial recording instruments scattered throughout London, and all controlled by one operator stationed at the central offices in Cornhill.

The Author, in reply, said that the type-bar translator was the only satisfactory translator which would make duplicates, but the one difficulty in making duplicates with the printing telegraph was that of feeding in blanks. The only practical way seemed to be to take press copies. The automatic suffered in the matter of delay in dealing with corrections. Hughes showed excellence in the workmanship of his printer, while Baudot put forward the correct alphabet, namely, the equal-letter alphabet. It was fair to state that Baudot founded the system of modern printing telegraphs. An objection to varying the current strength for signalling purposes, quite apart from its use on overhead lines, lay in the fact that, in order to produce a suitable alphabet, it required to be an unequal letter alphabet which could not be multiplexed. Generally speaking, it was better to keep away from a system depending on variable-current strength. In the author's opinion, a type-bar translator would give excellent results when worked at 45 or 50 words per minute, or even higher. Regarding type-wheels, he did not think a shaft material could be produced which would stand a speed of 45 or 50 words per minute for any reasonable length of time without shearing. In America, artillery fire control was actually carried out by means of a rather primitive and simple form of printing telegraph using only 16 letters.

National Business Organisation.—The Institute of Industry (of Great Britain and Ireland), Ltd., has appointed a Special Committee of its court of directors to meet representatives of important trade interests, with a view to considering suggestions having for their purpose the strengthening of the court of directors, and the co-operation or amalgamation of other similar movements.

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JOHANNESBURG ELECTRICITY SUPPLY.

At the meeting of the South African Institute of Electrical Engineers on November 18th, 1915, Prof. J. H. Dobson, M.I.E.E., read a paper on the distribution plant of the Johannesburg Municipal electric supply system, of which he is the engineer and manager. The following is an abstract of the paper :—

The municipal area of Johannesburg is over 80 square miles in extent, and is one of the largest of its kind in the world. Electricity is supplied for domestic, industrial, and tramway purposes, there being nearly 20,000 meters on the system, and the annual output being over 25 million units. In 1886, when gold was discovered on the Witwatersrand, the township had a population of 50, which grew to about 3,000 in 1887, and in 1914 had reached 253,274. After the Anglo-Boer war in 1902, Messrs. Mordey and Dawbarn were appointed consulting engineers to the Council, relinquishing their connection with the Council in 1908.

The consulting engineers adopted three-wire D.C. supply at 230-230 volts for the inner area, 3-wire single-phase A.C. at 200-200 volts for the outer area (feeders at 3,300 volts, single-phase, one pole earthed), and 575 volts D.C. for traction. The two voltages for lighting supply cause some annoyance to consumers who move from one area to the other, and the generators being two-phase, some difficulties are experienced in balancing the phases.

The author joined the municipal service in 1909; at that time there were ten feeding points, to which two have since been added. The feeders were single-core cables of 1 sq. in. section (neutrals 0.5 sq. in.), insulated by prepared paper, vulcanised bitumen, and impregnated tape, with two layers of steel armouring, jute served and compounded. The distributors were triple-concentric cables paper-insulated, lead-covered, jute served, and double steel armoured, jute served and compounded. At each main feeding point was a feeder box in the pavement, containing three-wire bus-bars on porcelain insulators, the box being filled with diatrine. Similar boxes were used at the junctions of distributor and sub-distributor cables. Each feeding area was fed by one feeder and was entirely independent of the others; the cables were coupled with studs and links, so that on the occurrence of a fault the whole feeding area was cut off, and the fault had to be localised by disconnecting and reconnecting the distributor cables in the feeder box, causing loss of time.

The system had to be entirely reorganised, owing mainly to frequent interruptions caused by faults on the D.C. feeders. Owing to the vulcanised bitumen becoming soft and plastic, the whole of them decentralised at loads of less than 600 or 800 amperes per square inch—in some cases less than 400 amperes. The insulation resistance of the cables dwindled away, and short-circuiting between the copper and steel armouring was a regular occurrence. "Such a state of feeder cables, attached to a system as has been described and coincident with the failure of the gas engine scheme, made conditions absolutely appalling."

Financial considerations required that the best arrangements had to be made of the existing cables, and the reorganisation of the system occupied several years. The feeder cables were picked up, stripped of all the armouring, and relaid on the solid system in glazed earthenware troughs with proper bridge pieces, the troughs being filled with bitumen and covered with bricks. First an additional feeder was run to the centre of the town, so that the feeders could be relieved one by one; the additional feeder was eventually absorbed by the growth of the load. Nearly all the pavement boxes were discarded; underground chambers were built at the feeding points, and feeder pillars at the sub-feeding points. Two or more cables pass each feeding point, with three exceptions, and provide a duplicate or triplicate supply. Isolating switches enable the distributors to be quickly disconnected from the bus-bars when necessary. Direct telephone communication with the power station is provided.

At the chief sub-feeding points, feeder pillars have been substituted for the surface boxes, with isolating switches. Wherever it is possible, duplicate supplies have been provided.

The alteration in the "inner area" took three years to carry out, and little or no trouble has been experienced since the changes were made. The insulation resistance of the feeder cables, however, is relatively low. Joints in the distributor cables were originally made in cast-iron boxes; faults frequently occurred in these, and in such cases the joints have been remade without boxes. Service joint boxes are eliminated as far as possible by running back important services to chambers each dealing with four blocks of buildings.

The "outer area" is supplied with single-phase current at 3,300 volts, transformed down to 200-200 volts three-wire, distributed by underground and overhead networks; an exception is a new industrial area, which is given a three-phase four-wire supply. The high-pressure cables are two-wire concentric paper-insulated and lead-covered, the inner core being insulated for 3,300 volts and the outer, which was earthed, for 500 volts. They were laid on the solid system, and terminated in kiosks containing transformers and switchgear. The high-pressure cables were looped into the kiosks and bolted to the terminals without disconnecting links; in some cases six or seven kiosks were all connected to the same cable without means of disconnecting whilst the cable was alive.

The type of cable and method of laying were quite good, but unfortunately two high-pressure cables often were laid in the same trough, and experience proved that a fault on one cable often affected the other, thus doubling the extent of the damage and the magnitude of the interruption of supply. Locating a fault, with the high-pressure cable bolted hard on to each transformer, was a very lengthy process, especially as there were no easy means of splitting up the high-pressure cable into sections. There were certain disconnecting boxes where high-pressure cables branched, but excavation to the boxes and melting out the insulating compound took hours of labour. Generally, to restore supply took a day or more. Replacing the high-pressure fuses in the transformer kiosks when the high-pressure bus-bars were alive was very dangerous, and the only alternative was to put all the districts served by the cable in darkness until the fuses had been re-inserted. The fuses were of faulty construction, and there were no interconnections on the low-pressure network. From the operative point of view, the transformer kiosks were "veritable death-traps."

The system was reorganised by the installation of link chambers and pillar boxes for high-pressure cables, the linking-up of high-pressure mains to form ring mains, the grouping of transformers, the replacement of certain of the iron kiosks with brick transformer houses, and the installation of proper control gear in all transformer kiosks. Where several feeders run in the same direction for considerable distances, they have been provided with link chambers which enable any of the outgoing cables to be fed from any of the incoming cables, and provided with circuit-breakers. These arrangements have proved of immense value in dealing quickly with cable faults; and similar arrangements on a minor scale have been carried out in pillar boxes. In several cases the high-pressure cables have been joined up to form ring mains. Several sub-stations have been built in which the transformers have been centralised and provided with switchgear, which facilitates the maintenance of continuity of supply, better pressure regulation, and economy in core losses. In all iron kiosks which have not been replaced by transformer houses, suitable switches and fuses have been provided on both the high-pressure and the low-pressure sides.

The three-phase four-wire power supply to Newtown is derived from the two-phase system by the Scott method at 400 volts.

The tramways comprise a total of 42.29 route miles, 66.17 track miles, and are supplied with direct-current by underground cables up to two miles from the centre of the town, after which the feeders are carried overhead on the tramway poles. The original feeder cables are of the single-conductor leadless type, bitumen-insulated, with a layer of paper next to the copper and jute serving outside the bitumen. They were laid on the solid system, the best for the purpose where atmospheric disturbances occur, the path to earth from the copper conductor through the bitumen insulation and filling and the trough being a long one. Unfortunately, a telephone cable with earthed lead sheathing was laid in the same trough as the feeder, and the latter was connected with the trolley line through fuses by lead-covered cables in the tramway poles; the phenomenal storms experienced in Johannesburg quickly found out these weak spots. The telephone cable system became alive at 500-600 volts, and was rendered useless; the traction cables broke down to the earthed lead sheathing of the telephone cables, causing long stoppages, and the line connections were pierced where the lead sheathing touched the poles. To relieve the system from such troubles, all the paths to earth that could be got at were cut out, the telephone cables were pulled up whenever possible, insulated cable without metallic sheathing was substituted for the line connections, and British Westinghouse lightning arresters were fixed at quarter-mile intervals on the overhead equipment. Porcelain insulators replaced the original compressed-fibre insulation of the trolley line, and have stood up well against the severest electrical storms. Disconnecting switches have been installed on the line connections, and arrangements have been made to link up the feeders and to confine the area of stoppage due to a breakdown to a minimum. Whereas formerly some portion of the tramway service was interrupted during every storm, such interruptions have been almost wholly eliminated.

The tramway system as originally laid down was hampered by no Government regulations, and naturally, therefore, no precautions against electrolysis by stray currents were taken. In 1913 the Government formulated regulations practically identical with those of the British Board of Trade, necessitating the partial reorganisation of the traction supply and the erection of rotary-converter sub-stations at three points, fed with two-phase current at 3,300 volts. The secondaries of the single-phase transformers are double Scott-connected, with two distinct windings, to give a six-phase supply to the A.C. side of the rotaries, which are provided with starting motors and are self-synchronising.

The public street lighting of the inner area was originally carried out with arc lamps, nine in series, but was unsatisfactory owing to frequent faults on the cables, which were rubber-insulated and lead-covered, laid direct in the ground without protection. An average of at least four faults per week occurred on these mains, and in wet weather five or six sometimes took place in one day. The cable being hopeless, the arc lamps were temporarily replaced by large half-

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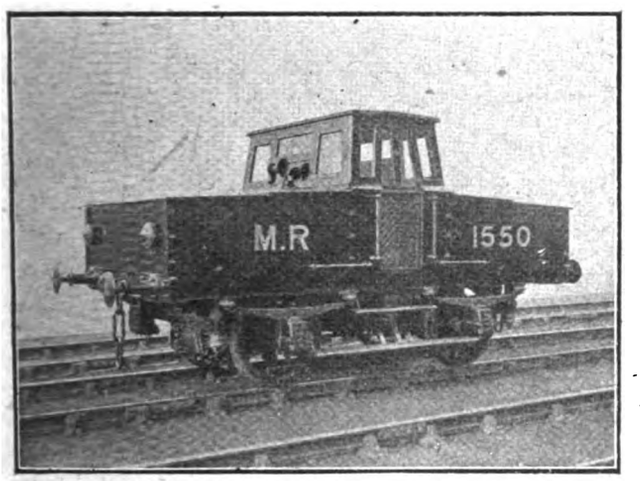
watt lamps or clusters of ordinary metal-filament lamps fed by new steel-armoured cables from the mains. A complete scheme of arc lighting with centralised control has been devised, but lack of funds prevents its being carried out.

From 1909 to 1914 the number of connections increased from 5,720 to 16,091, and the total units consumed from 11.3 millions to nearly 25 millions; the maximum load from 5,400 to 10,900 KW., and the number of street lamps from 5,340 to 7,400. The undertaking is equal in point of magnitude to the whole of the other municipal undertakings in South Africa.

AN ELECTRIC BATTERY LOCOMOTIVE.

Some eighteen months ago the Midland Railway Co. put to work a battery-operated electric locomotive for shunting and sorting the coal traffic in the West India Dock Depôt, London, which investigation showed could be performed more satisfactorily and economically in this way than by horses, hydraulic or electric capstans, and snatch-heads. As the ordinary steam locomotive cannot enter the yard, the whole of the work had to be performed by the electric locomotive.

The maximum speed attained with full load is about seven miles per hour, speeds up to 12 miles per hour being attained with light loads; the rated capacity of the locomotive is six



Electric Battery Locomotive, Midland Railway.

loaded wagons weighing 15 tons each, and 12 light wagons of approximately six tons each.

The weight of the locomotive complete with battery is 17½ tons, and the wheel base, which is, of course, rigid, is 8 ft. 6 in.

The general appearance and method of construction of the locomotive is well shown in the accompanying view. It is fitted with two 22-H.P. motors—one per axle—supplied by Messrs. Dick, Kerr & Co.

The battery, which is situated in the two end compartments, was provided by the D.P. Battery Co., and consists of 108 cells, 21-plate T.L. type, with a capacity of 300 ampere-hours. The cells are the D.P. standard train-lighting pattern in lead-lined teak boxes, and are fitted with "block" type lids.

The locomotive has not been out of service at any time on account of the failure of the battery, and no single cell has failed since put to work about 18 months ago. The battery has been in daily use (except Sundays), the discharge rate varying from 40 to 90 amperes, with occasional spurts up to 150 amperes.

The battery is charged every day from about 12.30 p.m. for one to two hours, and a "refreshing" charge is given in the early morning.

When the battery was cleaned out the work was done without interrupting the service in any way, and the plates were found to be in excellent condition, despite the severe jolting occasioned by continual shunting of the coal wagons. Out of over 2,000 wood separators in the battery it was found necessary to renew only about three dozen, and only very few ebonite sheets were split. This is partly due to the careful suspension of the truck, and also to the tough qualities of the accessories. The four-bar bottom block on which the plates stand, a special feature of the D.P. cell, proved its worth; no shorting had taken place, and there was no indentation, as the weight is better distributed than on the two-bar blocks.

The control is by the ordinary series-parallel method, providing two economical running speeds, but no restrictions are put on the drivers with regard to the use of the other notches; the braking is of the rheostatic type operated by the main controller, this method being very useful for shunting operations. A band brake with hand operation is also fitted to each axle, being equivalent to the tender brake on steam locomotives.

The mechanical portions of the locomotives are largely constructed of standard wagon parts, *e.g.*, the wheels, axles, draw-gear, &c. The body and cab are of wood, suitably braced with ironwork. The covers over the battery compartments are arranged to drain off all rain water, while both sections are so ventilated that gases given off during charging or working the battery are carried off.

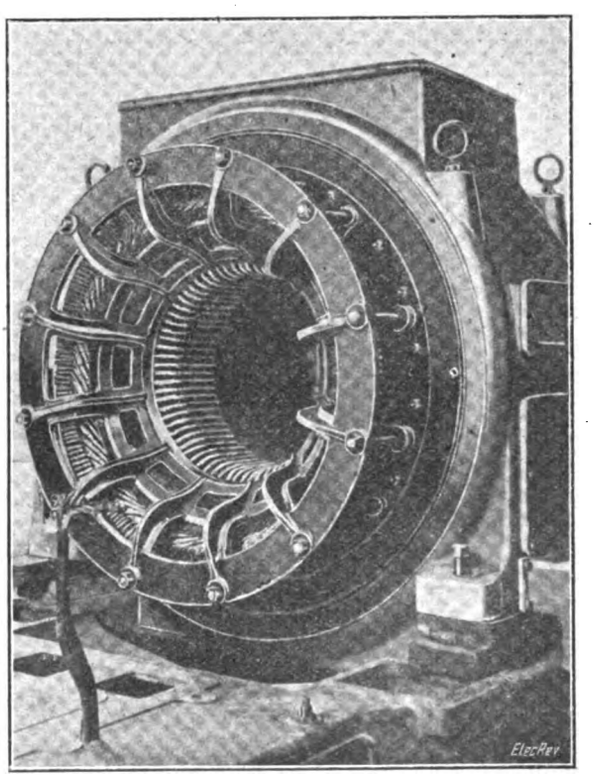
Charging is performed by a motor generator, the pressure of supply from the Poplar Borough Council—460 volts—being too high to offer any advantages for the use of a reverse booster. The generator is differentially compounded, so that after current is switched on, further attention is unnecessary except in the case of a "gassing" charge.

We are indebted to the D.P. Battery Co. for the foregoing particulars.

THREE-PHASE PLANT AT SHIPLEY (YORKS.).

The first venture of the Shipley Council in public electricity supply was in 1900, when a small generating plant in connection with a Meldrum refuse destructor was brought into use. This plant was soon supplemented by two 240-KW. Parsons direct-current turbo-generators (in 1901), and considerable praise is due to the Council, and to its enterprising engineer at that time—the late Mr. Quinn—for pioneering a type of plant which has proved to be possibly the most important factor in modern electricity supply work.

Further developments followed, and by 1905 the Council's plant consisted of four boilers and four turbo-generators of a total capacity of 1,000 KW. In 1912 the Council, after inquiry, decided that the time had arrived to install a modern three-phase system to meet the industrial requirements of the area, and, having obtained borrowing powers for £30,000, proceeded to put down a three-phase 6,600-volt 50-cycle alternating-current system with rotary converters for traction supply and direct-current lighting and power, thus falling into line with the majority of progressive industrial towns.



Bracing of Stator End Windings, Shipley Alternators.

This new installation was officially inaugurated on February 2nd, the occasion being celebrated by a dinner at which many of those interested in local electricity supply work attended. The new plant includes two Babcock & Wilcox boilers fitted with integral superheaters and chain-grate stokers, with a rating of 20,000 lb. of steam at 160 lb. pressure, superheated to 550 deg. F.; two steam-driven Clarke-Chapman pumps have been provided for boiler feeding. Two Westinghouse-Rateau turbines, running at 3,000 R.P.M., each with a continuous output of 1,250 KW., have been installed; these are coupled to alternators by the Phœnix Dynamo Co., a special feature

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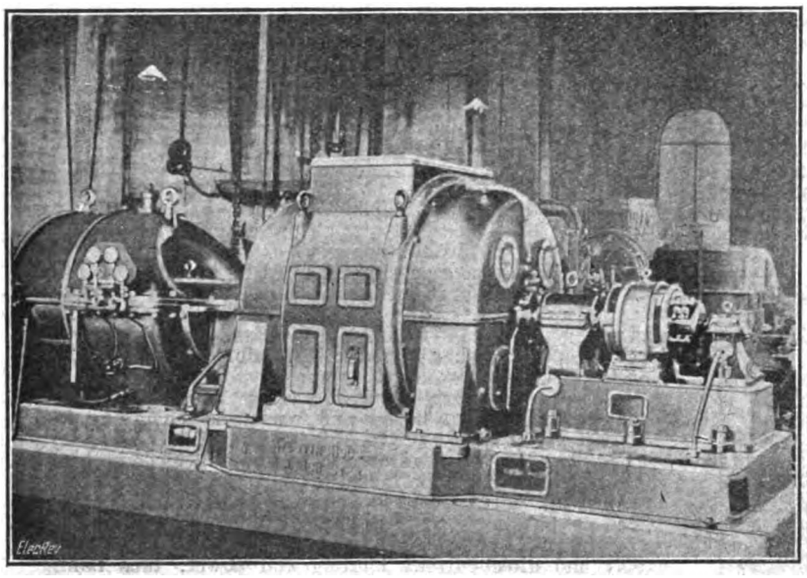
of the machines being the heavy steel clamping rings round the stator end windings and the ventilating arrangement, for which air is supplied from two Sturtevant dry-air filters equipped with motor-driven fans.

Each turbine exhausts into a Cole, Marchent & Morley surface condenser capable of dealing with 20,000 lb. of steam per hour.

The new three-phase switchgear was supplied and erected by the British Westinghouse Co., and is of the cubicle pattern designed to take care of future needs; supply is given to a large sub-station in the centre of the town, from which all distributing cables will run, the cable contract for some ten miles of three-core lead-covered cable drawn into ducts having been placed with the Western Electric Co., who have, we gather, supplied the bulk of the cable in use in Shipley.

Two rotary converters have been installed, one of 500 KW. capacity and Westinghouse make, and one of 300 KW. by the General Electric Co., for general direct-current supply purposes. The electricity works are situated on the Dockfield estate, which, together with two adjoining estates, amounting in all to 50 acres, were acquired by the Council and are now being disposed of for industrial purposes. During 1914-15 1,735,000 units were sold, and for the year nearly completed it is expected that 2,500,000 units will be sold.

We understand from Mr. W. Redmond, the Council's electrical engineer, to whom we are indebted for these particulars and under whose supervision these extensions have been carried out, that the new plant is giving every satisfaction, and that the coal consumption has been reduced by 50 per cent.; moreover, some of the local factories have already been connected to the new system, and others are in prospect.



WESTINGHOUSE-PHŒNIX TURBO-ALTERNATOR AT SHIPLEY.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

The Lighting of Drawing Offices.

For the lighting of drawing offices, the BRITISH THOMSON-HOUSTON CO., of Mazda House, Upper Thames Street, E.C., usually advise the use of Mazda half-watt type lamps in their "Lumina" semi-indirect lighting fittings. A number of drawing offices have been equipped in accordance with this recommendation, and in every case great satisfaction has been expressed by the draughtsmen.

This system of lighting is used by a certain engineering and shipping firm in the Newcastle area, whose reputation is known all over the world—the engineer of which has stated that he had great difficulty in preventing the draughtsmen using the new lighting during the day time—they declared it better than the natural daylight. We illustrate the pendant and the close ceiling patterns of the "Lumina" fittings in figs. 1 and 2.

FIG. 1.—PENDANT TYPE.

FIG. 2.—CLOSE CEILING TYPE.

B.T.H. "LUMINA" SEMI-INDIRECT LIGHTING FITTING.

Anti-aircraft Lamp Screen.

We have received from Mr. J. W. Beauchamp, manager of the West Ham electricity undertaking, particulars of a new type of lamp screen, for which a patent has been applied for, and which has been designed as an inexpensive method of cutting off upward rays from lamps and avoiding the bright patch of light which usually results from the use of a conical reflector on an incandescent lamp. We understand that in practice it gives a very fair distribution of light.

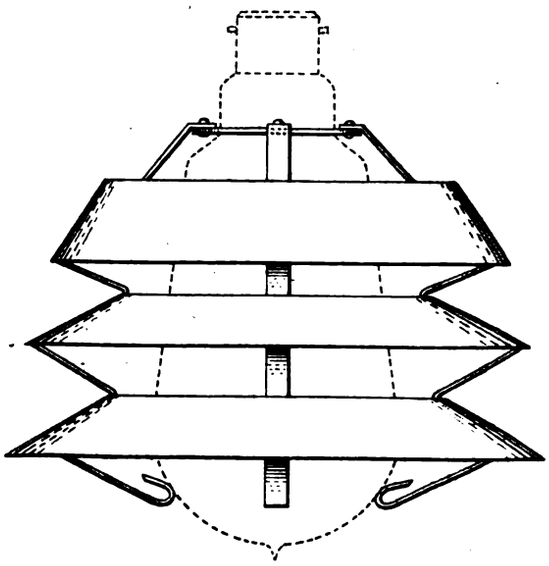


FIG. 3.—NEW TYPE LAMP SCREEN.

Figs. 3 and 4 show the construction and application of the screen which is made of sheet tin, and is being placed on the market by MESSRS. FALK, STADELMANN & CO., of Farringdon Road, E.C.

FIG. 4.—NEW LAMP SCREEN IN USE.

The reduced brilliancy required by the authorities can be most effectively obtained by using lamps of smaller candle-power or under-running or frosting; the practice of covering the lamp with an opaque coating is ineffective owing to the difficulty of maintaining it, and because by increasing the temperature, it shortens the life of the lamp. It is, in fact, obvious that the methods at present adopted for securing reduced illumination of our streets are crude and wasteful.

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THE FUTURE ORGANISATION OF ELECTRICITY SUPPLY.

[COMMUNICATED.]

Considerable interest is attached to the circular issued a short time ago by the South Metropolitan Gas Co., inviting subscriptions to the company's stock by their consumers, in amounts of £5 and multiples thereof, at the price of £82 per £100 of stock. This investment, with gas at its present figure of 2s. 10d. per 1,000 ft., yields £5 7s. 3d. per cent., which is undoubtedly attractive; indeed, one is tempted to wonder at the Treasury giving their sanction to what must be a competitor to the War Loans. However, the scheme is distinctly interesting, and worthy of some consideration. The war will end sooner or later, and a difficulty will probably be found in raising capital for the many extensions and enterprises which have, perforce, been held in abeyance.

The issue of "Baby Bonds," as they are termed in America, has long been in operation in that country. The advantages of spreading a considerable portion of their stock amongst their consumers and employés have been realised by the companies, and used as a bulwark against the municipalisation of their properties and the undermining of their consumers by the gas opposition. The plan of giving consumers a direct holding and interest in their electric supply company has undeniably done much to restrain municipalities from undertaking work in this direction. One cannot help being forced to the conclusion that up to the present such enterprise has been against the development of the electrical industry in its broadest possibilities.

With the first boom of electric lighting, numerous provisional orders were granted in this country to small towns and districts; some of these were not even taken advantage of, but were merely obtained to block private enterprise. Nevertheless, at that stage a great impulse was given to electrical progress, but the cream of the possible lighting load having been obtained, most of these small municipal concerns have found themselves handicapped by the difficulty of obtaining powers for the hire of motors and apparatus. The fullness of time has shown that the effect of these small undertakings, with their cast-iron boundaries and restricted powers, has been to put the brake on still greater expansion by means of companies or authorities generating on a grand scale with the efficiency of big units and the advantages conferred by large diversity factors. Many of these concerns may be said to be in a state of polarisation, affording little or no profit to their owners and scant opportunity to those requiring cheap light and power.

The present chaotic condition of London's electric service is an example of this. We have numerous comparatively small areas supplied by municipal undertakings which are working under the disadvantages referred to, and companies who are deterred by the shortness of their tenure from exerting their full powers. So far, the various schemes put forward for solving the question of a comprehensive and cheap supply for this city have been abortive.

Much the same state of affairs obtained in the early development in America, except that in their case most of the towns and districts were catered for by companies. Therefore, as the advantages of amalgamation have been realised, it has been possible to assemble small operating companies into large holding companies. An American contemporary classified the advantages to be obtained into several divisions; briefly, they were :—

Efficiency.—Operating efficiency is greatly increased because the directing officers of large holding companies are the ablest men in the business, who contribute expert knowledge, superior administrative ability, and sound judgment. Those superintending actual operations possess abilities which command larger salaries than are obtainable in the smaller companies, and the benefits of their supervision are distributed among a large number of properties at a comparatively small expense. Holding companies have on their staffs expert engineers. Such engineering service is impracticable in small concerns. Alert, legal supervision is maintained, which is frequently of great importance but usually too expensive for a small company. Departmental operating costs are closely kept, carefully analysed and compared. Publishing and advertising can be co-ordinated and directed into the most profitable channels.

Economy.—In addition to the economies resulting from efficient operation, there are economies in the purchase of material by bulking the orders. The holding companies are always in touch with the markets, and are able to take advantage of cheap prices in any commodity or article, and to buy in advance of rising prices.

Holding companies, by the creation of large issues of securities based upon securities of subsidiary companies, give to this class of security a broad market. They distribute the risk among a large number of properties in different parts of the country, so that any adverse circumstance affecting one property does not materially injure the integrity of the security as a whole.

To sum up, it is claimed that the advantages rendered to the community are better service, cheaper service, broader service in populous centres, and service extension to village and rural communities.

The selling of "Baby Bonds" to consumers, which is a part of the policy of holding companies, has been reduced to a fine art, and almost every conceivable talking point is tabulated. Many of the arguments advanced are ingenious, but not of a nature to appeal to a British investor, who appears to prefer a certain stateliness in the dressing of a financial statement for his consumption. The issue of stock in small units, enabling small consumers to invest, and so acquire a real interest in the industry, has several very obvious advantages. It turns each holder into a friend, who will do his best to forward the development of the company amongst his acquaintances. This is an active influence, and is likely to do more good than the reliance on public spirit and civic pride, which it was hoped would do so much to foster municipal undertakings.

The popularity in America of the "Baby Bond," and of similar issues made in this country, invites the consideration of the extension of the principle to such a public service utility as electricity supply. In fact, it is nibbled at when deposits bearing interest are enforced, but as such they are usually a source of annoyance, operating against the supply authorities' welfare.

The present state of affairs is that with the idea of public control, huge monsters such as the Port of London Authority and the Water Board have been created. Most of these are financed with moneys borrowed upon public credit, and one could fairly safely say against the wishes of half the ratepayers concerned, who, however, seldom obtain the control that they are supposed to exercise, by reason of the multitude of questions generally involved at election times. This remark is not made as an attack on these services or with a view to belittling their work, but merely to emphasise the small amount of public control actually existing.

Assume that instead of forming such trusts on public credit, they took the form of companies with the controlling capital issued in small bonds. The board of directors would contain certain representatives of the municipalities whose districts were affected, much on the lines of the last L.C.C. scheme, who would be charged with the duty of seeing that the interests and rights of the community were protected. The affairs of the company would come up for revision at the usual general meetings, and where a vote was required it could be taken upon the direct issue with no consideration of politics supervening. One ventures to think that a more businesslike administration and better management would result.

No doubt the question bristles with difficulties, but it should not be impossible to discover some method which would open the way for a cheaper and more general supply of electricity. Some discussion of the subject may forward the question to a stage where it will be ripe for practical steps when the passing of the war leaves us free to act again. It may be that the application of the principle of the "Baby Bond" can be made in a way that would help to smooth the path for the large composite bodies that appear to afford a solution of the present state of deadlock. It will also be borne in mind that money is

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changing hands, and there will be many small people with money to invest who will only be attracted by a class of investment which is sound. One with the possibilities and assured future of electricity supply should be well in favour if we work to deserve it.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Cause of Flicker.

I have under my charge three Belliss-Crompton D.C. generating sets, rated at 50 and 100 KW. at 450-550 volts, operating a three-wire overhead network, with Crompton's C.M.B. balancers. Only one machine is at present working at once, and the load is metal-filament lamps and fans.

We are experiencing trouble with a flicker in the lights, which seems to synchronise with the engine beat, and we are unable to find any cause for it. It does not always occur, but is sometimes scarcely noticeable, and at other times it becomes objectionable. All machines seem to be affected, but not to the same extent, the small set being the worst, and one of the 100-KW. sets. The third set very occasionally gives trouble, and then only slightly, and we have found that changing over to this set will stop the trouble. The flicker seems to start at half load on the first two machines, when the bus-bar voltage is about 485-490. The machines have only been in use two years, but this flicker was noticed from the beginning.

I should greatly appreciate any information or advice that your readers can offer as to the cause and remedy of this trouble.

F. C. Bulsara.

Nagpur, India, *January 29th*, 1916.

German Interest in Swiss Concerns.

In your valued paper issued January 28th, under the heading of "War Items," you have printed an article dealing with the German capital invested in Swiss concerns, in which you state that the Swiss journal, *Elektro-Industrie*, the paper of the Association of Electrical Contractors in this country, has expressed its sympathies for the Central Powers. This statement is apt to be misunderstood by the majority of your readers, who will wrongly be led to believe that the Swiss electrical contractors are to a large extent sympathising with the enemies of Great Britain. We feel it our bounden duty to challenge this view. Even if a few members of the Swiss Association of Electrical Contractors should in consequence of personal relations and, last, but not least, through lack of understanding of other people and nations and ignorance of conditions existing abroad, sympathise with the German cause, the majority of us have long ago realised that a too powerful commercial supremacy of one group of the Powers will endanger our economical and political independence. Our trade had suffered a great deal from disloyal German competition long before the outbreak of the war. The article in the *Elektro-Industrie*, written in favour of the German electrical trade, proves that in Switzerland both opponents in a dispute get a hearing, but it does not follow that it expresses the views of *all* its readers.

In conclusion, we should like to explain that the "blockade" policy practised in England and France against neutral Switzerland is hitting our trade badly, and we are wondering whether it will dawn on the Allies some day that their action in binding industrial forces over here that might be useful to them tends to strengthen the position of the German industry in Switzerland. It must be noted that the Germans are already organising themselves in order to win back the Swiss market after the war, if possible to a still larger extent than in pre-war times, and it looks as if they will succeed unless the Entente Powers discard their over-anxious policy of mistrust against Switzerland.

Théodore Schwarz.

Basle, Switzerland, *February 15th*, 1916.

City Guilds' Subject: "Electric Wiremen's Work."

"Electric Wiremen's Work" concerns not only wiremen, but also a much greater number of people who are intimately concerned with and interested in what might otherwise be termed "Everyday Electrical Applications." These other people are contractors, foremen, architects, charge electricians, inspectors, builders, clerks of works, students who will one day take up one of these callings, other students, and many others.

The subject (to quote another writer) deals (or should deal) first, with the elementary electrical principles involved; secondly, with the hundred and one kinds of consuming devices and accessories that are to (or should) be found in ordinary electrical installations (houses, shops, offices, small workshops, &c.); thirdly, with the simple theory of their construction and working; and, lastly, with the various methods of "wiring them up."

The above shows the fundamental importance of the subject, and the City Guilds' report for last session proves how grossly it is neglected by those in authority in some of our technical colleges, institutes, and polytechnics.

On page 20 of the Report we find that "Electrical Engineering" was taught at 117 centres last session, and "Electric Wiremen's Work" at only 57. Turning to page 22, we find, further, that there were 1,341 candidates for examination in "Electrical Engineering," and only 253 in "Electric Wiremen's Work." The 1,341 above does not, by the way, include those taking telephony, telegraphy, and electro-metallurgy. These figures indicate a very topsy-turvy condition of things, and prove that fundamental training in applied electrical work is to a great extent ignored by those whose duty it is to foster it.

For every student who is investigating the mysteries of dynamo design, alternating-current work, transmission systems, electrical instrument making, &c., &c., there should surely be a dozen or so who only desire a working acquaintance with everyday electrical matters.

It would be absurd, of course, to depreciate the value of the subjects included under "Electrical Engineering" in the City Guilds syllabus. But it seems quite evident from the above-quoted figures that we are paying too much attention to what might be termed exclusive subjects, and neglecting another subject which, if properly handled, should be spreading everyday electrical knowledge amongst thousands of people yearly. This would be to the ultimate benefit of the whole electrical profession and industry.

It is a fact, we believe, that in many institutes the students, though they have practical tuition in jointing, &c., are not treated to lectures based on the "E.W.W." syllabus, but have to attend the elementary electrical engineering classes. This, obviously, is very unsatisfactory.

Had things not been as they are, we should not, perhaps, have had *The Wireless World* saying in its February issue (p. 734) that the City Guilds Institute was "not really very well known"! A rather remarkable statement, considering it has been carrying on its work for about 35 years.

A. P. Lundberg & Sons.

London, N., *February 21st*, 1916.

WAR ITEMS.

Enemy Companies.—The "Times" states that the committee appointed to advise the Board of Trade in tackling companies of enemy nationality or association held its first meeting on February 17th. The affairs of four companies were gone into, but as the proceedings were private no decision was announced.

In the House of Commons, on Monday, in reply to a question, Mr. Pretyman stated that the committee had numerous cases before them. The list of persons, firms, or companies whose businesses might be ordered to be discontinued wholly or partially or wound up would be laid before both Houses from time to time, and notices of such orders would be gazetted. There would be no unnecessary delay, but it was desirable to pass all the names through the committee. It was difficult to draw the line as to exactly whether a firm should come before the committee or should not. In reply to another question, Lord R. Cecil said that the black list under the Act was in an advanced state of preparation, and publication would be commenced shortly.

Westinghouse War Relief Fund.—We have before us a copy of the balance sheet down to December, 1915, of the British Westinghouse Employés' War Relief Fund. A meeting of the delegates was called for yesterday evening at the British Westinghouse Club, Moss Road, Manchester, when Mr. J. H. Tearle was to preside. During the period from August, 1914, to December, 1915, the contributions by employés amounted to £13,648, and that contributed by the company was £6,291; adding a small sum for donations and bank interest received, the income was £20,038. The payments to dependents were £12,047. Christmas gifts stand at £885. Donations were sent to local hospital, Red Cross, and other funds to the tune of £500, and national donations were £680. There has been transferred to the Widows' and Orphans' Fund £4,000, and a balance of £2,312 remains at the bank. The Widows' and Orphans' Fund is almost entirely invested in Treasury Bills.

Tramcar Lighting Prosecution.—At Blackpool, on February 18th, Arthur Bolton, tramcar conductor, was summoned for failing to obscure the car lights. Three other conductors were summoned for similar offences. The car in question was seen standing in Talbot Square with 13 lights switched on, and they were visible seawards. No blinds were drawn. The Chief Constable said he had brought these matters to the notice of the tramway people time after time. Some of the complaints had been attended to, and some had not. A fine of 20s. was imposed in each case.

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Trading with the Enemy.—The Board of Trade has appointed Sir Edwin Cornwall, M.P., to be a member of the Advisory Committee in connection with the Trading with the Enemy Amendment Act, in place of Sir George Croydon Marks, M.P., who, owing to work under the Ministry of Munitions, cannot serve. Sir George is at present acting as Special Commissioner in the Tyne district to deal with the inauguration of schemes for the dilution of labour.

Use of Electric Torches.—The use of electric torches in Essex has become so great that the Chief Constable has issued a notice to all superintendents in the county that in future proceedings will be taken against any person displaying any light in such a manner as to serve as a signal. Unless the nuisance is abated, an order will be made by the competent military authority prohibiting the use of electric torches in the open.—"Times."

IMPORTS OF HOLLAND.

THE following figures, showing the imports of electrical and similar goods, for consumption, into Holland during the year 1914, are taken from the recently-issued official trade statistics; the figures for 1913 are added for purposes of comparison, and notes of any increases or decreases are given:—

	1913. Gulden.	1914. Gulden.	Inc. or dec. Gulden.
Machinery, steam, industrial and agricultural.—			
From Belgium	3,690,000	2,513,000	– 1,177,000
,, Great Britain ...	11,062,000	6,481,000	– 4,581,000
,, Hamburg	236,000	191,000	– 45,000
,, Germany	29,036,000	23,867,000	– 5,169,000
,, United States ...	4,758,000	2,678,000	– 2,080,000
,, Other countries ...	798,000	515,000*	– 283,000
Total	49,580,000	36,245,000	– 13,335,000
* Sweden, 338,000 Gulden.			
Gutta-percha, raw.—			
From France	333,000	31,000	– 302,000
,, Great Britain ...	174,000	549,000	+ 375,000
,, Dutch Guiana ...	1,959,000	744,000	– 1,215,000
,, Java, &c. ...	1,650,000	709,000	– 941,000
,, Other countries ...	237,000	113,000	– 124,000
Total	4,353,000	2,146,000	– 2,207,000
Gutta-percha manufactures.—			
From Belgium	578,000	503,000	– 75,000
,, Great Britain ...	156,000	176,000	+ 20,000
,, Germany	402,000	221,000	– 181,000
,, Other countries ...	1,000	1,000	—
Total	1,137,000	901,000	– 236,000
Iron wire.—			
From Belgium	3,785,000	4,143,000	+ 358,000
,, Great Britain ...	21,000	32,000	+ 11,000
,, Germany	86,486,000	18,577,000	– 67,909,000
,, Sweden	546,000	347,000	– 199,000
,, Other countries ...	23,000	42,000	+ 19,000
Total	90,861,000	23,141,000	– 67,720,000
Instruments, physical, chemical, &c.—			
From Belgium	810,000	384,000	– 426,000
,, Great Britain ...	547,000	538,000	– 9,000
,, Hamburg	401,000	439,000	+ 38,000
,, Germany	7,639,000	6,246,000	– 1,393,000
,, Other countries ...	149,000	271,000	+ 122,000
Total	9,546,000	7,878,000	– 1,668,000
Copper wire.—			
From Belgium	211,000	90,000	– 121,000
,, Great Britain ...	152,000	392,000	+ 240,000
,, Hamburg	6,000	306,000	+ 300,000
,, Germany	4,038,000	2,643,000	– 1,395,000
,, Other countries ...	80,000	78,000	– 2,000
Total	4,487,000	3,509,000	– 978,000
India-rubber manufactures.—			
From Belgium	2,343,000	2,417,000	+ 74,000
,, Great Britain ...	8,548,000	2,271,000	– 6,277,000
,, Java	2,917,000	8,520,000	+ 5,603,000
,, Germany	115,000	106,000	– 9,000
,, Russia	1,273,000	*	*
,, United States ...	91,000	12,000	– 79,000
,, Other countries ...	791,000	912,000	+ 121,000
Total	16,078,000	14,238,000	– 1,840,000
* Not shown separately.			
Steel wire.—			
From Belgium	866,000	581,000	– 285,000
,, Great Britain ...	909,000	571,000	– 338,000
,, Germany	5,283,000	2,124,000	– 3,159,000
,, Other countries ...	118,000	70,000	– 48,000
Total	7,176,000	3,346,000	– 3,830,000
Glass manufactures.—			
From Belgium	330,000	195,000	– 135,000
,, Great Britain ...	141,000	114,000	– 27,000
,, Germany	2,303,000	2,206,000	– 97,000
,, Other countries ...	18,000	13,000	– 5,000
Total	2,792,000	2,528,000	– 264,000
Porcelain.—			
From Belgium	224,000	129,000	– 95,000
,, Great Britain ...	94,000	44,000	– 50,000
,, Germany	1,577,000	1,400,000	– 177,000
,, Other countries ...	112,000	107,000	– 5,000
Total	2,007,000	1,680,000	– 327,000

NOTE.—Gulden = 1s. 8d.

REVIEWS.

Dielectric Phenomena in High-Voltage Engineering. By F. W. PEEK, JUN. London: Hill Publishing Co., Ltd. Price 12s. 6d. net.

The author sets out in this book the properties of gaseous, liquid, and solid insulators, and the methods of utilising these properties to the best advantage in the problems of high-voltage engineering. Methods that have proved useful in designing apparatus, transmission lines, insulators, bushings, &c., are discussed and illustrated by practical examples. In addition, such subjects as the manner of making extensive engineering investigations and of reducing data, the measurement of high voltages, the effects of impulse and high-frequency voltages, methods of drawing dielectric fields, outline of modern theory, various dielectric phenomena, &c., are considered.

A great deal of original work is described (and this is what makes the book so valuable), and there is ample reference to other investigations. It is interesting to note that the author's extensive research was made possible by facilities afforded by the Consulting Engineering Department of the General Electric Co. His work has to do chiefly with the "visual" corona, which may be defined as follows:—If potential is applied between the smooth conductors of a transmission line and gradually increased, a voltage is finally reached at which a hissing noise is heard, and if it is dark, a pale violet light can be seen to surround the conductors. This voltage is the critical visual corona point. If a wattmeter is inserted in the line, a loss is noticed. When alternating voltage higher than the critical voltage is applied between two parallel polished wires, the glow is quite even, but after operation for a short time reddish beads or tufts form along the wire, while round the surface of the wire there is a bluish-white glow. If the conductors are examined through a stroboscope, so that one wire is always seen when at the positive half of the wave, it is noticed that the reddish tufts or beads are formed when the conductor is negative and the smoother bluish-white glow when the conductor is positive. The author gives particulars of different sets of experiments in the study of corona, amongst others the effect of spacing and size of conductor, the effect of temperature (the experiments varied over a range of – 20 deg. C. to 140 deg. C.), effect of oil, water, or dirt on the visual point. Tests made over a very wide humidity range show that humidity has no appreciable effect upon the starting point of visual corona, but after corona is present, humidity has an effect on the spark-over voltage. Change of initial ionisation of the air, even to a considerable extent, has no appreciable effect on the starting point of corona. A test was made to see if heavy current flowing in the wire would change the starting point, but it was found that such current does not appreciably affect it unless the temperature of the wire is increased.

Specially interesting is the author's photographic study of corona on wires and cables. The method adopted was as follows:—Two parallel conductors were spaced 122 cm. between centres. The camera was focused on one conductor only. The distance to the lens was such as to show the conductors at approximately actual size. An exposure was made for a given time at a given voltage. The plate was then shifted slightly, the voltage increased, and a second exposure was made for the same time. Thus a given series shows the same part of the same single wire at different voltages.

Two photographs are given showing the effect of moisture. A stranded cable was brought up to the critical point, and water was then thrown on it. What was a glow at the surface of the dry cable became, at the wet spots, a discharge extending from 5 to 8 cm. from the conductor surface. Other

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photographs show the corona on bright tinned phosphor-bronze wire, on copper wire polished after each exposure, on weathered galvanised iron wire, on a polished brass rod, and unpolished copper cable, and so on.

The author is to be congratulated on the quantity and quality of the original work he has done. The account of his extensive experiments on high-voltage electricity is exceedingly interesting, and his descriptions of apparatus are always clear and his photographs excellent.

Rubber Machinery. By Henry C. Pearson. New York: 1915. *The India-Rubber World* Press. Price 6$ in U.S.A., post free.

Mr. Henry C. Pearson is the editor of the *India-Rubber World*, the chief organ of the rubber trade in the U.S. But besides being a most successful and brilliant technical journalist, he is, and has always been, a practical rubber man, keenly alive to every phase, past, present, and future of the rubber industry. As a result, he has in the past produced works, such as "Crude Rubber and Compounding Ingredients," which are to be found in the reference library of every self-respecting rubber manufacturer. His latest effort, *Rubber Machinery*, is perhaps the most useful of the series, for while—as the author points out in the preface—"mechanical and inventive ingenuity has been producing machinery for use in rubber manufacture" for fifty years, this volume is, so far as we are aware, the first published work, at any rate in the English language, dealing comprehensively with rubber machinery. There have been many rubber books in which typical machines have been features in illustrations of processes, but none in which the processes have been referred to merely to explain the machines. Technical works dealing with machinery are frequently no more than a series of illustrations from manufacturers' catalogues strung together on a thin chain of uncritical letterpress. Such works serve, perhaps, to remind us of much that we had forgotten, but they are scarcely stimulative of thought. Mr. Pearson's volume does not belong to this class; he writes with discrimination as well as with skill. His object, he states, is . . . "to record the machines that are of general application either to all or to a number of the lines into which the trade is divided . . ." To this end, he tells us, "voluminous matter has been collected from machinery makers the world over; from rubber factories, from patent specifications—American, English, German, and French. The actual value of such a collection to the rubber manufacturer, whatever his line, should be great, but the *suggestive value* (the italics are ours) will be even greater." In our view, Mr. Pearson has very largely achieved his object, but his success in this regard is not due entirely to "collecting voluminous matter" from various sources; without the author's practical knowledge of the industry and the exercise of his critical faculty it might have been a poor thing. As it is, however, the volume should find its way to the shelves of all those whose work brings them into contact with rubber machinery. The book is sub-divided into twenty chapters; of these, the first two are devoted to machinery used in washing and drying crude rubber; Chapters III and IV deal with the handling of mixing materials and the process of mixing; Chapters V and VI with calenders and plant for preparing fabrics for calendering and spreading; Chapter VII with clutches, drives, and safety stops for mills and calenders; Chapters VIII to X with vulcanising plant, materials, and methods. Chapter XI is a useful contribution on the subject of tube-making machinery, while the two succeeding chapters are devoted to spreading, doubling, and finishing plant. Chapter XIV, on cement and solution machinery, is the last on what may be termed rubber manufacture proper. After a couple of chapters on the extraction of rubber and gutta from shrubs, vines, &c., and of resins from low-grade rubbers, we have (Chapters XVII and XVIII) a very interesting section dealing with reclaiming. Chapter XIX, on temperature recording and controlling devices, will be of more than passing interest to those (and they are many) who have endured losses and worry as the result of over or under-vulcanising. The concluding chapter is on rubber laboratory equipment, and in this, we think, will be found much that is suggestive even to those whose work lies wholly in the laboratory. Here and there we meet with views or statements that are capable of criticism; for instance, the authors' estimate of the capacity of certain types of crude rubber washing plant appears to us to be rather high; again, the views expressed on the subject of the "nerve" of crude rubber and methods of determining it will scarcely meet general acceptance. They appear to be based on some recent publications of Caspari's, which will, however, require a great deal of confirmatory work before the somewhat sweeping deductions made from them can find practical application. These and other minor blemishes do not, however, affect the character of the book as a whole, nor need they interfere with our congratulations to Mr. Pearson for having given us a most valuable and interesting work.

British Trade Interests in Denmark.—An Exchange dispatch to the *Times* states that a special British Commercial Adviser has joined the British Legation at Copenhagen.

LEGAL.

Motor-car v. Tramcar.

Stipendiary Neilson has issued judgment in the Glasgow Police Court in the prosecution of a Glasgow T.C. motorman who was charged with recklessly driving the tramway car under his charge, and causing it to collide with a motor-car and damage the vehicle and injure its occupants. The impact was so great that the tram-car was forced off the rails. Dealing with several authorities which had been submitted to him, the Stipendiary said the principle laid down in Macandrew & Tillard (1909) clearly applied to the present case, so as to primarily lay the responsibility of avoiding the collision upon the vehicle which was emerging from a small side street upon an important public thoroughfare on which there were tramway rails along which, according to the Board of Trade regulations, it was lawful for a tramway car to travel at a rate of sixteen miles per hour. A motor-car was a much more mobile vehicle than a tramway car, and therefore the chief responsibility for the avoidance of danger lay upon the motor-driver. He found the charge against the motor man not proved.

Munitions Court Cases.

At the Manchester Munitions Court on Saturday, a firm of electrical engineers summoned Messrs. Humphrey Lloyd & Sons, for engaging a youth named Carnall and taking him away from a controlled establishment. The case was brought under Sec. 12 of the Amended Munitions Act, and it was stated for plaintiffs that they had warned defendants that they were infringing the Section by employing Carnall. Defendants' statement was that Carnall replied to their advertisement for a clerk, and he was engaged subject to his references being satisfactory. Plaintiffs subsequently informed them that theirs was a controlled establishment and that they could not spare Carnall, whereupon Humphrey Lloyd & Sons informed the youth by letter that they could not continue the engagement. On the following day, February 8th, Mrs. Carnall called and the youth also wrote, and both stated that he was not employed on munitions, that he had no badge, and that he would not return to his old place. Defendants, added the statements, were not a munition firm, and as the statements seemed satisfactory, the defendants kept the youth at work. The defendant firm were fined £3 and the youth £1, the latter not to be enforced if he returned to his work by the following Wednesday.

An electrical fitter employed by the Admiralty at Sheerness, last week applied for his discharge, on the ground that, as overtime had been abolished, his wages were insufficient to keep himself and his home going at Ashton-under-Lyne. He desired (according to the *Standard*) to get work at Manchester. There were six fitters, two labourers, and an assistant doing the job which one man did before the war. A representative of the Admiralty said that no overtime was promised, but the man worked overtime from February, 1915, to January last, his average earnings being £4 6s. 3d. a week. There was a difficulty in getting electrical fitters, and the Admiralty had to keep up a large staff to deal with any emergency that might arise. The certificate was refused.

Grocott v. Lovatt & Booth.

At Staffordshire Assizes last week, before Mr. Justice Avory and a jury, Richard Thomas Grocott, trading as Gaskell & Grocott, manufacturers of electrical earthenware fittings, of Longport, near Burslem, brought an action against Joseph Lovatt, general secretary, and Jabez Booth, organiser, of the National Amalgamated Society of Male and Female Pottery Workers, to recover damages for libel.

According to a report in the *Manchester Guardian*, Mr. Graham, for the plaintiff, said that he claimed damages for a libel contained in a handbill issued on May 25th last. In that month there was considerable agitation not only in the pottery trade, but in most other trades all over the country, for an advance in wages on account of the increased cost of living. This was shared by the workpeople at Longport, and on May 7th Mr. Lovatt, general secretary of the Union, wrote to the plaintiff's firm stating he was instructed by the operatives to ask for an advance of 10 per cent. in wages to all day wage and piece workers on account of the increased cost of commodities. This appeared to be an entirely gratuitous interference between Mr. Grocott and his workpeople, because the vast majority of them belonged to a special Union which looked after the interests of their particular branch of the trade. The plaintiff took no notice of the letter or of a similar letter written a little later, in which it was stated that the manufacturers had agreed to pay a bonus of 7½ per cent. Recognising the general demand for an increase of wages as being a just one, Mr. Grocott, in common with most other employers in the district, granted of his own accord a war bonus of 7½ per cent. to his employés, and paid it for the first time upon May 22nd for the week beginning May 15th. Three days later a handbill was distributed outside the works. It convened a meeting and stated that the business to be discussed was the 7½ per cent. war bonus, and added, "If you are anxious to secure the war bonus, attend this meeting. You can only obtain it by joining this society. Now is the time to join." The plaintiff complained of this as being a libel upon him, because it implied that he was not at the time paying the war bonus as other employers were doing.

Mr. Milward, for the defendants, asked the jury to say that

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there was no libel and no intention to libel the plaintiff. He pleaded that his clients had no knowledge of the handbill.

The Judge said the jury knew how dangerous it was in these days when the relations between employers and employed were delicate to ruffle or disturb relations between masters and men which were amicable. In this case there appeared to be no ground for the imputation alleged, because the plaintiff was already paying the war bonus when the handbill was issued, and this fact could easily have been ascertained from any of the plaintiff's workpeople.

The jury returned a verdict for the plaintiff, and assessed the damages at £200.

The Lighting of Kingstown.

The Court of Appeal, Dublin, was, last week, engaged considering an appeal brought by the Dublin Southern District Electric Supply Co., Ltd., from a decision of Mr. Justice Barton, refusing an application for an order directing the Taxing Master to tax the costs of the company against the U.D.C. of Kingstown, on the scale provided for by the Acts for the taxation of Parliamentary costs, or, in the alternative, directing that the costs should be taxed as Chancery costs on the higher scale, as between solicitor and client, or for such other order as the Court might deem reasonable. The case related to the arbitration proceedings between the Kingstown U.D.C. and the Dublin Southern District Electric Supply Co., in connection with the Kingstown lighting scheme.

On Monday the Lord Chancellor said that the view of the Court was that the appeal should be dismissed with costs, but as some questions of general importance had been raised with which it would be necessary to deal, they would deliver a considered judgment as soon as possible.

Farrell v. Bloxam

Before Mr. Justice Gibson and Mr. Justice Pim in the King's Bench Division of the High Court of Ireland, application was made on defendant's behalf for an order changing the venue of trial from the City of Belfast to the City of Dublin in the case of Mr. A. B. Farrell against Mr. T. W. Bloxam. The action has already been referred to in our pages.

In the result the Court changed the venue to the County of Antrim, costs to be costs in the cause, Mr. Justice Gibson remarking that this would enable plaintiff to have justice and to have the action tried (at Assizes) as cheaply as possible.

THE SWISS MACHINERY INDUSTRY.

The importance of Switzerland as a producer of machinery and competitor in the markets of the world is clearly illustrated in the annual report which was recently published by the Swiss Association of Machinery Manufacturers (Verein Schweizerischer Maschinen Industrieller). Although the report does not contain any record of the total output of machinery of all kinds in that country, it quotes details of the import and export trade in 1913 and 1914, and mentions that the number of works belonging to the Association was 154 in 1914 as against 155 in the previous year, whilst the workmen and apprentices, of whom one apprentice to 10 workmen appears to be the rule, comprised 36,123 and 43,081 in the two years respectively. As will be seen from the accompanying table, the total imports of machinery declined from £2,298 000 in 1913 to £1,647,000 in 1914, the reduction being entirely due to fewer deliveries being received in the second half of the year :—

Total Value of Foreign Trade in Machinery.

	Imports.	Exports.
1913 ...	£2,298,000	£4,473,000
1914 ...	1,647,000	3,561,000

There is no reason for assuming that the native makers secured any substantially greater share in meeting home requirements as a result of the diminished imports in 1914, as the decrease was rather due to the general depression in the purchasing industries through the war.

As might be expected from its geographical proximity and great industrial development, Germany occupied the principal position in the Swiss import trade, the deliveries from the former to the latter having been £1,600,000 in 1913 and £1,112,000 in 1914, or 70 per cent. and 68 per cent. of the total Swiss imports in the two years respectively. On the other hand, the exports from Switzerland to Germany only receded from £720,000 to £680,000 in 1914. The exports to Austria-Hungary decreased from £196,000 in 1913 to £140,000, but the imports from the dual monarchy are only mentioned in the sense that Austro-Hungarian machinery participated in the total exports from Switzerland to the amount of 4 per cent. in both years. The imports from France fell by £80,000 in 1914, and the Swiss exports to France also diminished by £124,000. In the case of Italy the Swiss imports receded by £8,000 and the exports by £40,000.

The Swiss trade with Great Britain is set forth in the report separately for the first time. The imports are given as having been of the value of £113,000 in 1913, as contrasted with £69,000 in 1914, whereas the Swiss exports are returned at £217,000 and £210,000 in the two years respectively, a substantial advance having taken place in dynamos and milling machinery. The report emphasises the great loss of trade which occurred in the most important market for Swiss machinery, namely, Russia, where a decrease of £228,000, or 33 per cent., took place in 1914 ; a diminution of £200,000, or over 50 per cent., took place in the case of South America, and one of £108,000, or 37 per cent., in the trade with Spain, as compared with 1913. The table which next follows also records the foreign trade in electrical and certain other machinery in the years set forth :—

	Imports of electrical machinery.	Exports of electrical machinery.
1910 ...	£48,000	£626,000
1911 ...	40,000	721,000
1912 ...	59,000	689.000
1913 ...	61,000	814,000
1914 ...	55,000	623,000

Foreign Trade in Certain Other Machinery.

	Imports.		Exports.	
	1913.	1914.	1913.	1914.
Hydraulic turbines and pumps	£29,000	£18,000	£340,000	£260,000
Steam engines and steam turbines	34,000	19,000	419,000	236,000
Gas, oil and benzine engines	24,000	21,000	476,000	350,000

If the imports are deducted from the value of the exports, it will be found that the latter represented an apparent surplus of £2,175,000 in 1913, and one of £1,914,000 in 1914. It must, however, be borne in mind that Switzerland is a large purchaser of foreign machinery for re-exportation as the report, although not specifically referring to re-exports, gives the share held by various countries in the total exports of machinery from Switzerland in the two years under consideration. If these shares are brought together for the principal countries, the following results in percentages of the values are shown :—

Participation of Foreign Machinery in the Total Exports from Switzerland.

	1913.	1914.
Germany...	16·3 per cent.	19·3 per cent.
Austria-Hungary ...	4·0 „	4·0 „
France	17·7 „	18·7 „
Italy	8·9 „	10·1 „
Great Britain	4·9 „	5·9 „
Total	51·8 „	58·0 „

The total sum represented by the above percentages of the exports in either year is greater than the total value of the imports either in 1913 or 1914, and the percentages can, therefore, not be regarded as thoroughly reliable. At the same time the figures lead to the assumption, which appears to be wholly justified, that the entire value of the imports of machinery is also contained in the total value of the exports for each year.

BUSINESS NOTES.

Inquiry from Canada.—A Montreal firm having branch stores in Quebec, Ottawa, Toronto, and Vancouver, and travellers throughout the Dominion, wishes to obtain agencies for British electric lamps, &c. Apply Board of Trade Commercial Intelligence Branch, London.

Trade Announcement.—Messrs. Napier, Kimber, Ltd., announce that Mr. R. N. Cunningham is not now connected with the company. He has disposed of the whole of his ordinary shares and resigned his directorship, and Mr. A. W. Kimber becomes principal shareholder and will remain managing director.

British Trade with Russia.—The Board of Trade Commercial Intelligence Branch has issued a special eight-page reprint relating to "Possibilities of British Trade with Russia." It is a memorandum prepared by the Acting British Consul-General at Moscow. We have not space to spare to deal with it at length at present, but we recommend it to the attention of all firms that are interested in our future trade relations with Russia. The writer emphasises the need for organised preparation ; shows the necessity for a knowledge of local conditions ; and makes a comparison between British and German methods. He discusses four suggested methods of developing British trade :—(1) Local representation ; (2) the "Group" agency ; (3) commercial banking ; establishment of forwarding agents ; (4) official visit of British merchants. In conclusion, the principles of successful trade are considered.

Science and Industry in Australia.—At a conference held at Melbourne, on January 5th, the Prime Minister, Mr. Hughes, presiding, it was resolved that an advisory council be established to formulate proposals for a national bureau of science and industry. The Prime Minister said that great industries, primary and secondary, must be stimulated, advised, and aided by scientific industrial research, and by wise laws. Provision would be required for a bureau of standards, and for industrial research ; there should be a scheme so broad as to reach right down from the central institution to the preparatory schools, for there was only one way by which the scheme could be effectively carried out—and that was to reach the people when they were young, and to impregnate them with science. Mere money would not be allowed to stand in the way.

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The British Industries Fair.—This Exhibition, which has been organised by the Board of Trade, will remain open until March 3rd. It is being held in the Victoria and Albert Museum, South Kensington, and in order not to interfere with the production of munitions of war, the exhibits have been limited to printing and stationery; china, earthenware and glass; fancy goods and toys. Over 100,000 invitations have been issued, but if there are wholesale buyers in any of these trades who have not yet received tickets they can obtain same by applying to the Board's Cheapside offices. Our own impression of the Fair, formed on Monday afternoon, when Her Majesty the Queen made a tour of inspection under the guidance of Mr. Runciman, is that an unqualified success may be expected. We confess to experiencing something in the nature of a shock when we found that the greater part of the ground floor of the Museum had been temporarily cleared of its serious permanent collection in order to make room for collections of dolls, teddy bears with sparkling electrical eyes which lit up by means of a switch at the centre of their frontal curvature, golliwogs, and all sorts of funniosities, but, after all, the Exhibition is a very serious affair, affording very acceptable indications of the efforts that British manufacturers are making in various departments of industry to dispense with German-made goods. Not many electrical articles come under the classification of trades adopted for this event, but those of our readers who visit the Museum should make a point of visiting the stands of the several enterprising firms who are engaged meeting the very large demand that exists for pocket and other portable electric lamps and articles that come within that category. From our conversation with those in charge of such exhibits, we gathered that the spirit of all engaged in this branch of the electrical industry was one of the most thorough-going optimism. What has been done since the outbreak of war, what is being done now, in spite of all the labour difficulties of the time, and what is in prospect for the days when military and munitions demands fall away, altogether make a most interesting story. Some there are who say that British manufacturers were beating German manufacturers in such lines before the first shot in this war was fired, but all are confident that we shall be so strongly prepared that there need be no fear of our losing the market after the war. The Efandem Co., of Wolverhampton, had an output of 3¼ million batteries last year—this year it will be 5 million. Of actual pocket lamps they turned out an average of 35,000 per week from January to December last year, and everything was made at Wolverhampton. There may have been difficulties in regard to glass lenses, but even here English manufacturers are rising to the occasion. The Efandem Co. are also developing a number of new lines, such as bells and indicators and general novelties in which Germany was to the fore in many parts of the world, and the result is gratifying. On their stand will be found many devices which certainly cannot correctly be called "toys," for we noticed military equipments of electric lamps for fixing on the bridle and on the stirrup, also lamps for shell inspection and trench service, which show the adaptability of the firm for meeting the requirements of the Forces. The British Ever-Ready Co., Ltd., also have what for this exhibition is a comparatively large stand where an excellent range of pocket lamps, portable hand and reading lamps, torches, miners' lamps, dry cells, accumulators, and many electrical specialities is well displayed. This company has been doing a splendid business for some time past, and we learned with satisfaction of important works extensions for dry battery manufacture which are in hand, concerning which more later we hope. Messrs. Ward & Goldstone, as our readers have already been made aware, are also exhibitors of many of the lines for which they have long been so well known. Pocket lamps and batteries, hand lamps, portable lamps, model motors and dynamos, Ford starting batteries, electric cycle lamps, magneto-electric machines, "Volex" dry batteries and electrical novelties are shown in great variety. Messrs. F. Darton & Co. have on display many hand and pocket lamps, model motors and dynamos, model electric boat motors, accumulators and dry cells, car-lighting dynamos, water motors and dynamos for running from household taps, Samson dry cells, and many electrical machines and novelties. But they have developed also very largely their lines of meteorological and other instruments, and are doing well in that department. Messrs. W. A. & R. J. Jacobs, Ltd., the Surrey Electrical Co., Ltd., and Mr. T. Baxter also have interesting exhibits of pocket lamps. Here and there the electrical visitor will find other features of interest, and in the pottery and earthenware sections the enterprise of the British manufacturer is very evident.

Catalogues and Lists.—Messrs. Smart & Brown, Erith, Kent, have issued a wall calendar, showing in colour one of their motor launches as supplied to the Thames Police last year.

Muldivo Calculating Machine Co., 49, Queen Victoria Street, London, E.C.—Leaflet relating to the "Muldivo" calculating machine, which is of French manufacture.

Sun Electrical Co. Ltd., 118/120, Charing Cross Road, London W.C.—Price list of "Britannia" metallic-filament drawn-wire lamps.

Jackson Electric Stove Co., Ltd., 38, Blandford Street, London, W.—Illustrated price cards relating to coffee percolators and hot-water urns.

The Schenectady Works.—Some of the London newspapers have published exaggerated reports respecting the recent fire at the General Electric Co.'s works at Schenectady. We learn on the best authority that the damage done is so slight as to be hardly worth mentioning, and that the work of production will not be in the least interfered with.

Bankruptcy Proceedings.—W. C. Wild, electrical engineer, Halifax.—First and final dividend of 5s. 7½d. in the £, payable at Official Receiver's office, 12, Duke Street, Bradford.

G. E. Bonner, electrical engineer, Palmer's Green.—The public examination of this debtor was held at the Court House, Edmonton, on February 21st.

F. H. Watts, electrical engineer, 40, Mincing Lane, E.C.—Trustee released, December 6th, 1915.

A. J. Loader, "Medical Electrician," Nelson.—Trustee released, December 13th, 1915.

Liquidation.—Electro Steel Foundries, Ltd., Darlaston.—March 4th is the last day for the receipt of proofs for dividend, by Mr. H. E. Burgess, the liquidator, 33, Carey Street, W.C.

Inquiry from Brazil.—The Acting British Consul-General at Rio de Janeiro reports a local demand for steel poles for the suspension of arc lamps. Satisfactory supplies have hitherto been obtained from Germany. Supplies of electrical insulators have also been obtained from Germany in the past, and consumers state that they have only been able to secure inferior substitutes from the United Kingdom since the outbreak of war. Samples of insulators of German make have been received from the Consul by the Board of Trade Commercial Intelligence Branch in London, to which communications should be addressed.

Book Notices.—"Wireless Transmission of Photographs." By M. J. Martin. London: The Wireless Press. Price 2s. 6d. net.

"The Rubber Growers' Association, London, E.C. Annual Report of the Council for 1915."

"Thomas Alva Edison." By F. Rolt-Wheeler. London: Macmillan & Co., Ltd. Price 2s. net.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXV. No. 2. February, 1916. New York: The Institute. Price $1.

The Committee of Management of the San Francisco International Engineering Congress, 1915, announces that the volume on Mechanical Engineering is ready for distribution, and the members who have subscribed for this volume will soon receive it. The other volumes will be issued as rapidly as possible.

LIGHTING AND POWER NOTES.

Argentina.—A new electric power house was formally inaugurated at Acebal (Province of Santa Fé) last month. The establishment belongs to Senor Julio Hardy.

La Prensa's correspondent at Tucumán says that owing to the shortage of water, the Electrica del Norte Co. has addressed a note to the municipality, stating that it will be obliged to leave the city in darkness unless the water required for the power station be forthcoming. The Intendent replies that the municipality must adopt measures to guarantee the regularity of the public and private lighting service in terms of the contract. It is believed that this attitude will give rise to a serious conflict, as the municipality owes the company $300,000 m/n. for lighting. On the other hand, it appears that the company has sought the present pretext with a view to arriving at a settlement.—*Review of the River Plate.*

Atherton.—The electrical engineer has reported that the output is steadily increasing, and will soon reach the maximum load which the Tramway Co. is able to supply until such time as the new generating set is installed.

Bungay.—E.L. Scheme.—With reference to the E.L. scheme proposed by Mr. Best, of Bradford, the U.D.C. has deferred the question of entertaining the proposal until it is ascertained how similar schemes work in neighbouring towns.

Continental.—Spain.—The new central station at Segovia, belonging to the Sociedad Co-operativa Electra Segoviana, has just been completed and put in operation. Water power is utilised, the plant comprising two Francis-type turbines supplied by Messrs. Escher, Wyss & Co., of Zurich, and two alternators by the Allmänna Svenska Aktiebolaget, of Stockholm.

Italy.—A report of the Demanio furnishes details of the natural water resources of Italy utilised for industrial purposes up to June 30th 1914. The concessions granted number 3,161, for the production of 770,000 kw., without taking into account a large number of concerns working without legitimate title, and 2,600 grants under construction. The regions in which the concessions operate are 16 in number, the most important being Piedmont, which has 620 concessions, yielding 216,000 kw. Lombardy has 394 concessions, totalling 205,000 kw., and Umbria with 101 concessions, obtains 100,000 kw. In addition to the foregoing there were granted in the working year preceding June, 1914, 116 concessions for a total of 20,000 kw. The revenue obtained by the State Treasury from the taxation of concessions totalled on June 30th, 1914, 2,871,202 lire, which is exclusive of the income which should have been derived from a number of free concessions, granted under special Acts, representing a total of 33,500 kw.—*Rivista Tecnica d'Elettricità.*

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Darlington.—Supply Developments.—At a recent meeting of the Electricity Committee it was reported that the supply of electricity for the 10 months of the year was up by 20 per cent. as compared with last year, and that for the last month there was an increase of 40 per cent. on the year, this, notwithstanding the reduced use of electricity for lighting purposes.

It was also reported that the contract with the N.E.R. Co. for the full supply of electricity for its works would date from June 1st next.

Dublin.—We briefly summarised last week the statements which were circulated locally regarding the contents of Mr. d'Alton's report on the Corporation electricity undertaking. From discussions which have since taken place in the Council chamber, we gather that all publication in the local papers, whether of the report or of the replies thereto, which have been made by certain officers of the department, is unauthorised officially and is premature. Doubtless Mr. d'Alton regards himself as being bound by those obligations of etiquette and confidence which for the present compel him to maintain silence. Probably when the proper time arrives, the Corporation Committee will officially publish the report and replies, and until then we prefer to withhold any comment that we may desire to make upon the matter.

In addition to the counter reports mentioned last week, Mr. Mangan, the city accountant, has now submitted a report more or less disagreeing with Mr. d'Alton's conclusions. Mr. Mangan apparently does not believe that the load conditions can be greatly improved in Dublin, and urges that in making price comparisons a distinction must be drawn between power and lighting supplies. He evidently agrees that some explanation is needed of recent coal costs and consumption, but points out that "units used on works" includes energy used at Fleet Street and other sub-stations, and, therefore, subject to transmission losses. He further considers that his own analysis of salaries, &c., submitted to the town clerk last June, made this matter clear.

Asylum Lighting.—The returns of the cost of electric lighting at Richmond Asylum for 1915, as compared with gas lighting in 1911 show a saving of £978, and this although added buildings are now lighted.

Eccles.—There was a surplus of £632 on the Council's electricity undertaking for the year ended March 31st last. This has been carried to reserve.

High Wycombe.—Street Lighting.—The Electricity Co. has accepted the terms offered by the T.C. in respect of the public lighting up to the end of 1915, but objects to the proposals of the Council as to payment since January 10th, the date of the new lighting order issued by the Government. The company has asked that the matter shall be referred to arbitration, but the Council has deferred the question until the end of the current quarter.

Huddersfield.—Year's Working.—It was stated at a recent meeting of the T.C. that the electricity department had used 28,242 tons of coal in 1915, as compared with 20,781 tons in 1914, and that the cost had risen 75 per cent., indicating the possibility of a further increase in the price of electricity. The units sold totalled 10,536,374, an increase of 30·5 per cent., due to the demand for power; due to the night work, a considerably improved load factor resulted.

The borough treasurer's revenue statement for the year ended December 31st last, shows a balance of income over expenditure in respect of the electricity undertaking of £3,441; £1,291 is to be transferred to the depreciation and contingencies account, and the remainder carried forward.

Hull.—Smoke Nuisance.—The local Health Committee has threatened proceedings unless the smoke emitted from the chimneys at the Sculcoates electricity works is reduced. The acting electrical engineer, Mr. Magoris, has presented a report, pointing out the difficulty of complying with the request at the present time, and this is to be forwarded to the Health Committee. In effect Mr. Magoris points out that it is impossible to restrict capital expenditure, obtain new plant, give the maximum output from the plant and yet study the niceties of smokeless combustion—especially if, as is probable, the staff is depleted.

Kingstown.—L.G.B. Inquiry.—An inquiry has been held into the Council's application for sanction to a loan of £6,000 for the payment of the arbitration award and costs connected with the transfer of the electric lighting undertaking under the Electric Lighting Order Confirmation (No. 8 Kingstown) Act, 1914. No objection was offered. The award was for £3 608. and the costs and fees brought the total up to £4.704. The costs of the arbitration proceedings amounted to £603. The total expense was estimated at £6,327.

Liverpool.—Annual Accounts.—During the year ended December 31st last, the revenue of the electricity department amounted to £345,808. the balance to net revenue was £209,558, and after meeting interest and sinking fund contributions, and providing £50,000 to rate relief, £36,223 was transferred to renewals. The department has a reserve fund of £183,000 and a balance of renewals fund in hand of £97,000; the rate contribution represents about 3½ per cent. on the unredeemed capital and 23 per cent. on the income derived from private lighting and power.

London.—Hackney.—As it is not possible to install two further boilers and economisers in the new boiler house to provide against breakdown, the Electricity Committee recommends that the stoker driving gear for the second boiler installation be provided immediately.

Rawtenstall.—Bulk Supply.—With a view to giving a bulk supply of electricity to Haslingden a Sub-Committee recently recommended the borrowing of £11,000 for the purchase of new plant for the station at Hareholme. It has been decided, however, that for the present this scheme shall not be proceeded with, but that a cable shall be laid as far as Lockgate, and as much current as possible shall be supplied to Haslingden in that way. The estimated cost of this is about £2,000.

Redruth.—Street Lighting.—Owing to restricted lighting the U.D.C. is negotiating with the Urban Electric Supply Co. for a revision of the existing charges for public lighting.

Surbiton.—E.L. Purchase.—The transfer of the Council's electricity undertaking to Messrs. Callender's Cable and Construction Co., Ltd., has been completed. Messrs. Callender will pay £51,732, by instalments, as purchase price, and have already paid £4,100, to reimburse the Council's losses, and for other matters, including instalments of purchase money due to date of transfer.

Swinton and Pendlebury.—The Lancashire Electric Power Co. has notified the U.D.C. that the price of current would be advanced as from January 1st, in accordance with the advance in the cost of coal, as provided for in the agreement.

U.S.A.—Half-Watt Lamps.—According to the *Electrical World*, all the arc lamps in the city of New York are to be replaced by large gas-filled tungsten lamps, under the terms of the contracts entered into for 1916 with the different lighting companies supplying the city. The new gas-filled lamps will range from 100 c.p. to 400 watts in size, and the ordinary type tungsten lamps from 40 to 100 watts. During 1914 the city decided to discontinue the use of the flaming arc lamp; beginning with 1915 there were in service 18,211 arc lamps, many of which were replaced during the year by gas-filled tungsten lamps, while this year the remainder are to be replaced, resulting in a saving in the larger sizes of about $10 a lamp over the arc lamps replaced. Our contemporary adds that besides saving in money, it was found after a careful investigation that the gas-filled unit afforded a more uniform distribution of light without glare or flicker, and had a much greater penetrating power in stormy or foggy weather.

The Inland Steel Co., Ind., is reported to have placed a million dollar contract with the Westinghouse Co. for steel mill electric plant, including two 5 000-kw. turbine sets, two fly-wheel motor-generator sets, two 8,000-h.p. motors and a 15,000-h.p. motor.

The Niagara, Lockport and Ontario Power Co. is contracting to deliver 40,000 h.p. to Niagara Falls manufacturing plants. This power will be supplied by the Ontario Power Co. from the Canadian side and used mostly for electro-chemical purposes.

West Ham.—Proposed Loans, &c.—In connection with the recent breakdown on the 5,000 kw. machine at the generating station, the engineer has made arrangements with the makers for the reconstruction of the electrical end of the machine on a more modern plan. The Committee recommends approval to the general principle of linking up with Poplar within the limits available at the present time. The engineer in the course of a report to his Committee, says he proposes that application should be made to the L.G.B. for sanction to borrow £3,000 for mains and £5,000 for sub-stations, transformers and switchgear, in order to cover amounts overspent, and to provide a balance to meet applications which may arise; £11,000 for increasing the capacity of mains in the Silvertown district required on account of the increasing demand by the Port of London Authority; £4,500 in connection with the linking-up scheme with Poplar; £3,275 in connection with the generating station, and £1,000 for meters. The Committee recommends the adoption of the report. The L.G.B. has given its consent to the borrowing of £2,000, being the balance unexercised on a sanction of £17,500 for services, &c.

TRAMWAY and RAILWAY NOTES.

Australia.—The N.S.W. Public Works Department has in contemplation four additional tramways in the Sydney area, at a cost of £164,000. The lines are from Bondi Road to Bronte, along Cooks River Road to connect with the Gardeners Road line, and from Burns Road to Ryde.

Bispham.—The Blackpool Corporation is in negotiation with the Blackpool and Fleetwood Tramroad Co., as an interested party, with regard to a scheme for the building of a sea wall north of Blackpool, to arrest the erosion of the cliffs. The Bispham U.D.C. feels itself too small a body to undertake such a large expenditure—about £25,000—and has approached the Corporation with a view to an extension of its boundaries, so as to absorb Bispham.

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Birmingham.—Trailer Cars.—The Tramway Committee has instructed Mr. Baker, the general manager, to inquire into the use of trailer cars on the London tramways with a view to their possible introduction in Birmingham, where the shortage of drivers is causing some concern.

Eccles.—Tramway Surplus.—There was a surplus of £2,220 on the tramway account for the year ended March 31st last; £572 of this has been appropriated for street improvements account, and the balance of £1,647 has been carried to the reserve fund.

Glasgow.—In order to comply with the terms of the restricted lighting order, the Tramways Committee has had the windows of the cars painted halfway down. In addition, nearly 20,000 lamps have been dipped, and measures are to be taken to dim the lamps on the forepart of the cars so far as is consistent with the public safety, and to dull the illuminated signs.

Halifax.—The B. of T. has extended the period for the completion of certain tramways authorised by the Halifax Corporation Act, 1911, for one year from August 18th, 1916.

Hull.—Tramway Surplus.—The income of the Corporation tramways up to March 31st next is estimated at £162 890, and the credit balance, after meeting all charges, at £13,762, against £19,112 in the previous year. It has been decided to grant £10,000 to the relief of the rates, as in previous years. During the year ½d. fares have been maintained and some five million free rides given to soldiers, &c. The department has a reserve fund of £143,000.

Lancs. & Yorks. Railway Electrification.—Sir George Armytage, chairman of the board, stated at the annual meeting of the shareholders on February 16th, that the electrification of the Manchester and Bury line was now almost complete, and that the electric trains would be gradually brought into use at an early date. The statement of receipts and expenditure on capital account showed that on electric power stations, &c., the company had expended up to December 31st, 1914, the sum of £392,804, and during 1915 £112 871 was expended, making a total of £505,676 on this head. Estimated further expenditure on capital account included £17,500 during the current year on the electrification of the Manchester and Bury line, and £6,500 subsequently; and £28 400 on electric power stations, &c., during 1916, and £5,500 subsequently. Under the heading of rolling stock, detailed figures were given respecting the trains worked by electric power, from which it appears that the number of cars had increased during the past year from 174 to 210, and the carrying capacity from 13,616 seats to 16,552 seats.

London.—Poplar.—Electric Wagon.—The Electricity Committee has recommended the B.C. to purchase, for joint use with the Works Department, a 4-ton Edison electric wagon, and a 4-ton Foden steam wagon. The total cost is estimated by the Committee at £2,000.

London and North-Western Railway Electrification.—The engineer's report on the progress of the work up to February 10th states that the bridges and tunnels for the junctions between the new electric lines and existing lines to Euston and Broad Street are in progress, and half the length of the iron-lined tunnels under Primrose Hill has been completed. The electric power station and repair shed at Stonebridge Park and six electric sub-stations are complete, and part of the plant has been installed, and the equipment of the new lines for electric traction between Willesden and Watford is in a forward state.

The electrical equipment of the North London, Hampstead Junction, and North-South Western Junction lines, which form the through route between Broad Street and Kew Bridge and Richmond, is being proceeded with, and the buildings for the sub-stations on these lines are complete.

Manchester.—Female Labour.—About 250 women are now employed on the Corporation cars, and others are being appointed to fill the places of men called to the army under the group system.

Monmouthshire.—The Board of Trade has extended the period of the Western Valleys (Monmouthshire) Railless Electric Traction Act, 1913, for one year.

U.S.A.—Electric Truck Parade.—An unusual demonstration occurred in December last, in Chicago's "loop" district, when 89 electric trucks, loaded with tea and coffee, paraded in the streets to mark the inauguration of exclusive electric truck delivery service by Messrs. Reid, Murdock & Co., wholesale grocers. The procession was accompanied by mounted police, and a band enlivened the proceedings—in American fashion. The goods were consigned to 1,920 customers in 875 cities in the States, and the result was "some" advertisement. But we wonder what would happen were a London firm to suggest a similar demonstration in the City!

60,000-kw. Turbines.—The Interborough Rapid Transit Co., of New York, is considering bids for two 60 000-kw. steam turbo-alternators, which, according to the *Electrical World*, will each be made up of three separate electric generators driven by one high-pressure and two low-pressure turbines, the latter being connected in multiple. Apparently it has not been decided yet whether to install 60,000-kw. units or the equivalent in 30,000-kw. units.

Walthamstow.—The Tramways Committee recommends a revision of the fares and fare stages, including an increase of 50 per cent. on the prices of workmen's tickets. Having been advised by the contractors for the supply of tickets that the restriction of the importation of wood pulp would result in them being able to supply only 50 per cent. of the usual requirements of tickets, the District Council has been recommended to communicate with the Board of Trade, pointing out that the proposed allowance would place the undertaking in considerable difficulty, and asking the Board to withdraw the restriction as far as tramway undertakings are concerned.

West Ham.—Halfpenny Fares, &c.—The tramways manager recommends the pulling up of the Beckton Road tramway, and the relaying of as many rails as are required in the doubling of the Connaught Road terminus track. The manager estimates the cost of this doubling at £970, the cost of pulling up the rails in Beckton Road and making good the roadway at £350, and the value of the rails, fish plates, &c., recoverable at over £2,000. The manager has submitted an exhaustive report on fares and stages, in which he recommends, *inter alia*, the abolition of the halfpenny fare. He estimates the cost of new track work requiring to be put in hand as soon as possible at about £100,000, and is of opinion that some action should be taken to increase revenue. Whereas the actual cost of carriage per passenger works out at 67d., excluding capital charges, 47 per cent. of the total number carried only pay one halfpenny. The halfpenny fare at West Ham, with the exception of one year, has never covered actual running costs. A scale of fares should be made which gives the journey desired at not less than cost price, and should be periodically revised in accordance with the requirements of the financial side of the undertaking. The Committee recommends the Corporation to put into operation the following fares on all cars running in the borough as and from the beginning of the next financial year:—(1) A universal 1d. fare for a continuous journey on any one car; (2) a 1½d. workmen's return fare for a continuous journey on any one car; (3) existing through fares where necessary to be adjusted to comply with the above scheme; (4) children's stages to remain in force as at present.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—March 8th. Electrical goods, for the Powell-Duffryn Steam Coal Co. Stores Manager, Aberaman offices.

March 11th. U.D.C. Electrical stores for 12 months. See "Official Notices" February 18th.

Australia.—Sydney.—May 1st. Two 300-kw. turbo-alternators, condensers, switchboard, &c., for the pumping station at Ryde, for the Metropolitan Board of Water Supply and Sewerage at Sydney.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-kw. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.*

Melbourne.—April 19th. Victorian Railways. One 1,000-amp.-hour storage battery, plant for impregnating electrical apparatus with insulating varnishes, &c.*

Belfast.—March 15th. Tramways and Electricity Committee. Stores, including a number of electrical items. See "Official Notices" to-day.

Birkenhead.—March 6th. Corporation. Cable and two rotary converters with switchgear. See "Official Notices" February 1st.

Bolton.—March 2nd. Electricity Committee. Stores, including some electrical items. See "Official Notices" Feb. 11th.

March 6th. Tramways Committee. Stores, including lamps, carbons, &c. See "Official Notices" to-day.

Dewsbury.—Electricity Department. Two second-hand 250-kw. generator panels, oil separator, piping, cables, &c. See "Official Notices" February 11th.

Dover.—March 9th. Electrical sundries and cables, for the Harbour Board. (Schedules 2s. 6d. each.) Mr. Martyn Mowll, Registrar, Castle Street.

Dublin.—March 1st. Battery materials for carriage lighting, for the G.N. Railway Co. (Ireland). See "Official Notices" February 18th.

Dundalk.—March 21st. U.D.C. Engine-room stores, cables, lamps, &c., for the Electricity Department. See "Official Notices" to-day.

Edmonton.—March 8th. Electric lamps for six months, for the B. of G. Mr. F. Shelton, Clerk, Lower Tottenham.

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Heston and Isleworth.—March 11th. U.D.C. Electrical supplies, including cables, meters, &c. See "Official Notices" to-day.

Heywood.—March 15th. Electricity Committee. Stores, including some electrical items, for 12 months. See "Official Notices" to-day.

Keighley.—30-H.P. electric motor installation for pump driving, for the Fleece Mills Co., Ltd. See "Official Notices" February 18th.

Manchester.—March 7th. G.C. Railway Co. Stores, including electrical items. Stores Superintendent, Gorton.

New Zealand.—Dunedin.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.*

Plymouth.—March 2nd. Corporation. Converter with starter. See "Official Notices" February 18th.

Pontypridd.—March 13th. U.D.C. Twelve months' supply of electrical stores for the Electric Light and Tramways Department. See "Official Notices" February 18th.

Spain.—Municipal authorities of Esguevilla (Province of Valladolid). Tenders for the concession for the electric lighting of the town during a period of four years.

Swansea.—March 6th. Education Committee. Electric lighting installation at Brynmill and Cwmbwrla Council Schools. See "Official Notices" February 18th.

West Ham.—March 22nd. B. of G. Three months' supply of electric fittings. Clerk, Union Road, Leytonstone.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Government Contracts.—List of new contracts for January, 1916:—

Electric cable and wire.—British Insulated and Helsby Cables, Ltd; Frankenburg & Sons, Ltd.; Hooper's Telegraph and India-Rubber Works, Ltd.; Johnson Matthey & Co., Ltd.; Johnson & Phillips, Ltd.; Liverpool Electric Cable Co.; St. Helens Cable & Rubber Co., Ltd.; Siemens Bros. & Co., Ltd.

Generating sets.—Aster Engineering Co., Ltd.; Austin Motor Co. (1914), Ltd.

Electric lamps.—Balfour, Baring, Ltd.

Switches.—Berry & Hayward, Ltd.

Terminals and electrical instruments.—British L. M. Ericsson Manufacturing Co.; Johnson & Phillips Ltd.

Works services.—Electric Light at Crowlarns Camp, Barrow-in-Furness, E. M. Evans & Sons, Ltd.; electric light installation at Haynes Park, Girdlestone & Co.; electric lighting at Bridge of Allan, Mackenzie and Moncur; electric lighting at Kenross, Mackenzie & Moncur; electric lighting at Dunfirmline, Grindley, Ross & Co., Ltd.; installation of electric lighting, bells, &c., at War Hospital, Bath, N. G. Middleton; power house, &c., at Lilbourne, Girdlestone & Co.

H.M. Office of Works.

Motor-generator, &c., at Research Building, Teddington.—Vickers, Ltd.

Supply of electric cable and wire during 1916.—General Electric Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.

Post Office.

Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; Western Electric Co., Ltd.

Insulator brackets.—Bullers, Ltd.

Telephone cable.—Union Cable Co.

Repeating coils.—Western Electric Co.

Flexible cords.—British Insulated and Helsby Cables, Ltd.

Earthenware troughing.—Doulton & Co., Ltd.

Lead tubs.—G. J. Chatterton, Ltd.

Bronze wire.—T. Bolton & Sons, Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. and Smith's, Ltd.)

London.—Poplar.—Tenders received by the Electricity Committee for switchgear for linking up with Hackney:—

British Westinghouse Co.	(recommended)	£1,498
Siemens Bros.		1,504
Johnson & Wright, Ltd...		1,621
Ferranti, Ltd.		1,760

Midland Railway Co.—Contract for Osram drawn-wire lamps for 12 months, placed with the General Electric Co., Ltd.

Reading.—Borough Education Committee. Wiring work, &c., for the X-ray apparatus at the School Clinic: Reading Electric Supply Co., Ltd.

Southend-on-Sea.—T.C. Two years' supply of coal for the electricity works, with an option of about 10,000 to 11,000 tons a year: Foster & Co.

Walthamstow.—District Council. Coal for the electricity works for 12 months, 50 tons per week: Myers, Rose & Co.

FORTHCOMING EVENTS.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, February 25th. At 7.30 p.m. At the Bolbec Hall, Newcastle-on-Tyne. General meeting.

Association of Mining and Electrical Engineers (Notts and Derbyshire Branch).—Saturday, February 26th. At 3.30 p.m. At University College. Paper on "Static Transformers," by Mr. C. Jones.

Manchester Association of Engineers.—Saturday, February 26th. At the Grand Hotel, Aytoun Street. Paper on "Cast Steel as a Material of Construction," by Mr. E. F. Lange.

Battersea Polytechnic, Battersea, S.W.—Saturday, February 26th. At 7 p.m. Annual conversazione and inspection of students' work.

Junior Institution of Engineers.—Saturday, February 26th. At 8 p.m. At the Holborn Restaurant. Concert in aid of the British Red Cross Society. Tuesday, February 29th. Lecture on "Chemistry and Engineering," by Prof. H. E. Armstrong, F.R.S.

Post Office Telephone and Telegraph Society of London.—Monday, February 28th. At 6.30 p.m. At the I.E.E., Victoria Embankment, W.C. Paper on "Loading of Telephone Circuits," by Mr. A. B. Hart.

Association of Supervising Electricians.—Tuesday, February 29th. At 7.15 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Illuminating Engineering," by Mr. L. Gaster.

Institution of Electrical Engineers.—Wednesday, March 1st. At 5 p.m. At the Institution. Special general meeting of corporate members.

Institution of Electrical Engineers (Students' Section).—Wednesday, March 1st. At 7.45 p.m. At Victoria Embankment, W.C. Discussion on "Suggested Applications of Science to Warfare," opened by Mr. R. E. Dickinson.

Chemical Society.—Thursday, March 2nd. At 8 p.m. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

Greenock Electrical Society.—Friday, March 3rd. At 7.45 p.m. At the Temperance Institute, 19, West Stewart Street. Paper on "The Life of Sir Charles Wheatstone," by Mr. A. R. Macaulay.

Royal Institution of Great Britain.—Friday, March 3rd. At 5.30 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Corona and other Forms of Electric Discharge," by Prof. Silvanus P. Thompson, F.R.S.

NOTES.

The Accurate Use of Technical Terms.—An engineering correspondent writes as follows:—It is with regret that one frequently sees the meaning of words blurred owing to continued wrong usage. Often one wishes for an English Academy to watch over our language in order to prune away such excrescences as they appear. The journalistic use of the word "decimate" provides a case in point. Its real meaning is to kill a tenth part, but now it is used as equivalent to annihilate! In engineering we often find the word "bearings" applied to that part of the shaft which runs in a bearing; surely a confusing term, when the bearing is obviously the fixed part which bears or supports the shaft. The part of the shaft in the bearing should always be called the journal. The word "rate" now shows signs of going wrong, being used with two quite contradictory meanings. In a recent Review article on Electric Lifts, the author writes as follows: "The resistance should be amply rated. . . so that they cannot be damaged if run for long periods with resistance in circuit." On the other hand, in connection with Prof. Field's recent I.E.E. paper, it was pointed out in the discussion that a turbo-generator which the Americans would rate at 20,000 KW., in England would be rated at 14,000 KW. In the first case the words "ample rating" mean of ample proportions, while in the second case the word rate has the opposite meaning. A most entertaining, not to say expensive, law-suit could thus be built upon the contrary uses of the word "rate," where the consultant had specified that the machine was to be amply rated, and where the maker had supplied plant of meagre proportions. One lot of experts would declare that, in engineering circles, ample rating means ample proportions, while the other side would produce equally eminent experts and also dictionary makers to prove that the words certainly mean that the materials had to be worked to their uttermost, and weight kept down.

What is the proper meaning of the word "rate"? The Standard Dictionary gives as the meaning of the word "To set an estimate upon, especially with reference to other similar things."

Hence a low-rated machine is one from which one does not expect very much, while a highly-rated machine is one from which one expects a great deal. The writer, therefore, submits that the meaning in Prof. Field's discussion is the correct one, and that an amply-rated machine is one having small proportions and heavy stresses.

How are we to express the intention of the author of the Electric Lift article so as to bear elucidation by the lawyers? Some makers advertise their motors as being liberally rated, and others state that theirs are conservatively rated. Doubtless, this is the unique case where the words conservative and liberal have the same meaning, but it does not seem likely that either of them in this connection would satisfy a judge.

Probably the best way would be to state that the machine must have proportions ample for the work specified, and that the stresses must be low. One might say that the rating must be low, but while correct it will be better to avoid this expression until the word is no longer used wrongly.

Our American friends have a way of stating that the construction of their plant is "rugged." To us this seems to mean that the workmanship is rough and unfinished, but a reference to the Standard Dictionary shows that in the U.S.A. the word "rugged" is used with the meaning "Possessing vigorous health, robust, sturdy." That is picturesque, like many Americanisms, but the Englishman will do well to avoid it. He might find that makers in this country interpret it as having the other meaning, namely, "having a surface full of abrupt inequalities or projections."

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Institution and Lecture Notes.—Institution of Electrical Engineers.—The Kelvin lecture which was delivered by Dr. C. Chree, F.R.S., on the 17th inst., was devoted to "Terrestrial Magnetism," a subject which had been dealt with by Lord Kelvin in connection with his important changes in the design of the mariner's compass, and with the possible relation between terrestrial magnetic storms and solar influence. Lord Kelvin in 1863 showed that if the sun's magnetisation were 120 times as intense as that of the earth, its complete reversal, if that were possible, would only produce a disturbance of 1′ in declination. He next referred to the subject in 1892, when he devoted fully half of his Presidential address to the Royal Society to terrestrial magnetism; he then stated that in order to produce appreciable disturbances the sun must be a magnet of 12,000 times the intensity of the terrestrial magnet, but held that even if the magnetic force of the sun were perceptible here, it was vastly less in amount than the abruptly varying force which was required to account for the magnetic storms which were apparently associated with the occurrence of spots on the sun. Further, he gave reasons which, to his mind, were absolutely conclusive against the supposition that terrestrial magnetic storms were due to the magnetic action of the sun, the expenditure of energy at the sun necessary to produce the observed results being inconceivably enormous.

However, Dr. Chree points out that Lord Kelvin's conclusion has little bearing on the theories of solar action mainly current to-day, which attribute the magnetic storms to the presence in the earth's atmosphere of something bearing an electric charge, originally projected from the sun.

The lecturer then discusses in turn the secular change, the solar diurnal variation, and the phenomena of magnetic disturbances, of which subjects, as Superintendent of the Kew Observatory, he is one of the foremost investigators.

The lecture forms a very important contribution to the literature of this subject, which may seem abstruse at the moment, but, like the phenomena of static electricity in connection with wireless telegraphy, high-pressure transmission, &c., may become of immense importance to electrical engineers in the not distant future.

Physical Society of London.—At the annual general meeting, held on February 11th, the reports of the Council and of the treasurer were adopted. The following officers were elected for the ensuing year:—President, Prof. C. V. Boys, F.R.S.; Vice-Presidents, Messrs. W. R. Cooper and F. E. Smith, Dr. S. W. J. Smith and Dr. W. E. Sumpner, D.Sc.; Secretaries, Dr. W. Eccles and Dr. R. S. Willows; Foreign Secretary, Dr. R. T. Glazebrook; Treasurer, W. Duddell, F.R.S.

Papers were read "On a General Bridge Method for Comparing the Mutual Inductance between Two Coils with the Self-Inductance of One of Them," by Prof. C. H. Lees F.R.S., and on "An Enclosed Cadmium-Vapour Arc Lamp," by Dr. H. J. S. Sand. The lamp is similar to the mercury lamp, and is constructed of quartz glass. To start the lamp, the metal is melted by means of a Bunsen burner, and the arc is struck by tilting. Before introduction into the lamp the metal is freed from oxide and dissolved gases by a special process of filtration while at the pump. It is prevented from adhering to the glass, which might lead to fracture, by the presence of a small amount of a loose powder in the lamp. The lamp gives a powerful light, and, once started, will continue burning indefinitely.

Two slides were shown by Dr. S Russ, showing the ultra-violet spectrum of the Simpson arc and that of pure tungsten. It was evident that the spectrum of the former was almost wholly due to tungsten.

Dublin Electricity Supply.—As we go to press we have received the following letter:—"We notice in your issue of February 18th a summary of Mr. P. W. d'Alton's report on the Dublin electricity undertaking, and a reference to the steam turbine supplied by us. In view of the recommendation put forward in the report that the turbine should be reconstructed, and to remove any misapprehension, we beg to put on record that the turbine referred to was supplied by us nine years ago. As you are well aware, considerable improvements have been made in turbine design since this machine was supplied, resulting in increased economy.

For Richardsons, Westgarth & Co., Ltd.
M. G. S. Swallow.

Hartlepool, *February 23rd*, 1916.

The War and Electrical Goods.—On Wednesday, in the Bow County Court, before his Honour Judge Graham, K.C., Mr. G. J. Wilson, of Liverpool, dealer in electrical appliances, sought to enforce the payment of a judgment debt of £16 10s. 9d. from J Goldberg, trading as the Anglo-Russian Electrical Supply Co., of 99, Woodstock Street, Canning Town. Mr. Daybell, who appeared for the plaintiff, said the case was bordering on fraud. The defendant extensively advertised electrical goods, and the plaintiff sent money along for them, but never got the things, nor had he had his money back. The defendant was cross-examined, and admitted that prior to the war, and up to about a twelvemonth ago, he did advertise very largely, but now his business had been completely ruined owing to the fact that so little electric light was used. The darkening of London had ruined him, as it had a good many others. He agreed that in April, 1915, he advertised 50,000 Excello carbons for sale at £1 a 100, but, as a fact, he had to dispose of them at 2s. 6d., and even as low as 1s. 6d. Before the war he used to get quite a number of these lines, but now he could do nothing. He thought he could pay 5s. a month. Judge Graham: 5s. is better than nothing, and that is my order for 12 months, with 10 days' imprisonment in default. In reply to Mr. Daybell, he allowed his client's costs from Liverpool.

A Turbo-Generator Steam Consumption Test.—The following corrections were received from the author of the article on pp. 240-241 after those pages had gone to press:—

Table I.—185 lb. pressure—allowance, '125 per cent.

TABLE III.

Per cent. of atmospheric pressure,	Allowance to be made, + per cent. — per cent.
85	+ 19
86	+ 17·2
87	+ 15·3
88	+ 13·4
89	+ 11·5
90	+ 9·6
91	+ 7·6
92	+ 5·8
93	+ 4·0
94	+ 2·0
95	·00
96	— 2·6
97	— 4·2

Volunteer Notes.—Engineering Institutions' V.E.C.—Orders for week commencing February 28th, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commanding.

Saturday, February 26th.—Uniform Parade, 2.45 p.m.
Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, February 28th.—Sections 1 and 2, Technical; Sections 3 and 4, Lashings and Trestle Bridging, Signalling Class and Recruits.

Tuesday, February 29th.—School of Arms, 6 to 7 p.m.

Thursday, March 2nd.—Shooting for Sections 3 and 4.

Friday, March 3rd.—Sections 3 and 4, Technical; Sections 1 and 2, Lashings and Trestle Bridging; Signalling Class and Recruits.

Saturday, March 4th.—Adjutant's Instruction Class at 2.30 p.m.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Capt. R. J. C. Eastwood (Sub-Commandant), Thursday, February 24th, 1916:—

Week-end Parades.—Saturday.—The Battalion will parade at Wembley Park at 3.15 p.m. for drill under Company Officers. "Derby" recruits are invited to attend.

Sunday.—The Battalion will parade at Liverpool Street Station (low-level entrance, G.E.R.) at 9.30 a.m., and proceed by train for Entrenching duties. Members will carry their own lunch. The Battalion will return to town about 6 p.m.

Musketry.—Acton Range will not be open on Saturday, 26th inst. A Match will be shot at Bisley on Saturday, Sergeants v. Privates. Men to Parade in uniform, at 12.45 p.m., Waterloo Station, No. 6 Platform.

A. G. Joiner, *Major and Adjutant*, O.B.C.

ELECTRIC SMELTING OF IRON ORES IN SCANDINAVIA.

Introduction.—We are indebted to the enterprise of the Canadian Department of Mines for a most useful report on the present state of the electric smelting of iron ores in Sweden and Norway (Notodden), which Dr. Alfred Stansfield has drawn up as a result of a visit of inspection made in the summer of 1914. The purpose of the investigation was to take particular note of the economics of the operation of the furnaces in use, in view of the possibility of establishing an electric pig-iron industry in Canada.

Types of Furnaces in Operation.—Two main types of furnace are at present in use for smelting iron ores: (1) The Elektrometall furnace; (2) Furnaces of the Helfenstein type. The following tables give a list of the 13 furnaces in operation and the 10 in course of construction in June, 1915:—

I.—Elektrometall Furnaces.

	In operation.	*Building.*
Domnarvet	2 of 3,000 H.P. 1 of 6,000 H.P.	—
Söderfors	—	3 of 3,000 H.P.
Ljusne	—	1 of 3,000 H.P.
Hagfors	3 of 3,400 H.P.	3 of 3,400 H.P.
Nykroppa	—	2 of 3,400 H.P.
Trolhättan	1 of 3,000 H.P.	1 of 3,000 H.P.

In the far north of Sweden a large iron-works of 25,000 H.P. is to be constructed immediately.

II.—Helfenstein and Tinfos Furnaces.

Domnarvet	1 of 5,000 H.P. 1 of 7,000 H.P.
Notodden (Norway)	4 of 1,600 H.P.
Ulefos	1 small furnace.

The Elektrometall Furnace.—The feature of this furnace is that the ore is preheated, and partially reduced in a large shaft before it reaches the smelting chamber, the heating and reduction being materially assisted by the circulation of the furnace gases, which

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is characteristic of this furnace. In the most recent examples the crucible is circular, and is lined with fire-brick, and it is provided with only one tapping-hole for both slag and metal, which are separated by a dam as they flow. The arch of the crucible, constructed of fireclay bricks, is cooled below by the cool gases from the top of the furnace, and also by cold air. The stack of the furnace is constructed in a steel shell, and is supported on steel beams independently of the crucible. The shaft is reduced to a neck where it enters the crucible, but the tendency is to increase the width of this to facilitate the passage of gases. The electrodes, which are circular, about 2 ft. in diameter, and 4 or 5 ft. long, enter the furnace through the arch just outside, and concentrically with the neck. The larger furnaces have six electrodes, which, supported by rollers, lie between two inclined guides. At the bottom of the guides is a water-cooled collar, built into the furnace arch, but supported from above, and above this collar is a water-cooled contact ring made up of a number of metal blocks forming a flexible collar round the electrode. These blocks are connected by cable to the bus-bars. A clamping ring above the contact ring serves to feed the electrodes, which do not, as a rule, need moving more than once in two or three days.

The furnaces with six electrodes are supplied from three transformers with three-phase current, each transformer being connected to diametrically opposite electrodes, so that the current tends to pass between these rather that between adjacent electrodes. The regulation of the current is effected by varying the supply voltage on the primary side, and not by moving the electrodes.

To circulate the furnace gases, the gas withdrawn from the top of the furnace is filtered, washed and dried, and returned—either through a Roots blower or else simply by means of the rotary washing fan—to the furnace through six tuyeres, entering beneath the furnace arch and between adjacent electrodes. Increasing the circulation raises the temperature in the shaft facilitates the reduction of the ore, raises the percentage of CO_2 in the escaping gases and increases the economy of electric power and of fuel, but it also increases the consumption of the electrodes. An important economy in operation will be effected when the escaping gases are utilised for heating open-hearth furnaces.

The Swedish iron industry consists principally in smelting the pure native ores with charcoal in blast furnaces. The industry is profitable, because the pig-iron produced is of high quality and commands a high price. Now the electric furnace can compete very favourably with these blast furnaces, first, because they are small; secondly, because the electric furnaces yield better metal; and finally, because only about one-third of the charcoal is consumed in the latter for the same yield of iron. The Elektrometall furnaces are small, too; the 4,000-H.P. unit at Domnarvet yields only some 30 tons daily, yet the cheap Swedish water power renders the cost of making iron less than in the charcoal blast furnaces. Attempts to use coke instead of charcoal in the Elektrometall furnace have so far been unsuccessful, although further experiments are being made in this direction by building the furnace shaft wider and lower.

Efficiency of the Elektrometall Furnace.—The Report contains some fully-detailed accounts of the working of the furnaces which were inspected, as regards power and material consumption, heat distribution, and output. We can only summarise them very briefly here.

The power is supplied at some 10,000 volts and transformed to 80 or 90 volts at the furnace terminals. The energy consumed for auxiliary purposes—motors and lighting—is some 2¼ per cent. of the whole supply. Neglecting transformer losses, the furnaces utilise during operation about 90 per cent. of the power supplied, and some 82 or 83 per cent. of the gross amount paid for, allowing for holidays and stoppages for repairs. This figure would be considerably higher—say, 90 per cent.—if three or four furnaces were worked together

The amount of electrical energy to be paid for (on the above 82 per cent. basis) to produce 1 ton of pig-iron works out at 0·41 H.P.-year utilising 60 per cent. ores and 0·47 H.P.-year for only 50 per cent. ores. These figures are for basic Bessemer or acid open-hearth iron. To make grey foundry pig about one-half of a H.P.-year is at present required.

The consumption of charcoal may be taken as 340 kg. per ton of white pig, and 370 kg. per ton of grey pig-iron.

The consumption of electrodes varies considerably, but it has been reduced as low as 3 kg. per ton of iron; an average figure is 5 or 6 kg.

The circulation of gases in the Elektrometall furnace economises the consumption of charcoal, but it increases that of electrodes.

(To be continued.)

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—Mr. A. R. Fox, who has resigned his position as shift engineer at the Macclesfield electricity works, will take up the post of resident engineer-in-charge at Chippenham electricity works a month hence.

On February 23rd, at Sheffield, Mr. F. P. Seager, of the engineering staff at the Manchester Corporation electricity works, was married to Miss Edith Maude Warburton, of Sheffield.

The Blackburn Electricity Committee has decided to increase the salary of Mr. Wheelwright, the electrical engineer, by £100 per year, bringing it up to the level of salaries paid to other officials of similar standing.

General.—Mr. W. Hooper, formerly on the staff of the Lynton (Devon) electricity works, was on H.M.S. *Arethusa* when she was mined, and was saved.

The *London Gazette* contains the following announcements:—Territorial Force: The undermentioned to be temporary captains: Second-Lieutenants (temporary Lieutenants) T. F. Middleton-Case, G. R. Madge, and M. G. Bland. The following Second-Lieutenants to be temporary Lieutenants: H. G. G. Clarke, Cecil H. S. Evans, W. H. Mather, G. E. Owles, E. O. Levett, and T. H. Gotch. Lance-Corporal A. S. Gill to be Second-Lieutenant (on probation).

Mr. J. G. Balsillie has vacated the post of radio-telegraph engineer to the Australian Commonwealth Government, to which he was originally appointed in 1911, for three years, for the purpose of establishing and developing a wireless system for Australia. His term expired last year, but in consideration of the vital importance of wireless telegraphy during the war, it was extended a further year. The system adopted by the Federal Government is the invention of Mr. Balsillie, and the originality of its distinguishing features has been recognised by its former disputants, the Marconi Co. Mr. Balsillie, however, placed the system absolutely at the disposal of the Federal Government, and has so far received no monetary consideration on its account. Mr. Balsillie will concentrate his attention on the artificial production of rain.—*Australian Mining Standard.*

Roll of Honour.—Lieut. Harry Marsh, who has been killed in action in France, was with the Lancashire Electric Power Co., Manchester, before the war.

Private Reginald Lightfoot, of Crewe University and Public Schools Battalion, who has been killed in action, was in the electrical department at Crewe Railway Works.

Sergeant E. J. Berry, formerly employed by the Chloride Electrical Storage, Ltd., Clifton Junction, is in hospital suffering from shell shock.

Rifleman Harry Scattergood, formerly in the electricity department of the Co-operative Wholesale Society, Trafford Park, has died from wounds received in action.

Obituary.—Mr. A. L. Sabine.—We learn with deep regret of the death of Mr. Alfred Louis Sabine, which occurred on Sunday last, at Herne Bay, at the age of 75 years. The deceased gentleman was for 50 years in the service of Messrs. Siemens Bros. & Co., Ltd., for 30 years (from 1880 to 1910) holding the position of secretary, from which he retired six years ago. Mr. A. L. Sabine was a brother of the late Mr. Robert Sabine, the eminent civil and electrical engineer. In our youthful days we were personally in constant touch with him, and we remember him as a man of most gentle and retiring disposition, with whom it was a pleasure to converse.

Will.—Mr. Geo. Angus, of Geo. Angus & Co., Ltd., belting manufacturers, left £24,541.

NEW COMPANIES REGISTERED.

Lower Thames Land Development and Power Co., Ltd. (143,059).—This company was registered on February 18th, with a capital of £7 in £1 shares, to acquire and turn to account a certain estate at Barking, Essex, fronting on the River Thames, containing 308 acres. The subscribers (with one share each) are: J. B. Braithwaite, 27, Austin Friars, E.C., stock and share broker; H. B. Renwick, Burnham, Chartfield Heath, S.W., director; F. W. Reynolds, Acorn Works, Edward Street, Blackfriars, S.E., director; F. C. M. Brown, 44, Marlborough Hill, N.W., secretary; G. Tweedie, 42, Palmerston Crescent, Palmer's Green, N., accountant; G. Scott, 30, Gloucester Terrace, Hyde Park, W., engineer; T. W. Cole, 44, Rose Hill Road, Wandsworth, S.W., secretary. Private company. The number of directors is not to be less than three or more than seven; the first are J. B. Braithwaite, H. B. Renwick, and F. W. Reynolds. Qualification, one share. Remuneration, £600 per annum, divisible. Registered office: Moorgate Court, Moorgate Place, E.C.

Coates and Co. (Sheffield), Ltd. (143,006).—This company was registered on February 14th with a capital of £3,000 in £1 shares (500 pref.), to take over the business of an electrical engineer and contractor carried on by J. Coates, at 345, Glossop Road, Sheffield, as Coates & Co. The subscribers (with one share each) are: J. Coates, 345, Glossop Road, Sheffield, electrical engineer; Mrs. M. A. Coates, 5, Peel Terrace, Sheffield. Private company. The number of directors is not to be more than five; J. Coates is first permanent director. Qualification, £100. Solicitor: C. Crowther, 23, Abingdon Street, Westminster. Registered by Jordan & Sons, Ltd., 116-117, Chancery Lane, W.C.

Scientific Inventors' Syndicate, Ltd. (143,070).—This company was registered on February 19th, with a capital of £1,000 in £1 shares, to experiment with, manufacture, and develop methods and means of light, heating, and ignition, produce and destroy gases, produce neutralising effects by electrical, chemical, or mechanical means, and to use, manufacture, aid in, and turn to account by-products and waste material. The subscribers (with one share each) are: F. Harrison, 12, Barry Road, East Dulwich, S.E., electrical engineer; F. L. Harrison, 12, Barry Road, East Dulwich, S.E., electrical engineer. Private company. The number of directors is not to be less than two or more than five; the first are F. Harrison (permanent chairman) and F. L. Harrison. Qualification, £50. Remuneration as fixed by the company. Registered office: 83, New Street, Kennington, S.E.

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Makin and Co., Ltd. (143,007).—This company was registered on February 14th, with a capital of £1,000 in £1 shares, to carry on the business of electrical and mechanical engineers and manufacturers, workers and dealers in electricity in all its branches, &c., and to adopt an agreement with Makin & Co., Ltd. (in voluntary liquidation) and P. Toothill. The subscribers (with 10 shares each) are: R. C. Smith, Mill Mount, Tuxford, retired grocer; R. C. Smith, Jun., 2, Anstey Road, Sheffield, electrical engineer. Private company. The number of directors is not to be less than two or more than five; the first are R. C. Smith and R. C. Smith, Jun. Qualification, 10 shares. Registered office: 39, Townhead Street, Sheffield.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Colston Electrical Works, Ltd.—Mortgage on certain moneys, dated January 25th, 1916, to secure all moneys due or to become due from company to Capital & Counties Bank, Ltd., Clare Street, Bristol.

Mawdsleys, Ltd.—Capital, £20,000 in £1 shares. Return dated January 5th, 1916. 18,937 shares taken up; £6,937 paid; £12,000 considered as paid. Mortgages and charges: £6,300.

Telephone Co. of Egypt, Ltd.—A memorandum of satisfaction to the extent of £700 on February 1st, 1916, of debenture stock covered by trust deed dated July 27th, 1904, and three supplemental deeds of acknowledgment dated Feb. 21st, 1906, March 4th, 1908, and October 27th, 1909, securing £200,000, has been filed.

Oriental Telephone and Electric Co., Ltd.—A memorandum of satisfaction to the extent of £1,450 on February 1st, 1916, of debenture stock covered by trust deed dated June 28th, 1905, and a supplemental deed of acknowledgement dated June 12th, 1907, securing £200,000, has been filed.

Sun Electrical Co., Ltd. (63,261).—Capital, £45,400 in £1 shares (20,000 pref.). Return dated December 28th, 1915. 17,141 pref. and 5,400 ord. shares taken up; £22,541 paid. Mortgages and charges: £3,050.

Alliance Electrical Stores, Ltd. (111,884).—Capital, £25,000 in 47,500 pref. ord. shares of 10s. each, and 1,250 def. ord. shares of £1 each. Return dated February 5th, 1916. All shares taken up; 10s. per share called up on seven pref. ord.; £3 10s. paid; £24,996 10s. considered as paid on 47,493 pref. ord. and 1,250 def. ord. shares. Mortgages and charges: Nil.

North Wales Power and Traction Co., Ltd. (78,193).—Capital, £270,000 in £5 shares (10,000 pref.). Return dated January 7th, 1916. 38,100 ord. and 9,200 pref. shares taken up; £5 per share called up on 34,100 ord.; £170,475 paid; leaving £25 in arrears; £66,000 considered as paid on 9,200 pref. and 4,000 ord. Mortgages and charges: Debt of £40,000, secured by issue of £80,000 first mortgage debs., 5 per cent.; debt of £7,000, secured by issue of £7,000 "B" debs., 6 per cent.; debt of £100,000, secured by £100,000 second mortgage debs., 7 per cent. Total debt, £147,000. Total debs. issued, £187,000.

Westinghouse Cooper-Hewitt Co., Ltd. (89,947).—Capital, £30,000 in £1 shares. Return dated December 17th, 1915. All shares taken up; 9s. 6d. per share called up; £14,250 paid. Mortgages and charges: Nil.

CITY NOTES.

Liverpool Overhead Railway Co.

Mr. H. C. Woodward, presiding at the annual meeting on Tuesday, said that they were still under the control of the Government, but the original terms of the arrangement had been modified, inasmuch as the proviso that the compensation payable should be reduced in the same proportion as the aggregate net receipts for the first half of 1914 were less than the aggregate net receipts for the first half of 1913, had been done away with as from January 1st, 1915, and in the place thereof it had been agreed that the company should provide out of their net revenue 25 per cent. of the amount of the war bonus granted in February last to employés who come within the Railway Conciliation Scheme. The bonus to the other employés, and the subsequent increase in the bonus generally, are allowed by the Government to be included as working expenses. The number of passengers carried created a new record. It was attributable to the abnormal conditions prevailing in the Port of Liverpool, whose docks had never at any time been so fully occupied. The receipts did not exactly represent the traffic carried; so many more passengers had added to their takings, but the surplus was not shown in the accounts, the difference having been handed over to the Government to assist in making up the deficiencies of some of the other railway companies. They had placed £4,000 to renewal fund and added £400 to contingent fund. Owing to the shortage of labour and the difficulty of obtaining adequate supplies of materials certain work in connection with maintenance had had to be postponed, but this would be done immediately opportunity again offered. The Government had agreed that companies so affected would be recompensed in respect of such deferred work. The heavy traffic of the past year had considerably taxed the accommodation of their rolling stock, particularly at certain times of the day, and in the hours of heaviest traffic a three-minutes' service was in operation, and some inconvenience had been inevitable. The Great Central Railway Co. had acquired the land for the Seaforth and Sefton railway. When this new railway was connected with theirs at Seaforth the interchange of traffic should prove beneficial, and, provided that Liverpool docks and shipping continued to prosper, he hoped that the results put before the shareholders this year might at least be fully maintained in the future.

Newcastle and District Electric Lighting Co., Ltd.

The gross profit for 1915 was £34,439, plus £14,617 brought forward. Interest on debentures and loans was £18,474, leaving £30,583, out of which £2,260 is put to second mortgage debenture redemption fund, £500 to debenture issue expenses, and £27,823 is carried forward. Though the net profit shows an increase, no dividend is expedient, owing to abnormal conditions. Owing to increased costs, the charge to consumers was raised as from the June quarter. Increased power demand has more than compensated for loss due to restricted lighting. A further £2,600 of the 6 per cent. debentures has been redeemed. Capital expenditure during the year was £48,818. Annual meeting: To-day.

London Electric Supply Corporation, Ltd.

The profit for 1915 was £77,688, against £93,234 for 1914. Including £8,824 brought forward, and allowing for debenture interest and debenture sinking fund, £50,992 remains, out of which 6 per cent. is paid on the preference shares, 3 per cent. on the ordinary, £5,000 is put to contingencies account, and £9,050 is carried forward. Units sold 50,757,584, as against 46,343,065; total costs per unit sold .61d., as against .59d. (increased coal and wages). Power supplied for traction, tramway, and industrial purposes increased by 11 per cent. Average receipt per unit sold (lighting and power) .96d., against .94d. in 1914. The expenses of generation increased by nearly 50 per cent. owing to the war. Although *primâ facie* the accounts show for 1914 an excess profit over the two previous years, no provision is made for Excess Profits Duty. The solicitor advises that "an electricity supply undertaking with a tenure expiring in 1931 comes, if need be, under the provision in Section 42 of the Finance Act referring to businesses which may apply for an increase of the statutory percentage in special considerations; and that when all proper adjustments are made, it will be clear that the Corporation is not liable to the payment of such Excess Profits Duty." Annual meeting: Yesterday.

Yorkshire Electric Power Co.

Mr. A. Lupton, at the annual meeting on February 15th, said that the capital expenditure (£3,550 less than in 1914) had been limited to extensions which could not possibly be refused. They would during the first half of 1916 receive benefit to some extent from the sliding scales in force in their agreements. The plant had been run at very great pressure, and maintenance and repairs were in consequence very high. New and larger plant was on order. In July, 1914, they seemed to have turned the corner, and they regretted that a higher dividend could not be paid. They must consolidate and secure their resources as they proposed by increasing the reserve to £20,000. Mr. T. O. Callender seconded the adoption of the report.

South Metropolitan Electric Light and Power Co., Ltd.

For 1915 there is a revenue credit balance of £49,190, plus £5,591 brought forward, and a dividend of 10 per cent. on the company's holding in the West Kent Electric Co., Ltd. Debenture charges are £12,612. 7 per cent is paid on the first and 6 per cent. on the second pref. shares, £16,750 is put to depreciation account, and a dividend of 4 per cent. is payable on the ordinary shares, leaving £6,605 to carry forward. For 1914 there was no dividend on the ordinary shares. The report gives the following figures, those in parentheses being for 1914:—H.P. connected, 19,389 (15,529); consumers, 6,781 (6,468); gross revenue, £80,576 (£66,792); expenditure, £31,386 (£23,737); net revenue, £49,190 (£43,054). There was a satisfactory improvement in revenue from energy sold, but coal costs were abnormally high, and wages increased considerably. A 5,000-KW. turbo-generator is being added to cope with the demand, and it will be in commission next month. Negotiations with the debenture trustees are pending with a view to defining the obligation of the company under the trust deed as to setting aside sums to depreciations, &c. In the meantime, at the suggestion of the trustees, the £20,000 carried to reserve in 1913 and 1914 has been transferred to depreciation account, although there is no obligation to do so, no dividend having been then paid on the ordinary shares. With Treasury sanction, £10,790 first debenture stock (4½ per cent.) and 15,926 second pref. shares (6 per cent.) were issued during the year. The business of the West Kent Electric Co. has made substantial progress, the gross revenue rising from £1,596 in 1914 to £13,320 in 1915, and the net revenue from £541 to £3,051. Mr. H. E. West has been elected to the board in place of the late the Hon. L. A. Brodrick. Annual meeting: March 1st.

Notting Hill Electric Lighting Co., Ltd.

The capital expended during 1915 was £1,556. The number of consumers is now 4,358, only 20 of whom are supplied at 200 volts. The lamps connected have increased from 234,608 to 238,981 (32-watt equiv.), and the profit (less income-tax) for 1915 was £22,617, as compared with £24,221 for 1914. Revenue from sale of current was £42,419, an increase of £332; the reduction of £1,604 in profit is mainly due to higher income-tax, which was £2,653, as against £1,499. There is put to depreciation, renewal, and reserve £3,000, debenture interest requires £2,267, interest, &c., on the Kensington and Notting Hill Joint Debenture stock takes £4,171, income-tax £2,653,

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distributed to staff under co-partnership scheme (8 per cent. addition to wages), which is still working satisfactorily, £253. After paying 6 per cent. pref. dividend, and 5s. per share, less tax, on the ordinary shares, £337 is carried forward. Units generated or purchased, 3,343,269; units sold, 2,436,496; used on works, 18,001; expended in distribution transformers and accumulators, 888,772; public lamps, 53. Annual meeting: February 29th.

London Electric Railway Co.

During 1915 the aggregate gross traffic receipts of the five companies to the agreement establishing a common fund, were £4,924,245. The aggregate receipts from all sources were £5,481,144. The amount retained by the companies for revenue liabilities (working expenses, prior charges, reserves, &c.) was £5,029,778, and the balance £451,366 is credited to the common fund. This company is entitled to 26 per cent., and receives £117,355, which, added to £11,547 brought forward, makes £128,902 available for ordinary dividend, an increase of £59,055 as compared with 1914. The dividends were announced in our last issue. Capital expended during 1915, £157,160. The traffic is satisfactory, and shows a substantial growth since the opening of the new Willesden Junction Station of the L. & N.-W.R. The total passengers and the average fare per passenger cannot be given, as the District line is under Government control. Annual meeting: Yesterday.

City and South London Railway Co.

This company's share of the common fund referred to above is 2 per cent, and it accordingly receives £9,027. The total net income was £91,780, an increase of £39,830. Interest, rentals, and other fixed charges require £30,253; reserve £10,000, against nothing for 1914; preference dividend £42,500, as against £18,133; and the balance is £9,027. The dividends were stated in our last issue. The year's capital expenditure was £59,104. Arrangements were made to obtain supply of current for working the railway from the Lots Road power station, and the Stockwell power station has been closed down. Annual meeting: February 29th.

Central London Railway Co.

This company's share of the common fund is 20 per cent., and £90,273 has been received, plus £15,413 brought forward. The gross receipts increased by £39,159 to £316,527, and the expenditure by £12,164 to £156,523. The net income was £160,004, an increase of £26,987. Interest, rentals, and other fixed charges were £38,131, there is put to reserve £10,000, as against nothing last year, and the preference dividend takes £21,600. The dividends on other stock were stated in our last issue. Capital expenditure during 1915, £35,440. The Treasury consented to the issue of £150,000 redeemable 4 per cent. debenture stock; this has been sold, and the proceeds will be available for the payment of commitments in connection with certain improvements entered into prior to the war. The construction of the Wood Lane and Ealing Broadway extension makes slow progress owing to the war. A year's extension has been granted for exercising the compulsory purchase powers under the Central London Railway Act, 1913. Annual meeting: Yesterday.

Metropolitan District Railway Co.

This company being entitled to 12 per cent. of the common fund receives £54,164, plus £13,888 brought forward. The receipts of the undertaking during 1915 were £1,066,247, and the expenses £511,721. Interest, rentals, and other fixed charges required £350,432; there is put to reserve £35,000; the dividends are as stated in our last issue, and £13,952 is carried forward. Capital expenditure of 1915, £17,059. Annual meeting: Yesterday.

Smithfield Markets Electric Supply Co., Ltd.

Sir H. S. Leon, presiding at the annual meeting last Friday, said that the increase of £1,355 in the capital account included the balance of the cost of the Diesel plant, in regard to which a satisfactory settlement had now been arrived at with the Diesel Co. The new set, which would be at work in a few months, would enable them to make a thorough overhaul of the existing ones. In regard to the heavy increase in cost of production, their oil contract carried them over last year. It was now double the price, and charges to consumers had had to be raised. The total cost of generation in 1915 was 6 per cent. higher than in 1914. At the quinquennial valuation their rateable value was considerably increased, but on appeal the original figure was restored. Receipts from sale of current were higher, but the total receipts were less, as consumers were disinclined in wartime to spend money on extensions and alterations. The net profit was £324 less than in 1914. A serious accident occurred on 7th inst. One of the compressors of a Diesel engine exploded, killing one man and wounding another. The cause was being investigated.

Bristol Tramways and Carriage Co., Ltd.

During 1915 the gross receipts were £512,385, and the working and general expenses and renewals were £413,521, leaving £98,864. After paying debenture interest, carrying £4,364 interest on investments to reserve, paying the preference dividend, and 5 per cent. for the year on the ordinary, less income-tax, £20,000 is carried to reserve fund for contingencies and renewals, and £6,056 is carried forward. The receipts of the tramways department increased by £8,703 (3.63 per cent.), and those of the carriage department by £49,017 (23.39 per cent.). Passengers carried were 60,272,400, an increase of 1,970,815. No fewer than 1,095 of the company's employés joined H.M. Forces. The depletion of the staff necessitated restricted public services. A motor omnibus service between Tewkesbury and Cheltenham has been inaugurated, but other new services remain in abeyance. Communications have passed between the Corporation and the company with reference to the former's purchase option, but without result. As the Treasury has refused consent to any public issue of stock by the Corporation for the purpose of tramway purchase the directors offered for the purchase price to be satisfied by the issue of Corporation stock to return half per cent. more than the market yield of Government stock at the date of the award. The offer has not been accepted, but it cannot remain open indefinitely. Annual meeting: March 2nd.

Rushden and District Electric Supply Co., Ltd.

During 1915 the number of consumers increased from 79 to 123; lamps and motors by 6,380 to 11,941; and the units sold were 249,783, nearly 4½ times more than in 1914. The H.P. of motors increased from 101½ to 292½, of which 290½ is let out on hire. The mains have been extended. Maximum load increased by 109 KW. to 183 KW. Revenue from sale of current advanced from £463 to £1,699. The rapid development of the undertaking has called for extensions, and new plant which will practically double the capacity of the works will soon be got into commission. After putting £300 to depreciation, and paying 3 per cent. dividend, £90 is carried forward Annual meeting: March 2nd.

Northampton Electric Light and Power Co., Ltd.

The results for 1915 are all that could have been desired. A favourable coal contract covering the earlier part of the year balanced the high prices paid in the latter half. Costs of other materials increased. 31,476 new lamps were connected, making 223,257. 733 H.P. was added in motors, making the total 4,668 H.P. New mains and feeders were laid, and the output was 5,055,643 units, as compared with 3,958,700. The existing station and site leave no room for expansion, and a large site purchased near Nunn Mills has been approved by the Board of Trade. A new generating station will be proceeded with as rapidly as present circumstances allow, also a railway siding for more economical conveyance of coal, &c. The general depreciation account has been increased by £6,750, £665 has been written off motors, and £1,750 added to reserve. After paying 5 per cent. on the preference shares and 6½ per cent. for the year on the ordinary, £3,114 is carried forward.

Kensington and Knightsbridge Electric Lighting Co., Ltd.—The number of houses and shops connected increased by 70 to 5,011 during 1915, and the lamps connected from 488,912 (14,660 KW.) to 510,785 (15,320 KW.). The lighting restrictions reduced the units sold by 9 per cent., entailing a still larger percentage of reduction in net profit. The available net profit is £11,653, plus £1,629 brought forward. After paying the preference dividends and 7 per cent. on the ordinary for the year, £432 is carried forward. The renewal and reserve fund has been increased by £7,137 to £139,021. Annual meeting: March 2nd.

Para Electric Railways and Lighting Co., Ltd.—The gross receipts decreased from £249,891 in 1914 to £243,483 in 1915. The operating expenses were reduced from £132,491 to £115,309, the net revenue earned in Para being £128,174, as compared with £117,400. The accounts are based upon the legal exchange rate of 16d. per milreis, and £33,205 must be deducted as the actual loss incurred on remittances. After providing also for the London expenses, the balance of operating revenue is £90,759, compared with £106,147 of the previous year. After paying debenture interest and preference dividend, and putting £15,000 to depreciation and renewals reserve, a dividend of 5 per cent. for the year on the ordinary shares, less income-tax, is paid, carrying forward £18,935.

Mexican Tramways and Light Companies.—The "Financial Times" states that circulars have been issued to bondholders of the Mexico Tramways Co., Mexican Light and Power Co., Mexican Electric Light Co., and Pachuca Light and Power Co., stating that in view of the difficulties of the companies caused by the unsettled conditions in Mexico, Messrs. E. R. Peacock (chairman), S. C. Boulter, H. F. Chamen, R. Fleming, A. Hill, H. M. Hubbard, and A. F. P. Roger have agreed to act as a committee for the protection of the bondholders' interests.

Mersey Railway Co.—The auditor has certified that the revenue available for 1915 amounts to £21,442, as against £21,279 for 1914. With the exception of £164 which is carried forward, this amount is distributed thus:—4 per cent. on 1866 stock, 3 per cent. on 1871 stock, 3 per cent on 1882/3/5 stock, and 1 per cent. on the "B" debenture stock. Annual meeting: To-day.

Beauly Electric Supply Co., Ltd.—Mr. D. McGrath presided at the annual meeting last week. Satisfactory progress, with an increase of 10 per cent. in the output, was reported. The profit was £140. A dividend of 6 per cent. was declared, £16 being carried forward.

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Bournemouth and Poole Electricity Supply Co., Ltd.—Final dividend on the ordinary shares at the rate of 7 per cent. per annum, less income-tax, making 6 per cent. for the year, as against 7 per cent. for 1914.

Oxford Electric Co., Ltd.—A final dividend of 3½ per cent., less income-tax, is declared, making 6 per cent. for the year, as compared with 6½ per cent. for 1914.

Newcastle-upon-Tyne Electric Supply Co., Ltd.—Final dividend on the ordinary shares 3½ per cent., making 6 per cent. for 1915, as against 5½ per cent. for 1914.

Direct West India Cable Co., Ltd.—Interim dividend at the rate of 6 per cent. per annum, free of tax, for the past half-year.

Halifax and Bermudas Cable Co., Ltd.—Interim dividend at the rate of 6 per cent. per annum, free of tax, for the past half-year.

Mirrlees Watson Co., Ltd.—A dividend of 5 per cent., less tax, is recommended.

STOCKS AND SHARES.

Tuesday Evening.

The incidence of the coming taxation hangs like a cloud over all the Stock Exchange markets. It was very much the same when the 4½ per cent. War Loan was coming; and for six weeks at that time markets were listless, apathetic, depressed. After the Loan had been issued and allotted, financial matters got tidied up, and business improved. So it is likely to be again, because there is plenty of money about for investment, and the only thing which the Stock Exchange really hates and fears is uncertainty.

The most important event of the week, so far as the electrical markets are concerned, is the issue of an appeal to bondholders in the Mexico Tramways, Mexican Light & Power, Mexican Electric Light, and Pachuca Light & Power Companies, who are invited to deposit their bonds, at as early a date as possible, with a committee that has been formed for the protection of the interests of the bondholders. A lengthy circular recalls the statement made by the Mexico Tramways Co. last summer, and quoted on several occasions here, with reference to the difficulties under which the companies were labouring.

Put briefly, the present committee's endeavours will be directed to securing such guarantees as will ensure that the tramways property, when taken back, can be worked with proper protection and under such conditions as will safeguard the bondholders' interests; while questions affecting the Light and Power companies are arising almost daily, and involve matters of policy that call for important decisions. The committee is a strong and workmanlike body, and the deposit of the bonds with the committee may well be recommended to the proprietors.

Prices in this market have been little affected, save for a fall of 4 points in Mexican Light common, by the step thus taken, but for Mexican issues as a whole there has been just a slight demand during the past few days. Affairs in the positions of various companies have reached a pass well-nigh desperate; and as the committee may be able to do something to mend the fortunes of these unhappy concerns, they are deserving of every encouragement and support.

Brazil Tractions have been moving between 53 and 51½, being at the moment nearer the lower point because of a disappointing slip back in the Rio exchange. The rate went just over 1s. last week, only to ease off to 11 3/16d. The bonds of the Rio Tramways Co., however, are steadily maintained at 88¾ for the Firsts and 73 for the Seconds. The Argentine Tramways group is steady, without showing any particular movement.

The London General Omnibus Co. issued its report early in the present week, and the company's receipts of £2,882,400 are £340,000 less than they were in the previous year, while expenditure was only reduced by £253,000. The dividend comes down from 16 per cent. to 12 per cent., but the latter is paid free of tax, instead of being gross, as it was in 1914, so that the actual shrinkage is less than appears. Underground Electric Income bonds are rather sellers at 85, but the £10 shares are 3/16 lower at 1¾, while the 1s. shares fell back to 5s. 6d.

Railway stocks as a whole are heavy. Two of the steam lines are making new issues of stock—an example which it is thought likely may be followed by others, unless the public reception to the newcomers is not favourable. Which, by the way, is likely enough, because the terms offered are none too tempting. Undergrounds are heavy with the rest; and the adoption of electric traction by the South-Western Railway has had no influence, so far, upon the prices of the stocks. Falling again into reminiscence, it may be recalled that the result of the Brighton Railway's electrification did not benefit the prices of the stocks until some months after the new system had been in operation.

Reduction of dividends in the electric lighting market is emphasised by a decline in the Kensington distribution from 9 per cent. to 7 per cent. Prices in this department are steady, and there is rather more business than usual doing in some of the shares. London Electric ordinary are ¼ lower, but there has been a little improvement in County preference, and these are the only changes on the week, as will be noticed from our share list.

Eastern Ordinary is the firmest spot in the telegraph market, and there is a rise of ¼ in Chili Telephones. Marconis are a trifle easier. New York Telephone bonds continue to be wanted by the Government at 101½. It had been expected that some announcement would be made by Mr. Asquith, in his speech on the Vote of Credit last Monday night, with reference to the amount expended up to the present by the Government in the purchase of American securities, but apparently the figures are not available.

Of the manufacturing shares, Callenders make the best showing, with a rise of 5s. to 11¾. Henleys are also a good spot at 14, the price being, of course, full of the dividend for the "fat" half of the year; anticipation looks for the announcement to be at the usual substantial rate.

British Westinghouse preference again lost 6d., but the market in the shares is not a bad one. There has been a little buying lately of the company's 6 per cent. prior lien debentures, the security for which is admirable; and the price of 102½ carries the £3 interest due on April 1st. Other industrials are firm. The rubber market has gone back a little by reason of a decline in the price of the raw stuff. This led to profit-taking amongst some of those who had been speculating in the shares. Business fell away considerably in volume. Advantage has been taken of the reaction by people who sold shares which they were unable to deliver, and their purchases sufficed to keep the market steady as a whole.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Feb. 22, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.				
Brompton Ordinary	10	7½	—	£6 18 4
Charing Cross Ordinary	5	8½	—	7 2 10
do. do. do. 4½ Pref.	4½	8½	—	6 0 0
Chelsea	5	8¾	—	6 18 4
City of London	9	12	—	7 10 0
do. do. 6 per cent. Pref.	6	10¾	—	6 11 7
County of London	7	10¼	+ ¼	6 13 3
do do. 6 per cent. Pref.	6	10½	—	5 17 8
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	1½	+ ¼	9 10 6
do. do. 6 per cent. Pref.	6	4½	—	7 1
Metropolitan	8½	2½	—	7 15
do. 4½ per cent. Pref.	4½	3	—	7 10 0
St. James' and Pall Mall	10	6	—	8 6 8
South London	5	8½	—	6 8 0
South Metropolitan Pref.	7	1 7/8	—	6 14 0
Westminster Ordinary	9	6	—	7 10 0
Telegraphs and Telephones.				
Anglo-Am. Tel. Pref.	6	1 0½	—	5 19 0
do. Def.	83/6	21¾	—	7 14 3
Chile Telephone	8	6¾	+ ¼	6 5 6
Cuba Sub. Ord.	5	7¾	—	6 9 0
Eastern Extension	7	12¾	—	*6 5 6
Eastern Tel. Ord.	7	127½	+ ½	*6 5 0
Globe Tel. and T. Ord.	6	10½	—	*6 12 6
do. Pref.	6	10	—	6 0 0
Gt. Northern Tel.	22	84	—	6 8 6
Indo-European	18	49	—	6 16 4
Marconi	5	1 1/8	+ 3/8	5 8 1
New York Tel. 4½	4½	101¾	—	4 8 4
Oriental Telephone Ord.	10	1 1/4	—	5 18 6
United R. Plate Tel.		5¾	—	*7 19 0
West India and Pan.	1	1 1/8	—	9 10 6
Western Telegraph	7	12½	—	*6 4 6
Home Rails.				
Central London, Ord. Assented	4	69	—	5 16 0
Metropolitan	1½	28	—1	4 7 0
do. District	Nil	15	—	Nil
Underground Electric Ordinary	Nil	1½	— 3/16	Nil
do. do. "A"	Nil	5/6	—6d.	Nil
do. do. Income	6	81½	—	*8 2 0
Foreign Trams, &c.				
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	4¾	—	6 13 6
do. 2nd Pref.	5½	8½	—	7 17 2
do. 5 Deb.	5	79⅛	—	6 5 6
Brazil Tractions	4	52	+ ½	6 11 7
Bombay Electric Pref.	6	10 xd	—	6 0 0
British Columbia Elec. Ry. Pfce.	5	55	—	9 1 10
do. do. Preferred	—	37	—	Nil
do. do. Deferred	—	34	—	Nil
do. do. Deb.	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	42	—	Nil
do. 6 per cent. Bonds	—	37	—	Nil
Mexican Light Common	Nil	25	—4	Nil
do. Pref.	Nil	28	—	Nil
do. 1st Bonds	—	42	—	—
Manufacturing Companies.				
Babcock & Wilcox	14	38	—	6 6 8
British Aluminium Ord.	5	22/-	—	4 10 0
British Insulated Ord.	15	102	+ ½	6 19 6
British Westinghouse Pref.	7½	44/-	—6d.	6 16 4
Callenders	15	11¾	+ ½	6 7 5
do. 5 Pref.	5	4½	—	5 17 8
Castner-Kellner	20	P¼	—	6 8 0
Edison & Swan, £8 pd.	Nil	7/-	—	Nil
do. do. fully paid	Nil	1½	—	Nil
do. do. 5% Deb.	5	60	—	8 6 8
Electric Construction	6	15/-	—	8 0 0
Gen Elec. Pref.	6	7⅛	—	6 4 8
Henley	20	14	—	*8 8 0
do. 4½ Pref.	4½	4½	—	6 6 0
India-Rubber	10	9½	—	*12 19 0
Telegraph Con.	20	57	—	*7 8 6

*Allowance made for dividends being paid free of income-tax.

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EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING JANUARY, 1916.

THE returns of electrical exports for the first month of the year show an appreciable improvement on the December position, the month's exports having advanced from £349,409 in value in December to £381,599 in January. The electrical imports, on the other hand, fell away in value, the month's business amounting to only £216,407, as against £238,691 in the previous month; the re-exports also receded to £10,612 in value from £24,382 in December.

The improved export total was mainly due to increased telegraphic, telephonic and battery exports during the month; cable export values remained stationary at a high figure, while machinery exports fell off considerably.

A marked decrease took place in machinery and cable import values, and in certain other directions lower values were recorded, while the only noteworthy improvement on the December figures was in telegraphic, telephonic and battery imports. Our most prominent customer during the month was India (£66,000), while France purchased nearly £40,000 worth of electrical material from us; our Australian Colonies and Argentina were also good customers. United States imports fell off as compared with December, as also did Dutch lamp imports.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports	Electrical goods and appliances.	Wires and cables rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	2,886	3,757	331	444	1,640	846	3,975	353	856	123	5,102	1,380	21,693
German West Africa	...	...	...	...	...	...	...	...	...	...	...	46	46
Netherlands, Java and Dutch Indies ...	627	10,979	194	...	...	15	990	...	125	68	1,243	2,015	16,256
Belgium	...	136	...	...	...	...	...	...	...	...	...	...	136
France	1,398	184	345	1,574	214	187	10,173	1,238	740	292	9,690	13,337	39,372
Portugal	101	79	...	358	...	18	169	...	28	...	2,515	32	3,300
Spain, Canary Isles and Spanish N. Africa...	266	49	6	182	...	557	2,850	6	21	11	44	68	4,060
Switzerland, Italy and Austria-Hungary ...	1,153	...	...	...	...	649	1,497	...	340	54	413	253	4,359
Greece, Roumania, Turkey and Bulgaria ...	...	107	...	...	...	...	...	107	...	...	...	...	214
Channel Isles, Gibraltar, Malta and Cyprus...	184	28	80	27	...	15	387	...	40	23	286	9,758	10,828
U.S.A., Philippines and Cuba	1,145	...	90	33	...	...	2,577	...	...	...	...	12	3 857
Canada and Newfoundland	160	...	88	474	...	1,285	1,232	...	675	...	...	9,598	13,512
British West Indies and British Guiana ...	210	91	119	62	...	...	196	...	126	...	142	...	946
Mexico and Central America	125	22	53	38	...	...	42	...	...	...	589	...	869
Peru and Uruguay	151	313	...	170	...	9	77	...	314	...	340	...	1.374
Chile	40	131	201	78	...	75	1 372	1 287	66	...	40	58	3,348
Brazil	88	112	165	164	...	114	27	20	382	...	...	...	1.072
Argentina	1,333	2 887	744	582	...	1,610	10,839	2,433	1,796	224	2,315	176	24,939
Colombia, Venezuela, Ecuador and Bolivia...	125	14	53	38	...	139	57	...	...	...	...	512	938
Egypt, Tunis and Morocco	239	342	186	14	...	...	541	254	963	26	879	903	4,347
British West Africa	100	68	109	305	...	47	613	182	...	...	75	124	1,623
Rhodesia, O.R.C. and Transvaal	1,583	1 868	343	893	26	686	3,651	78	271	85	788	256	10,528
Cape of Good Hope	394	5,152	238	288	...	...	1,982	151	156	29	1,304	177	9,871
Natal	529	5,030	461	142	...	10	1,886	329	113	34	...	...	8,534
Zanzibar, Brit. E. Africa, Mauritius & Aden	51	57	19	149	...	...	284	...	54	...	163	152	929
Azores, Madeira and Portuguese Africa ...	...	169	14	111	...	207	684	82	140	...	...	51	1,458
French African Colonies and Madagascar ...	...	...	...	...	...	...	...	11	...	...	...	...	11
China and Siam	139	527	982	119	25	467	761	97	150	...	50	27	3,344
Japan and Korea	215	...	...	58	...	215	254	79	649	...	...	7	1,477
India	4,699	17,440	2,190	2,147	490	1,983	16,329	4,909	6,316	752	7,257	1,490	66,002
Ceylon	81	331	57	212	...	111	99	...	210	...	49	...	1,150
Straits Settlements, Fed. Malay States and Sarawak	122	1,157	200	191	...	55	647	547	14	598	6,811	140	10,482
Hong Kong	83	3,039	172	134	...	59	1,901	25	15	17	20	23	5,488
West Australia	243	658	4,095	58	...	5,860	...	...	116	...	...	...	11,030
South Australia	109	2 046	137	161	...	...	486	...	264	...	211	343	3,757
Victoria	1,366	11,031	1,471	365	220	314	3,267	47	391	...	1,213	868	20,553
New South Wales	97	8,330	1,052	887	94	2,982	5,736	4,345	2,854	55	155	765	27,352
Queensland	106	158	76	289	...	89	687	...	3,943	5	224	...	5,577
Tasmania	230	1,315	12	76	...	...	210	...	...	...	50	...	1.893
New Zealand and Fiji Islands	1,060	6,726	1,736	1,270	15	1,133	8,527	...	581	35	10,065	3 926	35,074
Total, £	21,438	84,333	16,019	12,093	2,724	19,737	85,005	16,580	22,709	2,431	52,033	16,497	381,599

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	1,450	...	135	105	...	6,729	1,049	1,545	6,806	...	6,196	24,015
Germany	...	...	...	...	...	...	...	...	...	...	...	...
Holland...	...	1,650	45	11,166	1,96'	...	345	...	1,927	...	...	17,094
Belgium	...	...	...	...	...	...	...	...	...	...	...	...
France	440	333	368	577	169	1,067	69	...	6,724	3,284	86	13,117
Switzerland	1,067	...	511	292	...	3,587	3,184	1,309	499	2,618	...	13.067
Italy	...	...	...	...	...	...	1,195	...	...	...	...	1,195
Austria-Hungary	...	...	...	...	...	...	...	...	...	...	...	...
United States	8,449	1,368	4,104	2,045	5,885	9.066	4.198	70,628	11.610	2,022	22.444	141,819
Total, £	11,406	3,351	5,163	14,185	8,015	20,449	10,040	73,482	27,566	7,924	28,726	210,307

Additional imports.—Spain, carbons, £3,806; Japan, electrical goods, £166; fittings, £220; lamp parts, £173; Victoria, bells, £81; Canada, electrical goods, £120; lamp parts, £13; meters, £345; electrical machinery, £1,176.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above... ...	456	1,723	...	1,615	...	3,107	214	...	335	586	2,576	10,612

TOTAL EXPORTS: £381,599 TOTAL RE-EXPORTS: £10,612 TOTAL IMPORTS: £216,407

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

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A TURBO-GENERATOR STEAM CONSUMPTION TEST.

By a Station Superintendent.

Engineering has its trials, more especially in war time, and if it were not for the absorbing interest of the many problems that face the engineer, and give him occasional tastes of pure pleasure in solving them, the profession would easily be an alternative to a suicide club. Perhaps one of the deepest joys is planning and carrying out a steam consumption test. This pleasure was sufficiently marked in the old days when the indicator diagram and the weight of steam used were the chief factors, but the advent of electricity and the accuracy with which it can be measured has deepened the interest in proportion, no doubt, to the increased satisfaction to be derived from a nearer approach to the truth.

Let us suppose we are about to test a 5,000-kw. turbo-alternator. There is much interesting and careful preliminary planning, and to go back to the earliest stages we should consider the drawing up of the specification for the plant. The specification will determine at what time during the maintenance period the test should be taken; usually after a month or two's continuous run of the plant. It will call especially for a guarantee from the makers of a steam consumption per kw.-hour under certain given conditions of: (*a*) Steam pressure, (*b*) steam temperature, (*c*) vacuum, at overload, full load, three-quarters load, and half load. It will describe shortly the methods to be adopted in taking the test, and will say who provides the necessary apparatus, tanks, instruments, etc. The important clause is the one dealing with the guarantee, and some such wording as given below may be adopted.

"Should the steam consumption be greater than at the rate of lb. per kw.-hour at approximately full load, for each and every complete tenth of a pound of steam in excess of a margin of 2½ per cent. a sum of £400 will be deducted from the contract price. Should the steam consumption be less than at the rate of lb. per kw.-hour at approximately full load, for each and every complete tenth of a pound of steam saved beyond a 2½ per cent. margin a sum of £400 will be added to the contract price."

The figure of £400 will naturally vary with the value to the buyer of the gain or loss to him under his peculiar conditions. The contractor will insert the figure for steam consumption in tendering, and a further clause will give the purchaser the option of refusal to accept the plant should the consumption be, say, 10 per cent. above the guarantee.

So much for the specification, and it would appear simple enough to reproduce the conditions specified, to agree on how to take each reading, and to obtain a figure satisfactory to both parties.

To those who would tread this path happily, the writer would, however, sound a note of warning, and indicate that however much both the customer's and the contractor's engineer may have started out with a pure and firm intention to seek the truth, human nature will out, especially with a bonus in sight. So the best of intentions suffer, and things are apt to go awry.

Sad to relate, the writer has known human nature to fall so low as to exhibit a deliberate intention on the part of the respective engineers to hoodwink and deceive each other. However remote a contingency this may be, and the reader will guess its remoteness, it is well to provide for it. So before starting the test the parties should agree: (*a*) on how many readings shall be taken; (*b*) on what corrections are to be applied should the results obtained vary with the specified conditions. In this connection the following notes may be found of use:—

1. *Steam Condensed.*—The steam condensed should in all cases be weighed. This may be done satisfactorily by obtaining two large tanks, each of which will take about 10 to 15 minutes to fill on full load test. If of wrought iron, the tanks should be well stayed to prevent distortion on filling with water, and should be set on a weighbridge, previously checked by dead weights, and supported thereon by timber laid across underneath in a certain marked position. The tanks should be weighed empty and full, and the temperature of the water taken at the time. Care must be taken to mark the water level clearly on each side of the tank when full, and this level must be reproduced by adjustment of the tank support when the tanks are re-erected and supported ready for test.

The two tanks should be placed side by side and the condensate led to them by a pipe branched to each tank, each branch being controlled by a quick-acting lever-actuated valve. These valves should be worked alternately by the customer's and the contractor's man, the former being inclined to cut off the water a shade too soon and the latter a whit too late.

The time taken to fill each tank should be taken carefully, and particular note should be taken, preferably by a chronometer, of the start and finish of the test of, say, about four hours. It will usually be most convenient to stop at a "tank full," provided that the electricity meter reading is taken at the same time.

The correction in the weight of condensate to be applied on account of the variation in temperature between the water as weighed on the weighbridge and the condensate should be agreed upon. The agreement should present no difficulties, as the facts are well known.

2. *Steam Pressure.*—The steam pressure should be taken on the boiler house side close to the main stop valve, and the pressure gauge used should be checked before and after the test by a standard instrument. The steam consumption is affected to a comparatively small degree within the usual variations of boiler pressure, but it is essential as far as practicable to obtain a steady pressure even if it be a little over or a little under that specified. Table I gives the corrections to be applied in this connection, and follows modern accepted opinion.

Pressure in lb. per sq. in.	Allowance to be made, + per cent. − per cent.
170	+ .25
175	+ .125
180	.00
190	− .25
195	− .375
200	− .50
205	− .625
210	− .75

Table No. I.—Showing per cent. allowance to be added to or deducted from the steam condensed for variation in steam pressure. Steam pressure taken as 180 lb. per sq. in.

3. *Steam Temperature.*—The steam consumption of a set such as that under consideration will vary as much as 1 per cent. for every 10 deg. F. variation in steam superheat above 500 deg. F., and 1 per cent. for every 12 deg. F. below that figure. The importance of taking careful and accurate readings will therefore be understood.

The steel thermometer pocket should be located close to the pressure gauge above mentioned, and should extend well towards the centre of the steam pipe. It should be filled with mercury or cylinder oil, and the thermometer should be one that has been calibrated and certified as correct. Further, this thermometer, together with others used on the test, should be tested in boiling water immediately after the official run as a further check.

Table II gives corrections for variations in steam temperature, and is one now commonly accepted, but this is a matter which should be made a subject of agreement between the interested parties before the official test is made.

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Degrees Fahr.	Allowance to be made, + per cent. − per cent.
480	+ 2.00
485	+ 1.50
490	+ 1.00
495	+ .50
500	.00
505	− .416
510	− .83
520	− 1.66
530	− 2.50
540	− 3.33
550	− 4.16

Table No. II.—Showing per cent. allowance to be added to or deducted from the steam condensed for variation in superheat. Steam pressure taken at 180 lb.

4. *Vacuum.*—This, perhaps, is the most important point to watch, as a small departure from the specified figure calls for considerable correction. Here again the exact percentage correction to apply to any given variation from the specified vacuum is a matter for research and agreement by those concerned, but Table III indicates fairly closely commonly accepted figures.

Per cent. of atmospheric pressure.	Allowance to be made, + per cent. − per cent.
85	—
86	—
87	—
88	—
89	—
90	—
91	+ 8.00
92	+ 6.00
93	+ 4.00
94	+ 2.00
95	.00
96	− 2.00
97	− 4.00

Table No. III.—Showing per cent. allowance to be added to or deducted from the steam condensed for variation in vacuum.

The exact point at which the reading should be taken is frequently a matter of discussion, and rightly so, as the vacuum varies considerably between the last row of the L.P. turbine blading and the top of the condenser. The contractor's engineer will be found to exhibit a desire to drill the hole well up the exhaust leg some feet above the floor level. He will thus obtain a lower vacuum, and be thus entitled to a larger correction in his favour. On the other hand, by the way, if it is a question as to the condenser itself being of sufficient capacity to give the specified vacuum, he will quietly insist on making his gauge connection close to the condenser inlet. The point to be tapped should be previously agreed upon, and, in the writer's opinion, should, in fairness, always be taken half way between the centre of the turbine shaft and the top row of the condenser tubes. This will generally be found to be approximately floor level in the usual type of horizontal turbine.

The vacuum should be taken by the simplest means; that is a column of pure mercury in a straight tube, of which the height can be carefully measured. It is necessary at the same time to take careful barometer readings, the latter instrument being placed at the same level as the mercury column. If this be found impossible, then the necessary correction for difference in height of the two instruments must be applied. It is always wise to check the barometer from some recognised standard instrument, which may, however, again be at a different level.

5. The electricity generated must be measured by a KW.-hour meter of careful design and manufacture, certified immediately before and after the test for correctness.

With the above main features in mind and other small matters attended to, such as checking the condenser for leakage before and after the run, and agreement as to inclusion of steam or power used on steam or electrically driven auxiliaries, the test may begin.

The most careful and experienced men should be chosen to take the readings of weight of condensate, steam pressure and temperature, the vacuum and the electricity meter, the remainder being told off to take the various readings which will be found afterwards necessary in the continuous operation of the set.

These readings will include:—Temperature of condensate, temperature of circulating water inlet to condenser, temperature of circulating water outlet of condenser, speeds of main plant and auxiliaries, pressures and vacua of air and C.W. pumps.

The men should work in pairs consisting of a representative of the buyer and seller, and they should agree on every reading taken.

Generally four hours' running with a steady load will be found sufficient to obtain the necessary accuracy for a full load test, provided the plant has been running at approximately full load for four to six hours before the test starts—a wise precaution in all tests of this character.

Fifteen-minute readings will be found sufficient, but the time taken to fill each tank with condensate, together with the electricity generated within that time, should be noted separately.

It will be found, with these precautions, that a very enjoyable test will be experienced, and both parties may look to the result with eagerness and confidence.

BRITISH MANUFACTURING AND THE RUSSIAN MARKET.

We refer in our leader pages to an article which recently appeared in *Elektrichestvo*, of Petrograd, from the pen of Engineer P. Gurevitch, on the prospects of electrical trade between Russia and England. The writer says that the interruption of the German importation of electro-technical goods into Russia, which grew from 14,140,000 marks in 1909 to 34,505,000 marks value in 1913, constrained Russian importers to turn for such goods to other countries, particularly England. Unfortunately, however, while Russian buyers, faced with the necessity of filling up the blank that has been formed, are greatly interested in English goods, the English electro-technical industry—with a few exceptions—does not feel any special need of new markets, and, therefore, has not shown any particular interest in the Russian market. The writer says that this lack of interest may be partly due to temporary war conditions, but it is also based, unfortunately, on a variety of causes which are not of a transitory nature. Taking advantage of the information that he has collected, he proceeds to show the causes of the relatively feeble interest of the English electrical industry in the Russian market, after explaining its exports and its position in the world market. Electrical development in England itself is not particularly large compared with that of other countries. This is explained largely by the great prevalence of gas works in the country. England, with its cheap coal, as is known, was the pioneer in the business of gas lighting. At the present time there are 1,622 gas works in England, whilst in all Germany there are but 552; in Russia but 22. Further, in Paris, the output of gas per annum is 500,000,000 cubic metres; in Berlin, 300,000,000; in Vienna, 120,000,000; in Warsaw, 36,000,000; in Petrograd, 19,000,000; and in Moscow, 13,000,000. But every year the output of gas in London makes 900,000,000 cubic metres, that is to say, as much as in Paris, Berlin, and Vienna. Naturally, says the writer, owing to this great prevalence of gas lighting in England, electric lighting is by so much less developed. The use of electric power in London was 110 KW.-hr. per head of the population in 1910-11; in Berlin in 1911-12 it was 170 KW.-hr.; in Chicago, in 1911, 310 KW.-hr.; and so on.

The development of the English electric stations has been hindered not only by the number of gas works, but partly, also, by the fact that in England about 55 per cent. of all the stations are under municipal control, whilst in Germany 25 per cent. only of all the electric stations belong to municipalities. The small productivity of electric stations in London is explained to a certain extent by the fact that they are extraordinarily diverse. This great drawback of variety is also the defect that afflicts Petrograd in respect to its electric power supply. The use of electric equipment in England per inhabitant, according to a German estimate, amounts to about 2 roubles 83 copecks per head, whilst each inhabitant

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of Germany spends on electro-technical apparatus 7 roubles 36 copecks. But this relatively small quantity of electro-technical apparatus used in England was not all made in England itself. The importation during the past two years from Germany alone of electro-technical apparatus per annum reached 34,000,000 marks value, which makes about one-fifth of the total quantity of electro-technical apparatus used in England; whilst in Germany, with an annual production of 1,200,000,000 marks, there was an export in 1912 of 272,000,000 marks value (that is, 22.5 per cent. of the production) and in 1913 of 330,000,000 marks value (an increase in the export of 21.3 per cent.), and the export of electro-technical goods from England worked out in thousands of roubles as follows:—

	1907.	1911.	1912.	1913.
Total electro-technical goods ...	34,366	45,619	51,513	71,477
Electrical machines	9,292	16,836	18,400	21,469

It is to be observed in connection with this, that the year 1913 was a very satisfactory one for the English electro-technical industry, for its export, in comparison with 1912, rose by nearly 40 per cent., whilst the increase in the German export compared with 1912 improved only by 21.3 per cent.

The cable industry in England is very highly developed, and is one of the oldest and most flourishing branches of the electro-technical industry. This great consumption in England of cables is explained particularly by the submarine telegraph lines, and so on. Thus in 1913 the export of cables made nearly half, or 47 per cent., of the total English exportation of electro-technical goods, whilst the value of the cables exported amounted to £3,577,663 sterling. Submarine cables alone were exported to the value of £1,903,915; in other words, about a quarter of the total English export (to be exact, 25.2 per cent.) of her electro-technical goods was made up of submarine cables. For Russia, however, this extraordinary development of a branch of the English electro-technical industry in respect to changing over from importation from Germany is not of much importance, for, thanks to the high protective tariff on cables in Russia for some years back, with the active co-operation of foreign capital, this has been so far developed that nearly all the consumption in cables and insulated wire can be covered by the production of Russian factories, at the head of which stands the United Cable Factories of Petrograd, with a capital of 6,000,000 roubles (the last dividend was 15 per cent.), and the Kolchugin Latten and Copper Rolling Works Co., at Keleroff Station, Northern Railway, the production of which in the near future will probably increase, for the capital of this company was lately increased from 6,000,000 to 10,000,000 roubles. The importation of cables into Russia reached in 1913 155,000 roubles value, whilst from Germany the importation amounted to 81,400 roubles.

Russia does not require much of English telephone and telegraph apparatus, the exportation of which from England in 1913 was £290,279 sterling value. As the chief consumer of such apparatus in Russia is the Post Office Department, which orders them exclusively in Russia, the production of these apparatus has so far developed that the needs of the country can be supplied by existing Russian factories, at the head of which stand the Russian L. M. Ericcson & Co., in Petrograd, which recently increased its capital from 2,000,000 to 4,000,000 roubles; the Russian Siemens & Halske Co., capital 5,600,000 roubles, latest dividend 6 per cent.; and the N. K. Geisler Co., of Petrograd, 1,000,000 roubles capital, latest dividend 12 per cent.

The importation of telegraph and telephone apparatus in 1913, according to Russian statistics given in the *Elektrichestvo*, makes a total of only 363,000 roubles. These figures, however, do not agree with the German statistics, according to which, in 1913 there was exported from Germany to Russia, telegraph apparatus to the value of 188,000 marks, and telephone apparatus to the value of 1,079,000 marks; total, 1,267,000 marks, or 583,000 roubles. In 1912, the export from Germany to Russia of these apparatus reached a total of 562,000 roubles, whilst, according to Russian statistics, this importation of telegraphic and telephonic apparatus was in 1912 only 240,000 roubles. Since German statistics are generally very exact, we must suppose that part of the imported telegraphic and telephonic apparatus from Germany are entered in the Russian import list under some other heading. Already the export alone from Germany into Russia is more than one and a half times the whole Russian importation shown in the Russian statistics; while, according to Russian statistics, in 1912 there was imported from Germany only half of the total quantity of imported telegraphic and telephonic apparatus, one-third being imported from Sweden and one-sixth from other countries.

The acquisition of English carbons for arc lamps, for which in Russia, in consequence of the interrupted imports from Germany (amounting in 1913 to 447,000 marks value), at present there is a great want, unfortunately cannot be counted on. In England the production of carbons for arc lamps is even less developed than in Russia, since there is only one factory of the kind. In view of this cessation of imports of carbons from Germany, the exportation of such from England was forbidden with the opening of hostilities, so that England itself imports carbons from Sweden, Switzerland, and so on. In any case, the export of carbons from England in 1913 reached a value of only £10,064. England's exportation of incandescent lamps is also small. In 1913 England's export made £152,456 sterling value. The total English export of incandescent lamps was less than the German export of these lamps to Russia alone. In 1913, according to German statistics, there were exported to Russia 7,669,105 electric lamps with metal filament, value 7,296,000 marks, and 1,539,586 lamps with carbon filaments, value 768,000 marks; total, 8,084,000 marks, equal to 3,709,000 roubles. In 1912 this item was even larger, viz., 8,854,000 marks for metal filament and 617,000 marks for carbon filament, total 9,471,000 marks. Again, the German statistics do not agreed with the Russian, for according to the latter the total Russian importation of incandescent lamps was 3,849,000 roubles in 1912.

The feeble development of English production of incandescent lamps may be partly explained by the fact that only two English factories of electric lamps work with English bulbs. All the others obtain theirs from the Continent, which certainly makes the production dearer. The last fact is seen also in many other branches of English electrical industry, particularly in the production of various equipment material such as porcelain, glass goods, &c., which might often, indeed, be made in England; but, unfortunately, these auxiliary branches of the electro-technical industry are not sufficiently developed in England. The value of the English exportation of arc lamps and projectors was only £14,512 in 1913, whilst into Russia alone Germany exported in that year 12,369 arc lamps, valued at 652,000 marks; parts of arc lamps valued at 79,000 marks; and projectors valued at 500,000 marks; total 1,231,000 marks. England exported in 1913, £51,828 sterling value in parts of arc and incandescent lamps, including £19,737 value to Russia. Electric batteries and accumulators in that year were exported by England to the value of £226,325; but for Russia this branch of English electro-technical industry is, again, of but little importance, for the production of accumulators in the Russian factories can now be almost entirely covered by the national workshops. The importation of accumulators, according to Russia statistics, made in 1913 55,000 roubles value only, but the importation of galvanic batteries, not specially indicated in Russian statistics, from Germany alone, according to German statistics, made a value of 340,000 marks.

Respecting the important group of electro-technical manufactures which is indicated in English statistics under the title "not specially named manufactures and apparatus for electro-technicians," with a total exportation of £1,063,146 sterling, Russia received £16,007 sterling; that is scarcely 1½ per cent. of the total export. In this group, besides various ornamental materials in which England can scarcely hope to compete in Russia with other countries, there are also electrical measuring apparatus, meters, &c. The production of these instruments in England is considerably advanced, and their export into Russia might be increased. In view of Russia's great necessity it increased considerably in 1914.

Of the electro-technical manufactures under the above group, Russia imported in 1913 from Germany alone H.T. electrical apparatus, 8,967,000 marks, against 5,431,000 marks in 1912. Electric apparatus for heating, &c., 321,000 marks; electric signalling apparatus, 667,000 marks; electro-medical apparatus, 894,000 marks; insulation tubes, 273,000 marks; wireless telegraph apparatus, 111,000 marks; electric measuring apparatus, 4,247,000 marks (against 3,143,000 marks in 1912); insulating articles in asbestos, mica, &c., 76,000 marks; electrodes, 173,000 marks; or a total of 35,729,000 marks.

The first position, after the cable industry, in England is occupied by the production of electrical machines; therefore, on this branch M. Gurevitch dwells more fully, especially as in the Russian importation of electro-technical products dynamo machines and electric motors occupy the first place. Therefore, the possibility of increasing the importation of electrical machines from England becomes a question of considerable interest to Russian buyers of that class of goods.

The total export of electric generators and motors to Russia according to the official statistics of England, Germany, and Switzerland was valued at 5,440,000 roubles; but according to Russian statistics, as published in the *Elektrichestvo*, the importation thereof made 9,595,000 roubles. If we add to the 5,440,000 roubles the value of the importation of electrical machines from Austria, Belgium, France, and Switzerland, which made in 1912 only 7 per cent. of the total importation, then this sum would be only slightly increased. It remains, therefore, to suppose that under the heading electrical machines, there is included in the Russian statistics, besides dynamo machines and electro-motors, all other machines driven by electric current, for example, electro-magnetic separators, and so on. Part of the difference may still be explained by the fact that Germany, Switzerland, England, and other exporting countries give the export price, whilst the Russian statistics report the import price, that is, the price of the exporting country, plus the cost of transport, insurance, &c. But certainly the difference of nearly 4,000,000 roubles is not so explained, and it is regrettable that owing to inaccuracies in the figures in the Russian statistics the actual exchange of goods is confused, and one is lead (by using Russian statistical data) to incorrect conclusions. According to Russian data, for example, the importation of dynamo machines and electro-motors is of almost twice the value shown in foreign statistics. The difference, in fact, is nearly half a million roubles more, for in the German export of electrical machines the author has added also the importation of armatures, commutators, &c., which parts in the Russian statistics are classified separately, although to a very much reduced extent compared with German statistics.

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Taking advantage of the occasion, M. Gurevitch quotes one more inexactitude in the Russian statistics. These describe as German goods many articles of English, Swiss, and other origin, but imported over German railways because of the intermediate position of Germany, and the same applies to all goods arriving by steamer from Hamburg, which were described in Russia as German goods, although they may be of foreign origin, and only the last part of the way has been covered on a German steamer. Thanks to the foregoing, the importation of electrical machines from Switzerland, which made the solid sum of 1,250,000 roubles, by no means corresponds to the Russian statistics. As these machines were carried through Germany, they were described as German machines. Although, in fact, the importation of these machines from Switzerland is almost twice as large as from England, in the *Elektrichestvo* table they are not noted at all, whilst the importation from Sweden, making only one-tenth of the importation from England, is correctly described, since Swedish machines do not pass in transit through any other country. It may therefore be said with confidence that the importation of electro-technical manufactures from Germany is exaggerated in the Russian statistics, and the importation from other countries is underestimated. The question of the introduction of uniform statistics in all countries had been near to realisation not long before the war, for on the initiative of the Belgian Government, representatives of twenty-nine Powers, including Russia, were to meet in Brussels for the preparation of uniform statistical reports, but on account of the war this congress was not held. It is hoped, however, that this important question for making plain the real exchange of goods of various countries and the part they take in the world's business will be duly considered after the war.

Following this slight digression, made in view of the importance of statistics for establishing the real importation of foreign electrical goods into Russia from foreign countries, M. Gurevitch returns to the original point.

From the foregoing particulars on the importation of electrical machines into Russia, it follows that the Russian market for English manufacturers of dynamo machines and electromotors was not an important one before the war. Whilst Germany sent in 1913 into Russia 12.6 per cent. of all her export of electrical machines, totalling, with armatures and commutators, 7,867,000 marks, England sent into Russia only 2.7 per cent. of its total export of these machines. Even Switzerland exported these machines to Russia to twice as great an extent as England. Germany, on the other hand, exported six and a half times as many as England. Meantime, dynamo machines and electro-motors happen to be that department in which England, previous to the war, could compete more or less successfully with Germany on the Russian market.

On the causes of this indifference of the English to the Russian market M. Gurevitch dwells in somewhat more detail, having examined the export of electro-technical manufactures from England to foreign Countries. In the distribution of material included in the English official statistics, he divides the countries that are buyers of English electro-technical industrial manufactures into four groups. In the first are the English Colonies, Australia, India, South Africa, Canada, &c. In the second, South American Republics. In the third, Trans-Oceanic countries, Japan, China, United States, &c.; and in the last, European countries. The centre of gravity of English exports lies first in the English Colonies, whence over half of all the English electro-technical manufactures are exported. One-seventh of this export goes to South America; 11/100ths to Trans-Oceanic countries, and one-tenth to Europe. The stronger the competition of other countries was on the European market, and the more difficult became the export there the less interest did the English exporters take in it; because for them, until recently, there was an immense market in the English Colonies, where the English have a variety of advantages compared with other competitors. For export into these countries, the English exporter does not require to learn foreign languages, and for the transport of the goods he uses the immense English fleet, and so on.

The English Press advises the English merchant to turn his attention to these markets, as recently the competition of the German electricians has increased enormously there. The success of Germany in the English Colonies, in the opinion of the English trade Press, is explained to a large extent by the fact that the German merchants maintain large stocks there, thanks to which they can serve clients not only cheaply but quickly, which in many cases is very important for the client; and this, no doubt, explains to a large extent the success of the German firms on the Russian market too.

In view of the great competition of Germany in England, this classical country of Free Trade, recently, with growing frequency, there has arisen a voice on the necessity of introducing protective duties for the English industry. Conservative circles particularly call for these duties, and that such, at the end of the war, will be really introduced is very possible, for they will be particularly useful in the acquisition of fresh revenue.

If, however, England, with these additional duties, is put in a condition to preserve the English Colonies as a market for its electro-technical industry, then the English exportation to South America, which had been for England, after the Colonies, the best market, will doubtless fall away. In consequence of probable difficulties to German exports in the countries with which Germany is carrying on war, the German electro-technical industry will be obliged to devote much more attention to South America than hitherto. But already, before the war, South America was the best market for the importation of German electro-technical manufactures. The Argentine occupied the first position in 1913 in this respect amongst all other countries. If the export of Germany to European countries declines, then she will endeavour to press out the English electro-technical manufactures, at all events from South America. With reduced German prices, and long credit, which the German industry is in a position to give, probably she will succeed.

At the same time, it must still be remembered that in the United States, the question of seizing the South American markets is now greatly considered. The exportation of electro-technical goods from the United States has considerably increased recently. As the United States can become a large provider of electro-technical goods in the future on the Russian market, a number of figures are given by the author showing the business recently done by America. With the proximity of the South American markets to the United States of North America, and the existing good condition of trade, they will doubtless succeed, he says, in pressing out a considerable part of the English electro-technical goods from South America. The Secretary of the Department of Trade of the United States recently advised American financiers and industrialists to follow the example of Germany, and finance various technical projects in South America. Thanks to this system, Germany has acquired not only a profit on the capital owed to the German banks, but also the orders for machines, and so on. It is known, for example, that the A.E.G., not long before the war, completed a majestic, many million project of underground electric lines in Buenos Aires. Whether Germany or the United States obtains the South American market is all one. Undoubtedly the suffering factor after the war will be the English electro-technical industry. It therefore should, in order to fill up the blank from the reduced exportation to South America, seek new markets; and one of such markets, presuming sufficient enterprise on the part of the English, should be Russia. One of the hindrances to the extension of the export from England to Russia, as has been frequently shown in the Russian economic Press, has been the unwillingness of the English to give credit. Now, for Russia, which is still a country very poor in capital, sufficient credit becomes a question of first importance. For its success in Russia the German industry is undoubtedly indebted, to a large extent, to the circumstance that Germany, with the co-operation of her banks, offers Russian buyers extensive and prolonged credit. To the English merchants the German system of trading on credit was, therefore, very objectionable. Recently, however, in the English Press, ever more frequently are seen articles on this topic, and if English industry desires to sell its goods in Russia it ought to make similar concessions to those made by Germany.

Unfortunately, Russia's business people have abroad in respect to payments a very bad reputation. If, however, foreign providers were to make distinctions between various trading firms and factories, &c., in all probability their losses would be less. Most of the insolvencies in Russia fall to trading concerns, whilst insolvencies in the factories are relatively few, for in Russia large concerns prevail. For example, in Russia there are about 1,100 factories or works with the workmen exceeding 500, about 2,300 between 100 and 500, and about 2,150 with staffs of 50 to 100. The risk in giving credit to the first two categories of factories and a considerable portion of the third group is very small, for it is to a very large extent made up of sound concerns, and partly of share companies with large capital. But if it becomes a question of town councils, large electric stations, and the like, then the risk of non-payment is excluded entirely. Whilst as Germany, of recent years, understood the necessity of distinguishing between giving credit to tradesmen and factory owners, and then devoted all her strength to getting into direct business relations with the Russian users of machines and technical goods, in England the direct sale by English factories of machines to the Russian consumer is hampered by a series of causes. In the first place, in English industrial circles there is a complete ignorance not only of Russian, but of many other foreign languages. In Germany even small manufacturers send out catalogues at least in three languages, and often in five or six, including Russian. In England even large houses seldom send out catalogues in foreign languages, as their chief markets happen to be countries where the English language prevails. Further, whilst the German language is pretty well known in Russian business circles, the knowledge of the English language is very rare, which excludes the possibility of, or, at all events, makes very difficult, the use of English catalogues in Russia. In such circumstances, then, English manufacturers being anxious not to incur heavy expenditure do not consider it advantageous to print a catalogue in Russian. Thanks to all this, direct export by English manufacturers is made very difficult, and they prefer to deal with foreign commission houses knowing the English language or with English exporters. Of small exporters as known in Germany, there are but few in England. There are large export houses there that can maintain a large staff of foreign correspondents.

Thanks to such intermediaries, foreign consumers do not get into close relationship with the manufacturers, and this is certainly prejudicial to business, for the manufacturer does not properly realise the special requirements of the buyer in

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respect to the construction of the machine for such-and-such an application, and so on. The English manufacturer usually supplies a well-known type and the buyer has either to be content with that or to go elsewhere.

As the English manufacturer exports very little, he is little concerned whether with the aid of advertisements he can make his goods known to foreign buyers, as has been largely done by German industry in Russia. Generally the organisation of the English export trade has been very feeble. Of the necessity of better organisation of export business, there is now a clear conception in the English Press and technical journals. But this will take a long time to effect.

Russia can count in the future on receiving from England only electrical machines, and to a small extent electrical measuring apparatus. It is certainly necessary that English industry should give up its conservative methods of dealing and change over to the more modern methods, for, with normal conditions, the conqueror of the world's market will be the one which provides the necessary goods best, cheapest, and in the most convenient form for the buyer.

BURNING POWDERED COAL.

An article on this subject by Mr. A. S. Mann, in the *General Electric Review*, last year, dealt at some length with the experimental work carried out at the General Electric Co.'s Schenectady plant. One of these experimental applications was to boiler firing, the boiler unit being of the water-tube type and rated at 474 H.P.

The furnace was fitted with an extension front, making a 4-ft. Dutch oven, in the front of which were fitted six feeders and burners, the feeders being each operated by a ½-H.P. motor and drawing their fuel from a hopper immediately above them.

The feeder consists of a 2½-in. dia. screw, tapered down at one end, driven at from 300 to 600 R.P.M., according to the requirements of the furnace; this revolves in a feeder box, and delivers coal to a tee-piece, where it is picked up by the primary or carrying air current, and this apparatus can be placed a few hundred feet from the furnace burners if required, the fuel delivery being controlled by operating the motor rheostats. A screw of the type mentioned will feed 700 lb. of fuel per hour.

In the furnace itself additional air from a blower is admitted at six separate ports, that is, each coal particle encounters six air currents before it passes to the heating surface, these air currents passing across the burning current in order to give a stirring or mixing action. The six burners across the furnace front are arranged to give the air currents issuing from them a revolving action in a counter direction with respect to each pair. These incoming currents almost immediately meet a downward current of hot air, preheated by passing through the firebrick arch, which drives the main current down towards the hearth, which it passes over, curling up and back again from the brick bridge behind the furnace. With this arrangement combustion is virtually complete in 8 ft. travel, even with 200 per cent. or more load. As much as 520 lb. per front foot of furnace has been burned with only 7 ft. between header and floor line; the boiler has carried 265 per cent. load long enough to show that such loads are possible, and 220 per cent. or more can be carried indefinitely, as there are no cleaning periods.

The powdered fuel is burned in suspension; as it travels at 40 or 50 ft. per second, it must be consumed in 1/6th second or so. During this brief interval there is only 1/5th lb. fuel burning even at the heaviest loads, and at no instant is there a greater quantity of coal on fire. With an ordinary grate no coal particle must burn in a short time, the average time for all particles being half an hour, for there is a ton and a half or so of fuel on the grate burning slowly. With the powdered coal furnace, the fire has been started in a cold furnace beneath a boiler full of cold water and with half the coal burning capacity in use, the boiler pressure of 140 lb. has been available in 20 minutes.

A number of boiler trials were conducted, efficiencies being calculated by dividing heat in steam by heat in coal (laboratory test) that produced it. Test No. 11, with 205 per cent. load, which gave 75.7 per cent. efficiency, with 208 c.f. air per lb. coal, and a flue temperature of 724 deg., was the best of the series, and has since been repeated for a week at a time.

This result was obtained by experimenting with the air dampers, air volumes, flue temperatures, &c., and it has been found that the bulk of the air should be admitted through the arch, preheated, and that 200 c.f. per lb. coal represents about the best proportion. The dampers and rheostats being marked, the stoker can accurately adjust coal and air to obtain the most efficient combustion.

In order to utilise the heat in the escaping gases a feed-water heater is being installed in the chimney base; the soot drops in the gas chambers before reaching the chimney.

The three difficulties, which are not serious at light loads (140 per cent. or less), are slag, ash, and burned brickwork. A furnace temperature of 2,700 deg. F. is met with, and ash becomes slag (114 lb. per ton), and is run into a concrete pit containing water, from which it can be removed with pick and shovel.

About 2 per cent. of fine ash (a white powder) passes out of the chimney. Under heavy loads particles of slag will travel with the gas current and adhere to the first cold surface they meet, the bottom row of tubes, eventually choking the gas passages. This is overcome by admitting a little steam with the air; 140 lb. per hour is enough for 160 per cent. load, or 24,000 lb. of steam per hour. The slag is also blown off the tubes with a steam jet once a day. Most of the soot goes over into the back chamber and is washed out every other day.

The furnace is virtually surrounded by air passages, and heat that gets into them is returned to the furnace.

The air passages and deflecting air currents do much towards protecting furnace walls.

One arch was burned out in six months, being melted down from nine to four inches thick, but it was made of common firebrick. It is possible that it would pay to use carborundum for this purpose.

As to the cost of pulverising coal, a figure of 24.5 cents per short ton is given, including fixed charges, which would be reduced by a third with large plants. Two years' experience have shown that repairs are no greater than in all coal-handling machinery.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

1,773. "Sparking plugs." W. A. Clark, H. G. Longford & W. W. Longford (trading as Sphinx Manufacturing Co.). February 7th.
1,774. "Terminals." R. E. H. Lovelace. February 7th.
1,778. "Electrical apparatus for heating liquids." J. F. Barr. February 7th.
1,779. "Electrical apparatus for heating and/or sterilising liquids." J. F. Barr. February 7th.
1,787. "Junction box or sleeve for wireless armoured electric cables." F. H. Davies. February 7th.
1,794. "Portable electric lighting devices." W. R. Adams. February 7th.
1,811. "Electro-magnets for brakes, &c." J. Anderson & G. Ellison. February 7th.
1,821. "Automatic telephone systems." G. H. Bryant, T. M. Inman and Relay Automatic Telephone Co., and F. M. Ward. February 7th.
1,825. "Electric arc generators for high-frequency oscillations." J. Gill. February 7th
1,827. "Apparatus for wireless telegraphy, &c." B. Binyon & C. L. V. Lee. February 7th.
1,861. "Syntonisation by frequency of groups of electro-magnetic waves." M. B. Rodriguez. February 8th.
1,862. "Thermic telephones." Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. February 8th. (Germany, February 3rd, 1915.)
1,868. "Automatic telephone systems." G. H. Bryant, T. M. Inman, and Relay Automatic Telephone Co. & F. M. Ward. February 8th.
1,869. "Telephone systems." G. H. Bryant, T. M. Inman, and Relay Automatic Telephone Co. & F. M. Ward February 8th.
1,875. "Dry batteries." P. R. Porrill. February 8th.
1,876. "Machine switching telephone systems." Western Electric Co. (Western Electric Co.). February 8th.
1,897. "Sparking plugs." J. E. Evans. February 9th.
1,903. "Electrically-operated alarm signalling device." J. R. Garner February 9th.
1,904. "Alarm signalling device." J. R. Garner. February 9th.
1,915. "Electric radiator or heat projector." S. W. Hamlyn. February 9th
1,921. "Electrical signalling systems." W. A. Sharman. February 9th.
1,920. "Thermostats." C. E. Hearson. February 9th.
1,976. "Electric diaphragm automobile horn." A. W. Hulbert. February 10th.
1,983. "Trolley head replacement devices." H. R. Hayward. February 10th
2,020. "Sparking plugs and method of making same." W. J. Mellersh-Jackson (Champion Ignition Co.). February 10th.
2,028. "Telegraph repeating instruments." T. B. Dixon. February 10th.
2,044. "Wall boxes for electrical switches, plugs, &c." M. Brooks, J. E. Franks and A. E. Reed (trading as Walsall Hardware Manufacturing Co.). February 11th.
2,048. "Manufacture of electrically insulating coatings for metallic wires, &c." H. G. Rule. February 11th.
2,056. "Dry battery." F. P. Baumann. February 11th. (Switzerland. February 16th, 1915.)
2,058. "Dynamo-electric machines." G. Schroeder. February 11th.
2,065. "Radio-telegraphy." J. Bethenod & E. Girardeau. February 11th. (France, February 11th, 1915.)
2,066. "Wireless telegraphy." E. R. Clarke. February 11th.
2,068. "Electro-magnetic driving gear for clocks." J. Lameris. February 11th.
2,085. "Secondary or storage batteries." H. Wade (B. Ford). February 11th.
2,101. "Alarm or indicator apparatus for electric current supply warning systems." G. Chapman. February 12th.
2,114. "Electric switches." R. H. Williams. February 12th.
2,132. "Electric battery lamps." G. B. Jones. February 12th.

PUBLISHED SPECIFICATIONS.

1915.

722. Safety Devices or Vacuum Relays for Electric Circuits. Siemens Schuckertwerke Ges. January 16th. (January 16th, 1914. Patent of Addition not granted.)
1,093. Regulation or Control of Electric Currents. J. Stone & Co., and A. H. Darker. January 22nd.
1,346. Insulation of Telephone Cables. K. W. Wagner. January 27th. (January 20th, 1914.)
1,470. Automatic and Semi-automatic Telephone Systems. Relay Automatic Telephone Co. (formerly Betulander Automatic Telephone Co.) and W. Aitken. January 29th.
1,525. Construction of Electric Batteries. H. F. Joel. January 30th.
1,641. Electrically-driven Clocks. A. Webber & Standard Time Co. February 2nd.
1,670. Treatment of Air or a Gas with an Electric Arc. M. R. A. Samuel. February 2nd.
2,388. Portable Electric Lamps. Wallace Novelty Co. (Fairweather). February 15th.

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ORGANISATION.

IN those far-off days before the war, when we were discussing the respective strengths of British and Teutonic electrical manufacturing concerns, we were over and over again advised by those who are entitled to be described as leaders and experts in the industrial world that, if we were weaker than we ought to have been in certain departments, it was almost entirely due to want of organisation. We heard that statement in public speech and in private conversation; it was made in the technical and trade Press by editors and by their correspondents. Everybody seemed to be convinced that something along that line was needed, whatever other measures might be taken in our manufacturing interests. Attempts were, therefore, made to bring about that very desirable state of things when the electrical lion and the lamb would lie down together, when tangled skeins should be unravelled, when without the adoption of too harsh procedure manufacturers would sink as far as practicable their individual interests and adopt a uniform policy in matters of principle so that benefits might be secured for the whole of our national electrical industries. Nobody will say to-day that those attempts entirely failed, but for a variety of reasons they were never crowned with that measure of success for which some people hoped. They were, however, sufficiently successful to lead those interested in them to indulge in war-time in an appeal to all engineering industries to emulate their example, perhaps join hands with them, and thus pursue the same or similar good efforts in the direction of larger and more general national organisation. In the days of peace, propaganda meetings were held in some of the industrial centres, and a number of engineering firms were entered as members of one organisation. And now, while the war is at its height, others are embarking upon a somewhat similar series of propaganda meetings in provincial centres after holding two or three to create the right atmosphere in the metropolis. In addition to this, we have an elaborate Manchester proposal for roping in every engineering firm in the Kingdom, and an Institute of Industry which desires to secure the support of all branches of manufacturing. Yet further efforts are being made by others to establish organisations which are in some way or other to save the situation for us or assist us "after the war."

We profoundly hope that the cry for more efficient organisation, started long years ago and then so slightingly regarded, will in these times be taken up from one end of the land to the other, and will be rewarded with a fuller measure of success. But surely nobody anticipates that every firm will be induced to join hands in an engineering organisation! There always will be a number who will desire to "gang their ain gait," and it is for them to choose. There is, however, strong ground for hoping that there will soon exist amongst us an organisation which, while it may not include everybody, and while it may have little room for those who are inclined to give only a half-hearted support to true British interests, will be able to exert such an influence as shall both make it a power in Government circles and render it capable of conducting the most thorough-going campaign in Colonial and foreign markets for the benefit of British electrical and engineering industries.

Where is that organisation to be found?

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We do not know what measure of success has attended the steps taken by the B.E.A.M.A. towards securing the already suggested "Federation of All Associations," which it apparently regards as being essential if the Ministry of Commerce, when we get it, is to be of the fullest service. Probably it is considered that public opinion must first be cultivated before that idea of federation can be developed. If that be so, there is no time to be lost. We may even be allowed to express a regret that steps of the kind were not taken in those early days after the outbreak of war, when we were led to suppose that the situation demanded no unusual effort. However, the present policy has been gradually developed, and as we go to press we learn that the Secretary has written a book which is shortly to appear, and in which he outlines a scheme for federation.

Very fittingly Birmingham was chosen (Manchester will not mind! Birmingham is nearer to London) as the place for the first of a series of meetings organised by the B.E.A.M.A. with the object of providing a platform for the general expression of opinion by the engineering industry on the public importance of that industry "as affecting the restoration of commercial prosperity and the maintenance of impregnable national defence after the war." It was made clear that the views expressed by those taking part in the discussion were not necessarily those of the B.E.A.M.A., that association merely undertaking the duty of organising the gathering. Now after all that has been written and said about the war and the engineering industries, and the economic struggle that is expected to follow the war, it must not be expected that many things new or original will be spoken on such public occasions, though there are many things that have to be said over and over again if public opinion is to be formed or guided. Was it not so at the last B.E.A.M.A. meeting in London? It is not surprising, therefore, to find that many of the old things were reiterated at Birmingham. They had to be—what else was there to say? If we were to report the discussion we should have to place before our readers once more many things that we have urged for many years in regard to the measures that the engineering industries ought to take for themselves. How long is it, for instance, since we urged that, without engineers in Parliament, engineering could not have its interests properly watched over at St. Stephens? How often have we stated that our foreign rivals, whether German or trans-Atlantic, had a great advantage over us by reason of the largeness of their output? How many times has the Ministry of Commerce been shown to be a necessity if Parliament and Government departments are to be able to understand what is injurious and what is beneficial to our industries? How often has the danger of our past reliance—almost complete in certain cases—upon Germany and Austria for certain manufactures been pointed to and held up as a grave warning? How often, almost to the point of weariness, have we all seen how desirable it is that good relations between Capital and Labour should be fostered, instead of the politician being allowed to sway the public with his efforts to set class against class? Yet all of these, and a score of other matters, form perfectly legitimate subjects for discussion in connection with the present propaganda efforts.

Surely to-day hardly anybody is ignorant concerning the supreme position that engineering has occupied in assisting the cause of the Allies during the past twelve months. Will this be forgotten by the nation after the war? Or will the industry be allowed to occupy that exalted place in the councils of the State which is its due? If only the nation can be led to see that by safeguarding the best interests of the engineering industry the interests of the British Empire are being protected and strengthened, these conferences will not have been held in vain. In order that such may be the issue a federation of organisations seems desirable, if such federation is the best or only means of keeping so serious a matter lastingly before the mind of the voting public and of the elected politicians.

By effecting a better organisation of the British engineering industries, whether along Manchester, Birmingham, or Kingsway lines, if we act in time we shall be prepared to utilise our greatly enlarged manufacturing capacity and employ both those who return from the Front to these trades, as well as the many thousands of at present partly skilled workers, who will by that time probably rank in a class of higher efficiency, adaptable to work which, though it will not be on the production of shells, will still be of an engineering or metal-working character. The opener of the discussion said that we "must make the biggest effort ever recorded in industrial reorganisation," or "we shall have the biggest national scrap-heap ever witnessed." Of course, we have to remember that the words were those of Mr. Elder, not those of the B.E.A.M.A., that they were spoken at Birmingham, and that under these circumstances they will be none the worse for being taken *cum grano salis*. Those present were informed that the great problem of the future is not a manufacturing problem but a financial one. "What we shall be short of is working capital," but if we are short thereof, our enemies will assuredly be shorter. There will be plenty of work to do, but throughout the world there will be a limitation of purchasing power. "Finance alone can open the market gates and bring together the manufacturer and the user of machinery," all of which leads us on to those very familiar points that greater financial strength can be exerted by manufacturers who act in association than by single firms who, as we say, "gang their ain gait." "Our manufacturers should exploit foreign markets, not in a spirit of mutual rivalry, but in strong combination." This is as unquestionably true as it is hoary-headed. We trust that by means of a strong organisation it may become possible to make arrangements for industrial finance within industry itself, by means of "additional institutions" such as Mr. Runciman and his rejected sub-committee advocated. That certainly seems to be more within the range of practical politics than a conversion of our present sound and prosperous banking system which has so well stood the test of the strain of world-war. It was stated at Birmingham by Mr. Dudley Docker, who presided, that firms who deserved advances from the joint stock banks got them, but he added that the facilities might be multiplied by an adaptation of the German system, which combination among our manufacturers would make possible. It will be waste of breath to continue abusing our present banking system generally—we should be more profitably employed in working out our own salvation and forming our own "additional institutions" as the result of strong co-operative manufacturing action. It would probably be desirable to secure the co-operation of the banking interests, and some writers are advocating Government pressure to attain that end. We doubt whether much is to be gained either by such advocacy or by enforced co-operation.

Gas on Trains. The recent accident on Tyneside has once more directed public attention to the risks involved by the use of cylinders of compressed gas on railway trains, and has led to a good deal of correspondence and editorial reference in the pages of the lay Press. Unfortunately, the upshot is invariably the same—the matter drifts back into oblivion, until the recurrence of disaster stimulates public interest anew and calls forth a fresh crop of letters and articles. The difficulty at the root of the trouble is a financial one; much capital has been sunk in equipping railway trains with gas-lighting

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installations, and in providing gas generating and charging stations, and the railway companies cannot see their way to abandon this expenditure and spend fresh capital on electric lighting plant. The stringency of capital that will be experienced after the war will further retard reform. That the authorities recognise the danger is clearly proved by the fact that many of the railways are installing electricity in preference to gas on all new rolling stock, but many years must elapse before the obsolescence of their existing stock brings about anything like the complete abolition of gas lighting.

An article in a financial contemporary last week quoted "an expert of over 30 years' standing," to the effect that serious accidents resulting in loss of life by the use of gas practically never occur to comparatively slow trains, the impact being insufficient to smash up the carriages and demolish the gas cylinders; hence he concludes that only in the case of expresses need provision be made to avoid such occurrences.

That so short-sighted a view should be held is somewhat extraordinary. Surely it is obvious that if a fast train crashes into a slow train, the latter being equipped with gas, the danger is just as great as if the fast train were gas-lighted—even greater; for expresses usually consist of stronger and heavier coaches than slow trains, and are less likely to suffer destruction than the lighter rolling stock employed for slow traffic.

The expert suggests that the gas cylinders should be carried only under the last carriage of a train, whence the whole train would be supplied with gas, and here, again, it is obvious that the rearmost coach of a standing train is the very one most exposed to the impact of a following train. Such arguments are too transparently fallacious to carry any weight.

Rubber.

There has been irregularity of movement in the crude rubber market, but prices have registered an advance on balance, the improvement in sentiment being due, to some extent, to the presence at sea of at least one German raider. The rubber trade has not forgotten the consequences of allowing the *Emden* a free hand for so long, and is highly apprehensive regarding the possible exploits of the *Moewe*. There has been a very good demand from consumers both on home trade and on export account, Russia being particularly well to the front in the latter connection. The quantities of material reaching here of late have been comparatively light, but there is a moderate premium still for deliveries this side of June, and this feature will, no doubt, become accentuated if the German raider sets to work in earnest as the *Emden* did. One of the features which have been especially pronounced in the market within the past month has been the improvement in the demand which has been experienced for the lower grades of plantation material, the result of which has been that the margin between the finer and the poorer sorts has been reduced to a considerable extent. There is hardly any improvement in the shipping position owing to the congestion at the docks, and whenever there is any little quickening in demand, prices respond immediately. Lately there has been more disposition on the part of Brazilian holders to market material, and this recently caused a very sharp break in the price of fine hard Para, but the market has since steadied.

There is no doubt that the English market is losing its importance as the world's distributing centre, for all the statistics available here and in the nearer East are indicative of the greatly increasing importance of the quantities shipped direct from there to America. An official cablegram received from Singapore gives the amount of plantation rubber exported from the Straits Settlements for the month of January as 4,443 tons, compared with 3,005 tons in December last, and 2,576 tons in the corresponding period of last year. These figures include transhipments of rubber from various places in the neighbourhood of the Straits Settlements, such as Borneo, Java, Sumatra, and the non-Federated Malay States, as well as rubber actually exported from the Colony, but do not include rubber exports from the Federated Malay States.

Trade Union Rules.

A singular example of the way in which the rules of Trade Unions are sometimes sought to be applied is to be found in the case of Kelly *v.* National Society of Operative Printers, which was fully reported in a recent number of the *Law Times Reports*. The plaintiff, a printers' assistant, was a member of the defendant society in 1913, and was employed in the machine room from 10.30 p.m. to 6.30 a.m. During the day time he worked for several hours each day for a firm of carriers, unknown to his employers at the printing office and to the officials of his society. As stated by Lord Justice Swinfen Eady in his judgment: "He is 43 years of age. He said that he did not find the work of a reel hand heavy; he has two children, and a wife who is unfortunately a cripple; and for their sake he worked as he did." On his daily activities becoming known to the society, a resolution was passed for his expulsion. The resolution purported to be made under a rule of the society enabling a branch committee to expel a member for "misconduct calculated to damage the character and reputation of the society." The act of misconduct alleged against the plaintiff was not specifically mentioned in the rules; but another Rule 29 (2) provided as to the amount of overtime which night men were allowed to work. He brought an action in the County Court and obtained a declaration that the resolution was *ultra vires* and void, and an injunction with damages for £68. The defendant appealed on the ground that the society was unlawful as being in restraint of trade, and that the action was brought on an agreement and non-enforceable by statute. The Divisional Court was divided in opinion; in the Court of Appeal, however, all three judges held that the plaintiff having been expelled under a rule which gave no power to expel, and in respect of an offence which he had never committed, was entitled to the injunction claimed. It was, however, held that he could not recover any damages; but he was allowed the costs of the entire proceedings. This decision appears to us to accord with the first principles of justice. In effect, the Union sought to alter its rules in order to meet a particular case; but it has long been a principle of English law that no club or society can alter its rules so as to expel one of its members against the wishes of the minority. It may be hoped that the lesson of this case will not be forgotten.

Engineers and Economics.

Elsewhere in this issue will be found the announcement that the Council of the Institution of Civil Engineers has invited a noted economist to address the members on the subject of "Industrial Development," feeling that engineers should give earnest attention to the economic issues which, after the war, must profoundly influence the future of engineering, and the industrial and commercial enterprises which are vital to its progress. We cannot too cordially welcome this indication that the Council of our leading engineering Institution is alive to the importance of this aspect of the gigantic struggle which is now in progress.

Hitherto our engineering institutions have held aloof from the great questions which have racked the nation, refusing to "dabble in politics," and ignoring the fact that politics—the art of government—is the highest interest of the citizen. Not *party* politics—for that odious profession we have nothing but contempt; they have done well to keep their hands unsoiled by such contamination, but they would do better if, without neglecting the scientific and technical aspects of their work, they would recognise the duty that is laid upon them to discuss with calmness and discernment the great political questions which properly lie within their scope. Amongst these are the industrial, economic, and commercial problems which arise from time to time, and which at the present juncture have assumed new forms, and have become of the utmost urgency. We commend the excellent example of the civil engineers to the consideration of the Council of the Institution of Electrical Engineers, which in the past has shown a regrettable disposition to stigmatise such matters as sordid and unworthy of its attention.

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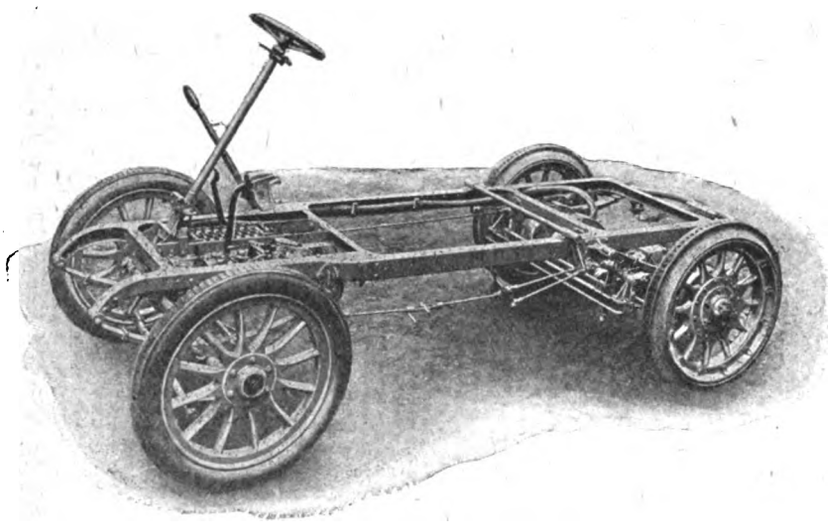
ELECTROMOBILE BATTERY CARS.

On the occasion of the official inauguration of the Swansea electricity department's new showrooms, a feature of particular interest was the electric saloon car in which the Mayor, Chairman and Vice-Chairman of the Electricity Committee drove to the ceremony, it being, we understand, the first electric battery car in Wales.



The Electromobile Chassis.

This car was lent for the occasion by Messrs. Johnson and Burgess, Ltd., the Swansea representatives of Messrs. Electromobile (Leeds), Ltd., who, we understand, built the car to the special requirements of Messrs. Johnson & Burgess, Ltd.

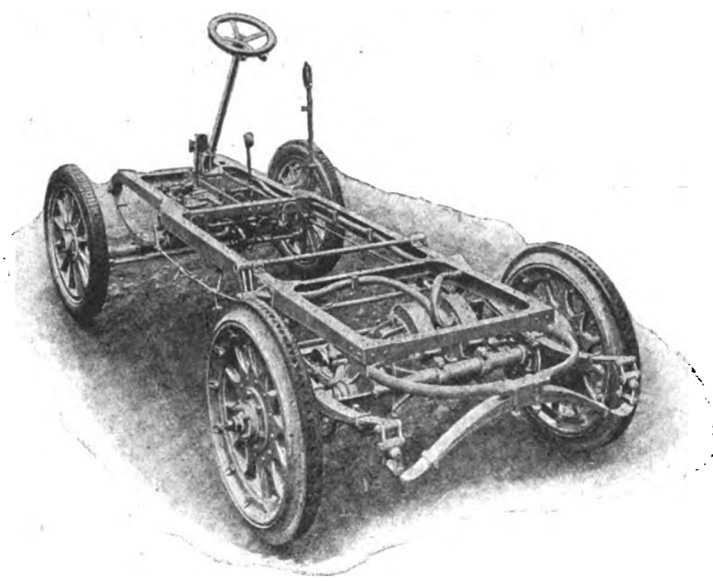
It may be added that many refinements have been incorporated, and the vehicle is considered, both in its technical features and in appearance, an advance on American designs.

It is fitted with an "inside drive" saloon body for four persons, collapsible swivelling seats being provided for the driver and his companion; the body is painted in Vauxhall brown and black, and upholstered in Bedford cloth.

The chassis is built up of pressed steel members, and is fitted with semi-elliptical springs, and wheels with Warland rims; it has a wheel base of 7 ft. 6 in., and a tread of 4 ft. 6 in.

The electrical equipment consists of an 8-B.H.P. double commutator series-wound totally-enclosed motor, running at 1,600 R.P.M.; this has a direct drive on to the differential on the rear axle, through double helical machine-cut gears.

The battery slung under the chassis consists of 44 Chloride super-Exide type cells; each cell has 15 plates with wood separators, and weighs 32½ lb. only. A special feature is the large sediment space at the bottom—3¼ in. instead of the usual ¾ in.—as a result of which there is no need to clean out the battery until the end of the life of the plates, instead of every thousand miles or so. The battery has an output of 165 ampere-hours, or sufficient for 50 miles running on one charge.



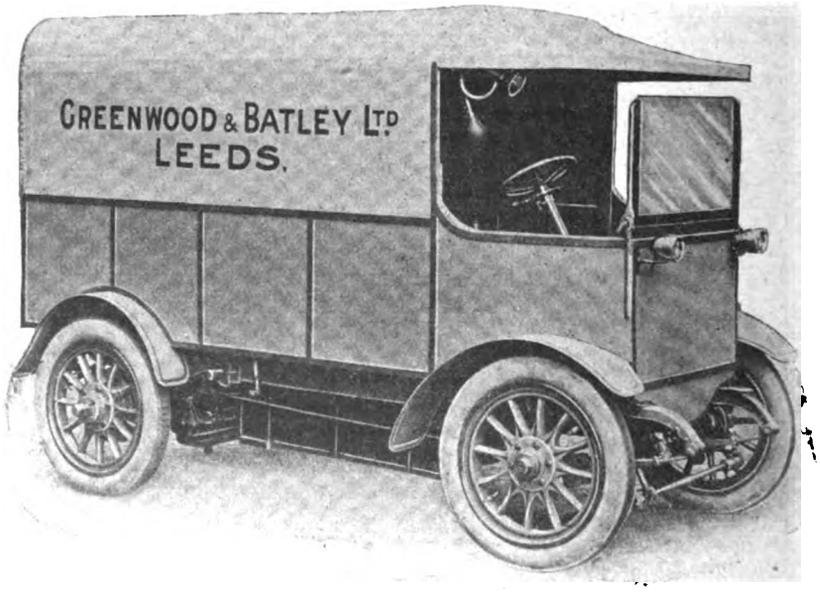
Rear view of Chassis, showing arrangement of Motor, Gearing, &c.

The electrical control of the vehicle is by means of a combined foot pedal main switch (with magnetic blow-out) and starting resistance—the arrangement being quite novel and particularly designed to facilitate driving in traffic where frequent and sudden speed reductions are wanted. The switch-arm coupled to the pedal is normally held in the full-load position by spring tension; a partial depression of the pedal gives the equivalent of "clutch slipping" for a momentary slowing up, and a full depression of the pedal cuts off current from the main controller, which can then be moved without sparking to any desired speed notch.

The driver can, of course, move the controller to the highest speed position to commence with, and start by the pedal, but this extremely rapid acceleration is not recommended, although it can be accomplished without any perceptible jerk.

It may be added that the resistance employed is of the carbon disk compression type, consisting of Ferranti tubular resistance units.

Speeds are selected by a control handle mounted concentrically with the steering wheel, and in this connection we may mention the electric horn switch of the Seng type, also a novelty in its way. This consists of a metal ring mounted underneath and concentrically with the steering wheel; when the ring is touched by the fingers at any point the horn is immediately operated. This is a great improvement in a small but important detail, as the driver can sound the horn without moving his hand or eye from their driving positions. Further, the electric wiring is fixed in one stationary position, and does not get twisted round the steering pillar, as is the case with a switch mounted in the usual way on an arm of the steering wheel. A polished



Electromobile Delivery Van.

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mahogany instrument dashboard is fitted, on which are lamp switches—for a Holophane roof light, a rear lamp, and two head and two side lamps—a flush Stewart speedometer, a flush Stewart rim-winding clock, the latest pattern Weston volt-ammeter incorporating a miniature electric lamp and a Sangamo ampere-hour meter of the differential shunt type with a reversible pointer and automatic cut-off, for disconnecting the circuit when the battery is fully charged without the necessity of an attendant standing by to switch off.

It should be mentioned that ball bearings are fitted throughout. Three brakes are fitted, operated by foot, hand and electrically, by using the motor as a dynamo short circuited through a resistance. Sufficient has been said to indicate that the Swansea car lacks nothing in up-to-date equipment; in normal running, it may be added, that it operates on ¼ to ⅓ unit per mile.

Through the courtesy of the makers, Messrs. Electromobile (Leeds), Ltd., we are able to illustrate a delivery van which they supplied to Messrs. Greenwood & Batley, of Leeds, last year. This has a light canvas-covered body, and carries 12 to 15 cwt. of goods, the speed being from 13 to 14 miles an hour. This vehicle was originally intended for carrying between different local works, representing very short journeys indeed, but its handiness was so apparent, that its radius of action has now been extended to places seven or eight miles distant.

The general constructional features of the Electromobile chassis will be gathered from the early part of this article and from the views of the chassis; the delivery van is equipped with an 11-plate type "Exide" 40-cell battery, giving 40 miles' travel on one charge, and with electrical control similar to that already mentioned.

ELECTRICAL TRADE AFTER THE WAR.

At a recent meeting of the British Westinghouse Club, Mr. G. H. Nelson, A.M.I.E.E., assistant superintendent of the Electrical Machines Department, read a paper on the advancement of British electrical industry after the war. He prefaced his remarks by a reference to the fact that the United States had realised the necessity of taking immediate steps to obtain a large share of the trade of the world, and was spending money freely on research work. The first thing for us to do was to win the war, and each one might help towards this end by making economies in living, avoiding imported luxuries, limiting as far as possible all necessities that came from neutral States, and investing the money saved in war loans. In business every effort should be made to produce as quickly as possible, at a minimum cost, all the requirements for running the war, and to employ men ineligible for the firing line.

The "Business as usual" campaign had been a mistake; our policy should have been to prosecute the war to a successful issue without delay. However, that phase had passed, and the German commercial section considered that the military party had made a great mistake, for nearly half Germany's export trade before the war was with this country and our Allies. Many weaknesses must be eliminated from our manufacturing and selling methods before we could even get level with Germany in many of our industries. Our enemies were already preparing for the problems of peace. Our exports at present made a good showing in pounds sterling, but a great deal of these would go to help win the war, and would not serve to develop our export trade. America and Japan were establishing their export trade while we were unable to compete, and no time should be lost in making preparations for the future.

The author gave a mass of statistics with regard to German electrical trade, showing that in the period 1907-1911 the number of concerns increased 41 per cent., and the number of hands employed 80 per cent.; the total earnings of employés increased 73 per cent., and the wages per employé 3½ per cent. No other industry showed so great a development. German electrical exports were valued at 7.7 millions sterling, ours at only 3.1 millions, and their electrical goods were sound and of high efficiency; they had established themselves in countries, such as Russia and Spain, where we competed with them on equal terms, and did more than their share of the trade with our Colonies. The white population of the British Empire was slightly less than that of Germany, but we had a total population of 400 millions, which should afford us an immense scope for trade, in addition to that with foreign countries.

The great progress of the Germans in commerce was ascribed by the author to careful manufacturing organisation and research work; technical education; selling organisation; their banking system; and import duties which secured to them their home markets.

Manufacturing organisation dealt with factory expenses and the design of products. As regarded factory expenses, the Germans ran their works night and day, and this had an important bearing on the subject. Factory expenses were made up of rents, rates, taxes, maintenance and depreciation of buildings and machinery, power, light, engineering, draughting, management, purchasing and accounting expenses, salaries of foremen and charge hands, and miscellaneous shop labour. Productive expenses, on the other hand, represented the cost of the workmen's time.

The selling price of an article was made up of the cost of material and labour (which could be easily determined), share of factory expenses and of selling expenses, which were not easily arrived at, and profit. The author showed that where an annual output of 1,000 motors would bring in a profit, a reduction of output by 50 per cent. would probably show a heavy loss, due to the fact that factory and selling expenses did not diminish correspondingly; further, if the output were doubled by working day and night, the profit would be very greatly increased. Hence, keeping down the factory expenses per article and securing the maximum output were considerations of the first importance. He declared that night working paid handsomely in the electrical industry, which carried such large overhead charges—but it was essential to success that the night shift should be run on the same lines as the day shift as regarded facilities for getting the work done. Moreover, the extra output could be profitably sold at reduced prices, thus enabling the makers to establish themselves in foreign markets. The greater proportion of repetition work with larger output also enabled the costs of production to be reduced.

The importance of good design had been fully appreciated by the Germans, who gave great attention to this subject. The most important question was—what did the customers want? Information under this head could be obtained from the selling organisation and erecting staff; these should keep accurate records of the machines sold, their load and speed, the nature of their work, and the conditions of running. The German was not content to rely on the ideas of one man in getting out, say, a new motor; he collected all the available information, including particulars of competing machines, the results of scientific investigations, the views of the heads of departments, and so on, and from this combination evolved a motor better than that of any competitor. It embodied the best of these men's ideas and experience, and the results of an enormous amount of research work on materials to aid the designer to secure the maximum output for minimum weight. The co-operation of all departments of the factory in this work was of the greatest importance. In this country there was not the slightest doubt that designs generally were not tackled on a thorough basis, and in consequence many designs were developed that the salesman could not sell or the shopman build.

The author gave some comparisons between British and German motors. The shafts of the latter had fewer diameters than those of the former. A 2-H.P. machine of German make had a main coil weighing 8¼ lb., and a commutating coil weighing 4¼ lb.; a similar British machine had a field coil weighing only 10 lb. The German coil was nicely shaped and better impregnated. A small German motor of 130 lb. weight, running at 1,200 R.P.M., had an output of 2 H.P.; a British machine of the same weight and speed, an output of 1¼ H.P. The British machine had no fan or commutating poles, and even if a fan had been fitted, the maximum output could not have been obtained without commutating poles; the German machine had both, its armature had larger slots and contained more copper—there was nearly twice as much copper in the German slot as in the British.

To bring the latter into line with the former, the makers had to fit a fan, wind the coils tighter, and get more copper on the armature. All this was done on an existing frame, but while making changes to fit a fan the machine was made so that the brackets at each end were alike. This was a point in advance of the German design, representing a saving of 15 per cent. on the building of 100 motors.

The author pointed out that an enormous amount of money was spent on experimental and research work of one kind and another, but it was not carried on in an organised fashion. He considered that there should be in London, or in some other centre, an experimental and research bureau, to which results of experiments were sent and recorded; to this bureau any firm could refer for information before commencing to carry out tests, and this information would be sent free of charge. The maintenance of this bureau should be covered by the State, as by circulating the results of research work the trade of the country must benefit. Similarly, many manufacturers should be educated to look at the matter exactly in the same way, namely, that by publishing the results of their researches they were benefiting the trade of the country, and, therefore, they personally must be benefiting in a proportionate degree.

Much of our own business was snatched from under our noses. For example, the Buenos Aires tramway undertaking was started by British capital, and electrified by German; similarly, the Victoria Falls power scheme contract went to Germany, as well as the orders of some of our great railways and corporations. Twenty years ago we practically mono-

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polised the Russian market, but previously to the war we were overtaken by Germany, because with our over-conservative methods of business we were not inclined to allow long credits, we would not quote in the weights and measures of the country, nor would we quote for goods delivered at the frontier, duty paid. We should study the requirements and financial methods of the country, deal in the business methods of the country, with men who were familiar with the people, their language, and their ways, deal in the units of weight and measure of the country, and correspond in the language of the country.

The German's home trade was secured to them by protective tariffs and the patriotism of the nation. The German Government, corporations, and railways would not give an order to Britain because the British price was less than the German, even if the British firm cut the price to get in. This could not be said of British corporations. Further, some of our big industrial firms did not consider one another. A special line was got out by one of our hosiery manufacturers. The samples were sent to a leading merchant house, and the line sold well. One day a traveller from a German house came in with samples, but was told his samples were not up to the English makers' standard. The German asked for a sample of the British make, and was given one. This was sent to Germany, duplicated, and offered to the English merchant at 10 per cent. less than the British makers' price, without actually giving the figure, and the English house gave the Germans an order.

Another case happened with himself. He had put an electrical installation in one of our big industrial places, costing upwards of £10,000. On completion it was found that a certain section of the works wanted lighting, and he was asked to get out a scheme and submit a tender. This was done; the tender included the supply of three small transformers and carrying out the necessary wiring, the whole costing about £700. He received the order for wiring, but not for the transformers. The wiring was completed, and the transformers arrived and had to be installed by the purchaser. The author was sent for the day after, and the manager told him the transformers were wrong and would not give proper voltage at lighting points. When asked what that had to do with the author, he coolly replied: "Well, I took your specification from your tender, and Bergmans' supplied the transformers on that specification."

Mr. Nelson concluded by remarking that we were a race that suffered from inertia, but, like all bodies that had big inertia, we should show that when we got on the move we took a lot of stopping. We should start by stirring up patriotism for our own products instead of installing foreign-made goods, and by adapting the German "ten commandments," which urged the reader in all things to study German interests, to our own case by substituting England for Germany.

AN ENCLOSED CADMIUM-VAPOUR ARC LAMP.

The following particulars of this new lamp are taken from the paper read before the Physical Society by Dr. H. J. S. Sand:—Lowry and Abram give an account of an enclosed cadmium-arc lamp designed to supply the cadmium lines only; the employment of this lamp was, however, not very convenient, as it had to be left permanently connected with an air pump. It was started by an electric spark and was run at a low temperature, being water-jacketed, but, even so, its life was not long.

The lamp which the author has constructed is run at a fairly high temperature, the metal being melted by means of a Bunsen burner before starting, so that the arc may be struck by tilting; and the temperature of the lamp is maintained high enough to keep the metal in a molten condition and to prevent condensation of metal vapour on the glass.

The principal difficulties to be overcome consisted in the removal of dissolved gases and oxide from the metal and in preventing it from adhering to the glass, which would lead to fracture of the lamp on heating and cooling. As the lamp is constructed of quartz glass, there was also the difficulty of obtaining an efficient vacuum-tight seal for the leading-in wires, but this difficulty was overcome in a perfectly satisfactory manner by the lead seals described about two years ago.*

The oxide and dissolved gases are removed by subjecting the metal to a process of filtration in a vacuum during introduction into the lamp. The adherence to the glass, which would be very great in the case of a metal freed from its coating of solid oxide, is overcome by introducing into the lamp a small amount of a fine powder which spreads itself out over the surface of the metal. The powder chosen for this purpose was always zirconia, obtained by igniting zirconium nitrate.

Fig. 1 shows the general appearance of the lamp. It consists of a quartz tube bent into an inverted U in such a manner as to give rise to a short cathode chamber A and a long anode chamber B. Each of these chambers is continued in a leg consisting of a thick-walled capillary through which a tungsten wire passes, the lead seals *s*, *s* being fitted at the ends of the legs. After the lamp has been carefully exhausted the metal is melted and allowed to run in. During this process it is freed not only from oxide but also very largely from dissolved gases. If desired, the metal may be further boiled while the lamp is still at the pump. The lamp is started by heating with a Bunsen burner from the top until the metal is well molten. When started from the cold it usually lights up even before tilting. It is usually run on a lighting circuit of 100 or 200 volts with a back resistance adjusted to take a current of 5 to 7 amperes on short-circuit.

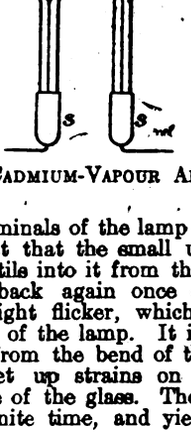

Fig. 1.—Cadmium-Vapour Arc Lamp.

The voltage on the terminals of the lamp is low, usually about 30. Owing to the fact that the small upper chamber holds the cathode, metal distils into it from the hotter lower anode chamber, and drips back again once every two or three minutes, causing a slight flicker, which does not, however, interfere with the use of the lamp. It is advisable after use to remove the metal from the bend of the tube, as it would probably otherwise set up strains on solidification which might lead to fracture of the glass. The lamp may be kept burning for an indefinite time, and yields a powerful light for optical purposes.

* Electrical Review, February 27th, 1914, p. 355, and May 22nd, 1914, p. 857.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Trade Discounts.

With reference to the meeting of the Motor Traders' Association, held at Leeds, the report of which was given in your issue of February 4th, I was certainly under the impression that if an electrical engineer was asked to fit a dynamo to a motor car he was entitled to trade discount from the manufacturers of the dynamo, as if this cannot be called work appertaining to an electrical engineer I shall be glad to know what can be; and an electrical engineer might with equal justification be refused trade discount on lamps used for motor-car headlights, or accumulators used for ignition or lighting purposes.

It might not be out of place to give my own experience regarding this. Some little time ago, having two orders from customers to fit dynamos to their cars, I inquired from one of the leading manufacturers of these articles regarding the cost, but was informed they could only be sold on the same terms to me as to the rest of the general public. I did not bother any further with this particular firm, but purchased them from another firm which was certainly more business-like, and at the time I made no remark whatever, owing to pressure of work.

I note, however, that the meeting eventually decided that electrical engineers are entitled to trade terms for articles like this, and I should hardly imagine it would require a Solomon to come to a decision of this sort. The motor traders seem to be a very highly favoured set of individuals, as they are enabled to purchase anything in the electrical trade at trade terms, and, apparently, there is no discussion about it. Further than this, it appears from the correspondence I frequently get that almost everybody is entitled to obtain electrical goods at trade terms. For instance, from my experience over a period of about two months, the following persons have stated that they can get trade discount on everything electrical that is made, through their works:—A leather merchant, wholesale clothier, draper, and grocer, and I should imagine, if one were able to go into it, almost every trade under the sun. Surely it is time, if the motor traders can make their trade such a close corporation that they even have to hold discussion as to whether electrical engineers should purchase a dynamo at trade terms, it is about time the electrical engineers retaliated by forming themselves into a similar combine to protect their interests; such a combination is, apparently, not unusual, as it is well known

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that plumbers have had an association of this kind for a long while.

One of the chief things in the electrical trade is the extraordinary number of so-called factors, and I cannot possible see what use these are at all, as the wholesale firms seem to have sufficient representatives to sell their goods without anyone else intervening at all. Personally speaking, I do not know that I deal with factors, but I do know that factors make a point of calling at mills, and even at country houses where the electric light installation is looked after by a gardener; under these conditions the factors claim them to be considered as keeping their own engineer, and consequently they allow them the trade discount off everything, and the electrical contractors have to look on and say nothing.

The Electrical Contractors' Association is an association formed for quite a different purpose altogether, being mainly concerned about the question of the rights of corporations trenching on their legitimate business. Various ideas have been brought forward to enlarge the scope of the Contractors' Association, and try and make this more popular with the whole of the electrical contractors of the country, but nothing ever seems to have been done in any way to make this such a powerful organisation that the manufacturers and factors dare not keep on trading as they now do.

It certainly does not seem quite right that almost every other business in the country should be confined to its own particular trade customers, and yet the electrical business seems to be the one where any person who likes to go and ask for trade terms gets them. In some cases I have found that large engineering firms might be legitimately entitled to purchase at trade terms, seeing they keep their own men to carry out additions to their installation work; yet it does not seem to stop at this, and I have a case in mind now where, in addition to their purchasing at trade terms for the private houses of their partners, they even go further than this and purchase at trade terms for their churches and chapels. I also understand that the same thing applies to their managers and everybody else in their office on the same lines. I do not think that this can be in any way considered trading fairly, as if wholesale people consider they can deal with the electrical situation by means of factors, then there is no need at all for the electrical contractor, and he might just as well be out of business altogether.

Consulting engineers do not in any way assist the movement for fair trading regarding electrical contractors, as it has got to be common custom in the case of country-house installations for a consulting engineer to send out the wiring specification to the electrical contractor, and the engine specification to engine builders, and so on, whereas if the electrical contractors had some combination they would say they must have all or nothing, which is the answer that every consulting engineer gets from my place.

There is room for the Electrical Contractors' Association to extend the scope of their operations, as I am satisfied that they could make themselves into a very powerful factor to regulate the manner in which trade discounts are allowed, whereas at the present time complaints come before the E.C.A. at their different sections, and the usual end of it is that the firm in question is reprimanded, but whether the contractor gets any satisfaction out of it I do not know. I certainly think that the work that has been done by the secretary and executive of the E.C.A. reflects the greatest credit on them, but I have never yet heard any proposals made to force a limitation of trade discounts, simply because, as a fighting force, the E.C.A. does not exist, except on the lines of fighting for the question of trade with regard to corporations.

Contractor.

February 21st, 1916.

[We quite agree with the views expressed by our correspondent with regard to trade discounts. The subject has often been discussed in our columns. It is curious, however, to note that "Contractor" is unaware of the fact that the Electrical Contractors' Association originated from correspondence on this subject in the Electrical Review, and that it was formed mainly for the purpose of putting an end to the misapplication of trade discounts, direct dealing between manufacturers and the public, and similar grievances. The question of municipal trading became acute much later.—Eds. Elec. Rev.]

Cause of Flicker.

I have read Mr. Balsara's letter concerning the trouble he is experiencing through the cause of flicker on his D.C. generating sets, and the following might be of interest to him. A few years ago the same trouble occurred in this station on a 315-kw. D.C. reciprocating set, and it was some time before the trouble was located. A heavier flywheel was first tried, but this did not get over the difficulty, and the trouble was finally found to be due to the interpole field. Probably the field strength under the interpole was not always in proportion to the armature current at any load, due to the iron core of the interpole being saturated.

A shunt was fixed across the main leads carrying the whole current, and this entirely did away with any sign of flicker.

W. A. Walker,
Electrical Engineer to the Kettering U.D.C,
February 26th, 1916.

A SUCTION GAS PRODUCER USING BITUMINOUS COAL.

At a meeting of the Institution of Engineers and Shipbuilders in Scotland on January 25th, Mr. R. V. Farnham read a paper on this subject, the data for which had been obtained from producers of 100, 250, and 500 B.H.P. All of these were supplying gas to electric power generating plant.

Fig. 1 shows the 100-B.H.P. size in section. A is the space into which the coal is fed through the door at that level. B is the chamber which contains the initial charge of gas coke. F F are the steel rams coupled to the rising grate; these rams have machine-cut teeth gearing into pinions. C is the main steam raiser. E is the sliding plate for supporting the fuel bed whilst charging the producer with coal. A 3-B.H.P. electric motor is coupled to the gearing which operates the sliding plate and the rising and falling grate. Suitable reducing gear is connected to the clutch gearing, which, in turn, carries out the four operations, viz., (1) the raising and lowering of the grate; (2) the inward and outward travel of the sliding plate.

This 100-B.H.P. producer, tested by Dr. Dugald Clerk, developed 4,824 B.H.P.-hours, in 48 hours. The grate area is 706.8 sq. in., equal to 6.6 sq. in. per B.H.P. A small cooler was fitted between the engine and the producer to cool the gas to atmospheric temperature, and was the only chamber employed in rendering the gas fit for use in the engine. Bituminous coal was used containing 34 per cent. of gas and tarry matter, and after the run no trace of tarry matter was found on the valves of the engine.

The essential features of the producer are the rising and falling grate and the sliding plate, and the chief characteristic

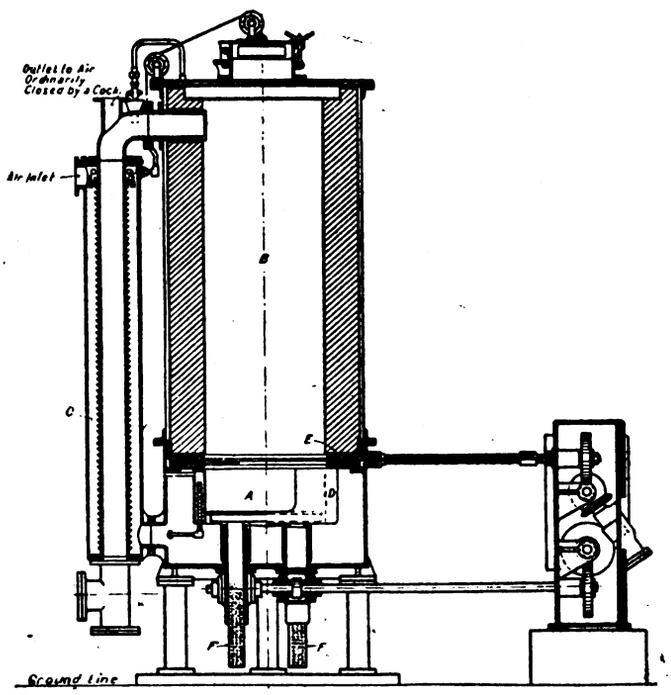

Fig. 1.—Vertical Section of Farnham Producer.

is the feeding of the coal through the firing door at the bottom of the producer.

The method of working the producer is as follows:—Ordinary gas coke is fed on to the grate when at its lowest position through the hinged door at the top of the producer. This charge of coke is brought up to the level of the gas outlet. The engine is allowed to run from one to two hours, according to the load, with gas which is generated from this coke only. As soon as it is necessary to begin to charge the producer with bituminous coal, the grate is raised to the level of the sliding plate, the travel of which is about 10 in. The sliding plate is now driven across the fire between the bottom of the fuel bed and the top surface of the grate. The grate is lowered to its lowest position, and the bituminous coal is then thrown through the firing-door opening on to the grate. As soon as this space is packed tightly with the coal, the sliding plate is withdrawn, allowing the incandescent fuel gradually to settle on to the fresh fuel. The firing door is now closed, and the same procedure is followed at intervals, which are determined by the load that the producer is carrying.

The pressure of the rising grate causes the fuel, which it supports, to become very dense and compact, preventing channels or cavities from forming in the fuel column, without the necessity of any poking of the fuel. This characteristic of applying pressure to the glowing mass of incandescent carbon is very important; in fact, it is the main principle of

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the suction producer in question. The pores of the fuel bed being closed by this pressure, the oxygen of the air which enters the firing door, whilst charging, comes into contact with a body of fuel which is of very close formation, and the necessary reactions take place, with the result that the gas generated is the same approximately as was generated immediately before charging.

If air and steam are being drawn through the outside steam raiser C (fig. 1) to the underside of the grate immediately before charging, and the percentage of hydrogen (H_2) is from 12 to 20 per cent., and the calorific value is from 130 to 140 B.TH.U. per cubic foot of gas generated, then a similar quantity of hydrogen (H_2) must be present in the gas which is being generated while the firing door is wide open. This hydrogen content is obtained whilst the operation of charging is going on, by simply damping the coal with water before it is introduced into the producer.

After the firing door is closed and the sliding plate withdrawn, it is most important to bring the fresh charge of fuel to a temperature that will prevent the regular supply of steam from condensing, and as quickly as possible, because the first object the steam comes into contact with, on entering the space under the grate, is cold and wet coal. This would, naturally, condense the steam flow, and the result would be that the gas would be minus its hydrogen content.

The raising of the fresh charge of coal to a temperature that will prevent condensation is carried out by pre-heating the air by means of an iron casing bolted to the top cover of the producer. The air entering the casing on one side of the cover is distributed over the entire surface of the producer top cover, and discharges through a pipe bolted to the outside steam raiser. This arrangement is clearly seen in figs. 2 and 3. The temperature of the air is as high as 350 deg. F. when it first comes into contact with the water flowing round the rings of the steam raiser itself, and, consequently, it enters the space under the grate slightly cooler than this.

Indicator diagrams demonstrate the regularity of the gas value whilst the operation of charging the producer is carried out.

While minor mechanical and gasification difficulties were met with and overcome in the 100-B.H.P. size, it was not until the larger sizes were made that very real difficulties began to assert themselves. The smallest size, that of 100-B.H.P. capacity, had a grate area of only 4.9 sq. ft., or 2 ft. 6 in. diameter, and no trouble was met with in employing an ordinary steel sliding plate ⅜ in. thick.

When the diameter of the grate was increased to 3 ft. 9½ in. (250 B.H.P.) and 5 ft. 10½ in. (500 B.H.P.) the plain steel plate was found to be unworkable. In the 250-B.H.P. producer a single water-cooled plate is used, and is clearly shown in figs. 2 and 3; in the 500-B.H.P. size two water-cooled plates are employed, both plates working towards the centre of the fire.

Though these water-cooled plates were subjected to a pressure test of 50 lb. per sq. in. before using them, after a few weeks' work the plates began to fail; the front end had a bevelled edge of about 3 in. width, and this bevelled edge would always split, due to the circulating water not reaching the extreme end of the plate. This trouble has been entirely obviated by the use of electrically-welded joints, which bring the circulating water to within ⅛ in. of the extreme end of the plate.

In the largest size (500 B.H.P.) a resistance is fitted in the main drum controller which regulates the speed of the motor in such a way that the plates are *withdrawn* at a reduced speed, allowing the inward travel of the plate and the raising and lowering of the grate to remain the same as in the other sizes.

In fig. 1 it will be seen that the main steam supply is obtained from the ribbed gas-main, which is surrounded by a cast-iron casing, through which the air, after leaving the pre-heater, is drawn on its way to the grate. This steam can only be generated when the gases, leaving the top of the producer, are hot enough. As the producer is started on the initial charge of coke, the gases generated before the first charge of bituminous coal is introduced would not reach the necessary temperature to raise enough steam to bring the calorific value of the gas up to the normal, and at the same time keep down the temperature of the fire.

A supplementary steam raiser has been designed in the form of a very fine jet of water distributed over the surface of the underside of the grate and the surrounding cast-iron grate guide, as well as the cast-iron bottom of the producer itself. When the gas has reached a temperature sufficiently high that steam can be raised by the gas main, the jet is dispensed with.

The regulation of the admission of steam to the fire is of the utmost importance when anthracite or coke is being gasified, but it is not so important when gasifying bituminous coal in the suction-type producer. The percentage of hydrogen is lower than usually met with in gas from producers using anthracite coal.

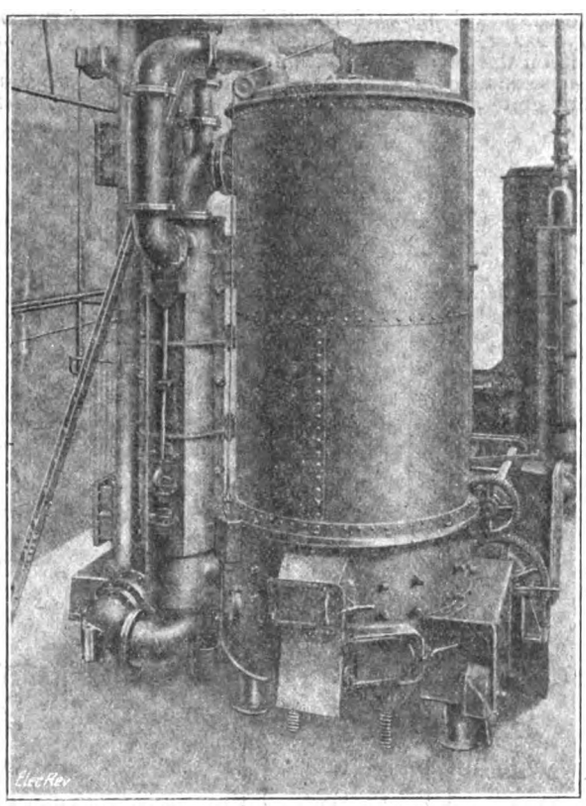
From 25 samples the average hydrogen content was only 10.29 per cent., but the average calorific value of the same 25 samples was 143.16 B.TH.U. per cubic foot (higher value).

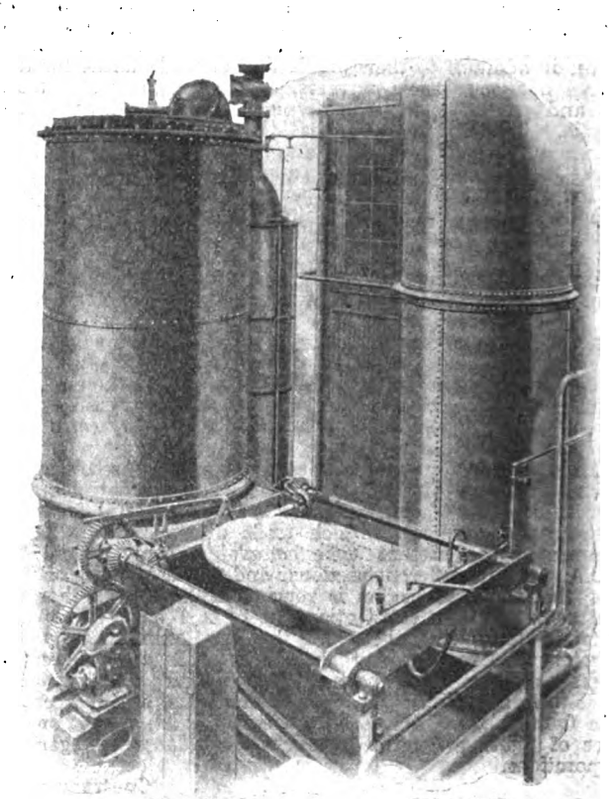
Various classes of bituminous coal are being gasified most successfully by the producer under review; the upward pressure of the rising grate causing the fuel to become thoroughly homogeneous renders caking coal just as suitable as the non-caking variety. Small coal has been found more suitable than large coal. Coal containing a high percentage of ash curtails the period that the producer can work without a complete clean out.

The most important feature of the Farnham producer is the entire absence of cleaning plant of any description, the only auxiliary chamber to the producer itself being the cooler.

Though the temperature of the gas before entering the cooler is high, it is absolutely free from any tarry matter, and when the gas leaves the cooler it is at atmospheric temperature and ready for use in the engine.

Gas enters the cooler at the base, and after leaving the coke in the lower half of the chamber, comes into contact with a very fine gauze screen, which can be rotated from the outside by means of a chain and pulley. This screen prevents any soot leaving the chamber, as jets of water play on the upper surface of the gauze, and drive the soot down-





Figs. 2 and 3.—Farnham Gas Producer for Bituminous Coal.

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wards into the coke immediately below. The coke itself has a separately controlled water supply.

The screen is always placed vertically until the first charge of bituminous coal is fed into the producer; by the time this is done, the coke has become hot enough to distil off any tarry matter which may have been present in the first charge of coke.

A screen working to-day has not been removed from the cooler for over one year, and the mesh of the screen is as clear as when first fitted. This mesh has 80 divisions to the square inch.

The ash content of the coal used determines the length of time the producer can generate suitable gas. With an ash content of 5.3 per cent., 148 hours' running has been obtained on a 250-B.H.P. producer without a pound of clinker being withdrawn. Of bituminous coal 12.8 tons were gasified, 22,000 B.H.P.-hours were obtained, and after the producer was cooled down about 1,200 lb. of clinker were withdrawn through the firing door.

A battery of these producers of 250 B.H.P. is now producing gas on the suction system from bituminous coal for driving gas engines of 850 B.H P. This producer is always run out entirely after the completed period of running; no charge of bituminous coal is ever introduced during the last 10 or 12 hours' run.

Careful consumption tests with bituminous coal gasified in the Farnham producer show a net fuel consumption of 1.47 lb. per B.H.P.-hour, including all losses, week in and week out. On the 500-B.H.P. size 2.01 lb. per KW.-hour was the consumption of fuel recorded weekly, the cost ranging from 13s. to 20s. per ton, against anthracite costing from 30s. to 40s. a ton.

WAR ITEMS.

Russian Journalists and German Commercial Penetration.—At the dinner given by the Newspaper Proprietors' Association on, February 23rd, to the Russian journalists now on a visit to this country, M. Egoroff, in replying to a toast, referred to the supreme importance of commercial relations between the Allies and Russia, and to the "penetration" policy practised by Germany. We quote the following extract from his most interesting speech from the "Times" report:—"Gentlemen, it has become an established axiom in political as well as in literary spheres that the most reliable guarantee of stable friendship between separate countries must be sought in their respective business relations. That is an idea which I, however, must accept with considerable reservations. It seems to me that the war has already introduced a very important factor. It has shown that economic relations may give place before other considerations of a more exalted order, moral and political. Let us not forget that Germany did not hesitate to declare war upon Russia, although her trade with that country ranked as one of the most important assets in German commercial prosperity. On the other hand, we have no example in history when the Russian nation entered upon a war with greater enthusiasm than now. Yet our trade with Germany was also one of the most important factors of our material welfare. What is the explanation of this apparent contradiction in terms? The answer is a simple one. There is one kind of trade which involves mutual benefit, another kind which is tantamount to a pacific conquest. Germany stood on the latter footing. In her commercial penetration into other lands she sought not only a means of self-enrichment, but a sure road to gradual conquest. She was aiming at the subjugation of the Russian people by means of her commercial and financial influences. Therein lies much food for reflection. Let us hope that our Allies, who are stronger than ourselves in the domain of industry, will not leave the German road an open one, but that they will oust Germany from the Russian market and succeed in establishing a basis of just and equitable business relations with Russia. There is no other method for assuring in the future the stable development of mutual friendship which will place our countries beyond the menace of any unforeseen events."

Wood Pulp and Tramway Tickets.—The February issue of the "Journal" of the Tramways and Light Railways Association contains a copy of a communication sent to the Board of Trade on February 16th by that Association respecting the possible effects of the restriction of importation of wood pulp on the production of tramway and omnibus tickets. The Association acted on behalf of itself, the London Omnibus Owners' Federation, the British Electrical Federation, Ltd., and the Provincial Omnibus Owners' Association (Incorporated).

Aircraft Risks.—The leading departments of Glasgow T.C. have considered the advisability of insuring their respective works against aircraft risks. The Tramways Committee decided, by 14 votes to 13, against insuring, while the Electricity Committee, by 17 votes to 9, proposed to insure the generating stations at Port Dundas and St. Andrew's Cross.

Reserved Occupations and Exemptions.—The revised list of reserved occupations issued by the Board of Trade on February 2nd contained the following:—

Electrical generating stations (including those for tramways and electric railways): All classes of workmen.

Gas works: All classes of workmen inside the works.

Tramways: Traffic inspector; driver, chief storekeeper; parcel superintendent.

Mechanics, etc., in all industries: Mechanics and other similar men engaged in the maintenance and repair of plant, machinery, and tools.

The Saltburn Military Tribunal last Friday exempted for two months Mr. T. W. Hulton, assistant electrical engineer to the Cleveland Trust. It was pleaded that he was the only person left to look after underground mains, that the original staff had been reduced from five to two men, including Mr. Hulton, and that advertisements had failed to find a successor with suitable qualifications.

The Halifax Tramways and Electricity Committee has recommended that the Ministry of Munitions be asked to take over, as controlled establishments, the tramways and electricity departments of the Corporation.

The Bolton Tramways Committee has decided to make application to the Ministry of Munitions for a certificate that the supply of tramway facilities by the Corporation is of importance to carry out munition work efficiently.

At a meeting of the Military Service Act tribunal at Dorking, on February 22nd, the chief accountant of the Electricity Co. applied for exemption, and was granted two months' extension only.

At the Recruiting Tribunal at Wallsend-on-Tyne, application was made, on February 25th, for the total or temporary exemption of a tramway conductor on the Tyneside Tramways and Tramroads Co.'s system. It was stated that the company was short-handed, and that that morning they had been unable to run a workmen's car. They would either have to stop the cars or employ female conductors, but before they could employ female conductors it was necessary to make certain alterations. A postponement for one month was granted.

Application is to be made to the Ministry of Munitions by the Glasgow Tramways and Electricity Committees for a certificate making the departments controlled establishments, and permitting the municipality to that extent to come under Section 7 of the Acts which prohibits the employment elsewhere of persons who have left munitions factories.

Dearth of Machinery in Russia.—With reference to our leading article of last week, the Board of Trade "Journal" quotes a report from the British Vice-Consul at Ekaterinburg, to the effect that in Ural mining works a great dearth of machinery in general is now beginning to be very seriously felt, and fears exist as to whether allied and neutral powers will be able to replace the tremendous quantity of machinery that Germany formerly supplied to Russia. Not to mention new enterprises, the machinery which is at present in use, owing to the difficulty of obtaining spare parts, is likely to be run out, so that practically all current businesses will require new machinery after the war. The demand for catalogues and specifications in the Russian language has never been so acute as it is at the present time. Russian buyers are at a loss to find out whence to obtain prompt and reliable information as to where special requirements may be bought. Great preparations should be made by all firms anxious to share in business in the Russian market after the war. Travellers having a good knowledge of the Russian language, as well as a technical knowledge of machinery, should be sent out to the Ural mining works, where the Russians would be only too glad to give them every assistance.

An Italian Company's Difficulties.—Owing possibly to the influence on traffic exercised by the war, the Società Tramvie Vicentine is in financial straits, and a petition for its liquidation has been filed by the Banca Popolare, of Vicenza. The Society, however, last August applied for and secured the protection of the moratorium, after a court expert had reported favourably on its finances. A meeting of shareholders is to be called to decide on its future course of action. The Society was started in 1906, and works some 135 kilometres of line between Vicenza, Valdagno, Chiampo, Recoaro, Bassano and Montagnana, and receives governmental, provincial and communal kilometre subsidies, which guarantee its bond indebtedness. Its capital is 4,000,000 lire in 100 lire shares.

After-the-War Trade.—The Council of the Birmingham Chamber of Commerce, in its annual report, expresses the hope that the Government will not fail to take such steps as may be necessary to enable the manufacturers and workers of the country to consolidate their position and enter into international competition after peace is declared without those enormous disadvantages which prevailed before the war.

It is stated that, on Tuesday next, Mr. Asquith will receive the deputation appointed at the Guildhall meeting on trade and employment after the war.

Enemy Trade Marks in Australia.—In furtherance of its policy of stamping out German influence and German trade, the Australian Commonwealth Government has suspended the trade marks of 450 articles of enemy manufacture.

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Trading with the Enemy.—The "London Gazette" for February 29th contains lengthy lists of persons or bodies of enemy nationality or associations in Greece, Morocco, Netherlands, Norway, Portugal, Portuguese East Africa, Spain, and Sweden, with whom or which trading is prohibited. A number of electrical companies are included.

The Board of Trade has made Orders requiring the undermentioned businesses to be wound up:—

Calmon Asbestos and Rubber Works, Ltd., Sheppy Place, Minories, London, E. Controller: Mr. E. H. Fletcher, 14, George Street, Mansion House, E.C.

Rhenish Rubber and Celluloid Co. (1908), Ltd., Basinghall Street, E.C. Controller: Mr. J. S. Cotman, 10, Coleman Street, E.C.

Harburg and Vienna India Rubber Co., Ltd., Golden Lane, E.C. Controller: Mr. C. W. M. Kemp, 36, Wallbrook, E.C.

Manchester and Future Municipal Contracts. — The "Morning Post" states that the Manchester City Council was on Wednesday to be asked to confirm a resolution to the effect that all municipal corporations in England and Wales should have their attention called to the following standing orders which have been adopted by the City Council:—"No contract shall be entered into with any person of German or Austrian nationality; no contract shall be entered into with any firm or company whose subscribed capital, whether by way of shares or otherwise, is held or controlled to the extent of one-third or upwards by persons of German or Austrian nationality." The resolution adds that the Town Clerk be instructed to transmit a copy to the Town Clerk of each borough with a suggestion that the respective councils will take into consideration the advisability of adopting similar standing orders.

LEGAL.

Attwell *v.* West Ham Corporation.

The West Ham Corporation on February 24th unsuccessfully appealed to Justices Ridley and Avory in a King's Bench Divisional Court against a judgment at Bow County Court, where a jury awarded Mr. A. E. Attwell, an electrical engineer, £350 damages against the Corporation for personal injuries he received through the negligence of the Corporation's servants. The matter has already been reported here. The plaintiff's case was that he was working at a H.T. chamber when an explosion occurred, with the result that he was severely injured. The West Ham Corporation appealed on the ground that there was evidence of contributory negligence, but Counsel for the respondent took the preliminary objection that the appeal was out of time, and that all the grounds of appeal were inadmissible by Sec. 120 of the County Court Act. The Court upheld the preliminary objection and dismissed the appeal with costs.

Munitions Cases.

At Oldham last week, the local Munitions Tribunal fined John Cox 7s. 6d. for a breach of the Act. His employers, a firm of electrical manufacturers, complained that he had attended at the works in an unfit state to work, being the worse for drink, and after being warned he repeated the offence; he later asked for his leaving certificate, which was refused, and he was told to come to the works when he was sober, but he did not return.—The Tribunal declined to grant leaving certificates to three Belgians who were employed by the same firm, and wanted to go to a place in London where they could earn more money.

A South Wales Mines Case.

On February 25th, at Merthyr, Mr. H. Thomas, manager of Hill's Plymouth Co.'s Graig Collieries, and Mr. W. W. Green, agent to the collieries, were summoned for nine offences in respect of electrical plant. The matter is reported in the *South Wales Daily News*, from which paper we quote. Mr. Vachell of the Home Office, who prosecuted, explained that at the collieries in question—the Nos. 1 and 2 South Pits—there was a very extensive electrical plant with over 20 miles of cable and 26 motors. The plant was one of the oldest, and was getting very antiquated. In August last there was a non-fatal accident at the collieries and one of H.M. inspectors was sent to make an examination. As a result of that Mr. W. J. Charlton, the inspector, would tell the Court that the plant was "extremely neglected," and was in "a very dangerous condition." The summonses had been taken out "to illustrate various offences," but they could have taken out a hundred.

Mr. C. Kenshole, for the defendants, raised objection to such a remark.

Mr. W. J. Charlton, junior Inspector of Mines, said that when he called Mr. Thomas's attention to the condition of the cable he said he had no idea it was in such a bad state, and he quite agreed that it was unfit for use.

Mr. C. Kenshole: Do you know the company are gradually putting in and installing new cables throughout these collieries?—I understand they are trying to comply with the rules.

They are gradually putting in armoured cables and replacing old cables?—I did see some old cables replaced.

Do you agree that to get cable now is a most difficult matter?—It would be some time before the whole could be completed.

Mr. W. W. Green said he had been for 12 years agent to the Hill's Plymouth Collieries, whose annual output was about 600,000 tons. He was not aware of any breach of the regulations in regard to the electrical apparatus in the mine. There was now a great difficulty in obtaining cables. The cables were from time to time damaged by falls of roof—and there were exceptionally bad roofs in these collieries, probably the worst in South Wales. The overlying strata were very weak and saturated with water. Probably these mines were the wettest in Wales, and possibly in the kingdom.

Mr. Henry Thomas, manager, said the company were gradually introducing new plant. The electrician had reported from time to time up to October 7th that the insulation was good. It was impracticable for witness to follow the electrician step by step to see that he was doing his duty.

The cases were adjourned until a date to be mutually agreed upon.

B.E.T.—Reduction of Capital.

The Court of Appeal, composed of the Master of the Rolls and Lords Justices Phillimore and Warrington, on Monday, heard an appeal by the Public Trustee as the executor of the late Leopold Salamons, the holder of £12,960 income certificates of the British Electric Traction Co., Ltd., from an order of Mr. Justice Astbury, sanctioning upon the petition of the company a reduction of its capital from £4,000,000 to £2,998,397 15s., and also sanctioning the scheme of arrangement under Sec. 120 of the Companies' Consolidation Act, 1908, so as to bind the various classes of shareholders and also the holders of income certificates issued by the company.

Mr. Clauson, K.C., in support of the appeal, contended that the scheme of arrangement under which the reduction of capital was effected might involve his client in some future liability.

The hearing was adjourned for a fortnight to enable the company to file further evidence.

Farrell *v.* Bloxam.

Mr. Justice Pim, in the High Court, Dublin, granted an application for service of a subpœna out of the jurisdiction on Mr. A. N. Moore, formerly chief assistant electrical engineer at the Belfast electricity works, now borough electrical engineer at Newport, England, who is a necessary witness in the action for slander brought by Mr. A. B. Farrell, resident superintendent in the Belfast central station, against Mr. T. W. Bloxam, chief electrical engineer, Belfast.

Assessment of Colliery Power Stations.

The Divisional Court, on February 25th, granted an application by Mr. Ryde, K.C., on behalf of the Pontypridd Union against the Cambrian and other colliery companies in Glamorgan, asking for an extension of time for setting down appeals. It was stated that the cases referred to the assessment of electrical power stations at the collieries.

CONCERNING DISCOUNTS.

By A STATION ENGINEER.

During recent years manufacturers have acquired the habit of sending out price lists with the most astonishing array of discounts attached. A glance through recent invoices gives the following discounts:—20, 10, 5, and 5 per cent.; 33⅓ and 30 per cent.; 7½, 15 and 10 per cent., plus 5 per cent. advance; 20, 7 and 10 per cent.; plus 10 per cent., less 33⅓. Just why makers do this kind of thing it is not easy to understand. Perhaps one reason is that buyers often add the discounts together, thinking to get an approximate result that way. Thus 20, 10, 5, and 5 per cent. sounds like about 40 per cent.; at any rate, a smart salesman will say that, and doubtless many an order has been booked on this understanding. A little thought will show that adding the figures together does not give the correct answer at all. Take this case:—20 per cent. off 100 gives 80. Then the 10 per cent. deducts 8, leaving 72. The two 5 per cents. reduce that to just under 65, so that the total effect of the discounts is only equivalent to 35 per cent., and not to 40 per cent. Similarly 33⅓ and 30 per cent. works out at 53⅓, and not at 63⅓ per cent. The strange assemblage of 7½, 15, and 10 per cent. looks like 32½ per cent., but it works out at 29·2 per cent.

The question frequently arises, does the order in which the discounts are taken make any difference? The answer is that the order makes no difference at all. The writer has had many arguments with friends on this point, and calculations have even been produced giving the opposite result. Yet the truth of the proposition can easily be shown. Taking 20 per cent. and 10 per cent. discount off an amount is equivalent to multiplying it by ·8 and ·9, while taking 10 per cent. and 20 per cent. off is the same as multiplying it by ·9 and ·8. Obviously, the effect is the same in either case. Similarly it makes no difference whether a percentage advance in price is added before or after the discount is taken.

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May one suggest that there is something silly in these elaborate discounts. Manufacturers would save so much time and labour if they quoted the equivalent figure instead of a multitude of discounts and advances, that it is hardly credible that they keep up the present method. The following accounts, copies of actual invoices, will show the waste of labour in making out accounts on the repeated discount system :—

	£ s. d.		£ s. d.
(1) Less 20 % ...	0 17 11	(2) Less 20 % ...	0 0 6
	3 11 7		0 2 2
„ 10 % ...	0 7 2	„ 7½ % ...	0 0 2
	3 4 5		0 2 0
„ 7½ % ...	0 4 9	„ 10 % ...	0 0 2
	£2 19 8		£0 1 10
	£2 10 7		£2 18 0
(3) Less 7½ % ...	0 3 9	(4) Less 25 % ...	0 14 6
	2 6 10		2 3 6
„ 15 % ...	0 7 0	„ 15 % ...	0 6 6
	1 19 10		1 17 0
„ 10 % ...	0 4 0	„ 10 % ...	0 3 8
	1 15 10		1 13 4
Plus 5 % ...	0 1 9	Plus 5 % ...	0 1 8
	£1 17 7		£1 15 0

The ideal method would be to quote the multiplier which would give the amount right off without subtraction. If we further adopt Mr. Planchon's decimalised shilling as the coinage unit, the above accounts would read thus :—

(1) 89·50s. at 66·6 % 59·60s. (2) 2·67s. at 66·6 % 1·78s.
(3) 50·59s. at 74·3 % 41·53s. (4) 58·00s. at 60·2 % 34·91s.

It is worthy of note that the equivalent discount does not give the same result as the repeated discounts, as errors necessarily accumulate in the latter method.

May we hope that a system capable of such perfect simplicity will ever come into use? Or are we to be put off by the conservative tendencies which form so strong a characteristic in our nation, tendencies which cause us to say that that kind of thing is all right for the benighted foreigner, but we are different? As one friend puts it, "If we had the decimal system of weights and measures and coinage, and simplified spelling, there would be nothing left for the schoolmaster to teach, and that would never do."

BUSINESS NOTES.

Board of Trade Inquiries.—The British Consul at Bordeaux reports that a local agent wishes to obtain agencies for British makers of electric lamps, for which there is a very great demand, the market having previously been inundated with German products. He says that manufacturers who wish to profit by this opportunity must be prepared to adopt the German system of sending stocks to agents, the latter sending monthly statements of sales. Applications regarding the matter should be addressed to the Board of Trade Commercial Intelligence Branch in London.

The Branch has received applications from firms at home for names of makers of :—Electric switches, ironclad, and switch parts ; tinned iron and steel wire ; coppered steel wire.

Patent Restoration.—Mr. W. Reavell and Messrs. Reavell & Co., Ltd., have applied for restoration of Patent No. 17,026 of 1907, granted to them for "Improvement in mechanism for converting rotary into reciprocating motion, applicable to pumps, compressors, and other machinery."

Condensing Plant Contracts.—The Mirrlees Watson Co. have recently received orders for condensing plant from a number of colliery companies, iron and steel companies, co-operative societies and others. Also a number of separate condensers and air pumps for various munition works, and for France and Russia.

Book Notices.—*How to Make a Transformer for Low Pressures.* By Prof. F. E. Austin, 11, South Park, Hanover, N.H., U.S.A. Price 40 cents in America.—This brochure should be very useful to amateurs wishing to build a small transformer for operation on lighting supply circuits, without using any costly tools, yet with the certainty of obtaining reasonably high efficiency and a reliable piece of apparatus. The data and specification clauses included should be useful also in building small transformers for laboratory use. The author gives complete instructions for making a ring-type, step-down transformer with tappings giving various pressures down to 8 volts, when supplied at 110 volts in the primary circuit. The transformer yields 100 watts output at 90 per cent. efficiency, and may be worked temporarily at 400 watts, the efficiency being then about 70 per cent. Figs. 2 and 3 in the booklet are capable of a good deal of improvement, but the author's meaning seems never in doubt, and any reader should be able to construct quite a satisfactory transformer from the instructions given. Among the uses to which such a transformer may be put are ringing door bells, operating small arc lamps or low-pressure tungsten lamps, performing light welding work, charging accumulators (using an electrolytic rectifier), operating small series motors, operating spark coils, and so on.

The Faraday House Journal for the Lent Term contains a portrait of Mr. C. P. Sparks, President I.E.E. and senior past-President of the Faraday House Old Students' Association, articles on the origin of the Fahrenheit scale, by Mr. G. Scott Ram, and on the Lake Coleridge (N.Z.) hydroelectric scheme, and numerous personal and other minor items, with portraits of past and present students serving with the Forces.

The Path Publishing Co. have in preparation a book by Mr. D. N. Dunlop, A.I.E.E., entitled "British Destiny—The Principles of Progress." The author will show the philosophical basis of voluntary co-operation and its possible combination with the British policy of Individualism, while preserving the full value of the latter. A scheme for national industrial federation will be outlined.

Bankruptcy Proceedings.—A. B. Craig, merchant, 8, Well Street, Cripplegate, E.C., trading as John Craig & Sons.—A sitting of the London Bankruptcy Court was held on Wednesday before Mr. Registrar Hope for the public examination of this debtor, who returns total liabilities £34,292, of which £23,668 is expected to rank, against net assets valued at £25,753, or sufficient to yield a margin of £2,085, after payment of all indebtedness. The debtor had been connected with a syndicate which had promoted several companies, including the Sturgeon Falls (Canada) Electric Light and Power Co., Ltd., whose operations were brought to a standstill by litigation. A dispute had been referred to arbitration, but the arbitrator died before making his award, and the matter was still before the Courts on appeal. Witness was entitled to 1,942 $10 shares in the Electric Co. ; it had paid no dividends, but had made profits, and witness valued his shares at £15 each, or about £30,000 in all. The Official Receiver suggested that the shares were not worth a brass farthing, as they related to a concern in a small town with works in the backwoods. The debtor asserted that, on the contrary, the shares were very valuable. The examination was formally adjourned till after the next meeting of creditors.

J. Whitehouse, Ltd., 15, The Parade, Golders Green, Middlesex. The following are creditors herein :—

Hands, A. C.	£171	Electrical Co.	£88
Armorduct Manufacturing Co.	101	Metallic Tube Co.	19
Sloan Electrical Co.	36	Sun Electrical Co.	288
Gurney, S., & Co.	85	Regent Wall Paper Co.	36
Russell & Co.	116	Colthurst & Harding	14
Siemens Bros.	18	Shearn, H. J., Ltd.	14

G. J. T. J. Parfitt, consulting electrical engineer, 11, Priory Road, Keynsham, Somersetshire.—An application was made at Bristol, on February 25th, for the discharge from bankruptcy of the above-named debtor. According to an amended statement of affairs prepared, the debtor's liabilities were estimated at £2,615, but would probably amount to £3,119. The assets were expected to produce *nil*, but realised £97 odd. A first and final dividend was paid on proofs for £2,266. The Official Receiver reported that the assets were not sufficient to pay 10s. in the £, and that the debtor had omitted to keep proper books of account. On behalf of the debtor it was stated that he had been the victim of misfortunes. The various enterprises upon which he had embarked were in connection with the business, which he had hoped to develop by means of them. He had incurred a heavy loss in connection with the Bristol International Exhibition, and the war coming after that, had simply shut down his business. His Honour said the debtor had failed to keep sufficient books to disclose his business transactions, but he would grant the discharge, subject to a suspension of two years.

Catalogues and Lists.—Messrs. Holophane, Ltd., 12, Carteret Street, Queen Anne's Gate, London, S.W.—New 84-page trade catalogue, containing illustrations of a wide range and variety of Holophane electric light fittings. Many excellent designs are given of brackets, office lighting standards, semi-indirect fittings, reflector bowl pendants, ceiling fittings, Excellite glassware pendants, sphere pendants, and electroliers with Holophane glassware. Sizes, prices, and finishes are indicated.

The British Thomson-Houston Co., Ltd., 77, Upper Thames Street, London, E.C.—New complete lamp price list (No. L 10,100) of 48 pages. This is, however, not merely a price list for it contains a great deal of data and tables respecting Mazda lamp characteristics, which should be useful to those interested in such matters. Forty-nine distinct types of Mazda lamp with tungsten filaments are now listed for various voltages, wattages, &c., for all classes of service. B.T.H. carbon lamps in the standard, radiator, and decorative types are also included. Half-tone photographic views show examples of interior lighting of shops, restaurants, business premises, theatres, &c.

Messrs. G. St. John Day (Patents), Ltd., Bank Mill, Morton Street, Oldham.—Illustrated pamphlet containing particulars and wiring instructions respecting the One-part lampholders and adaptors, the "Daybreak" switchholder, and the "Kombyn" insulation lampholder.

Liquidation.—Renew Electric Lamp Co., Ltd.—A meeting is called for March 29th, at 6, Old Jewry, E.C., to hear an account of the winding up from the liquidator, Mr. J. E. Percival.

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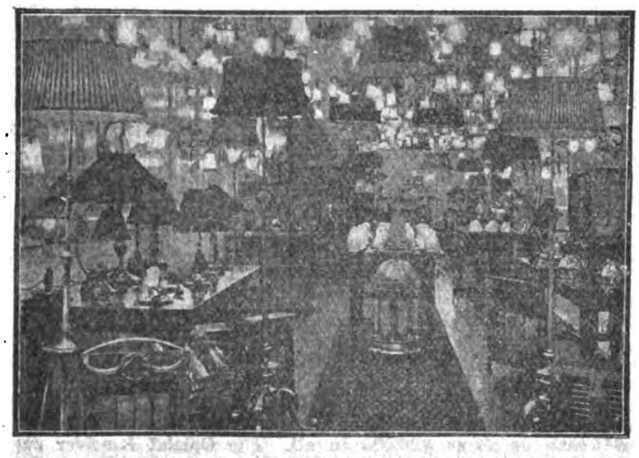
Ediswan Showrooms in Australia.—The accompanying picture shows the interior of the Melbourne showroom of the Edison and Swan United Electric Light Co., Ltd. Notwithstanding all the difficulties of shipping in these days, the company is enabled to make there a very useful collection of articles of such classes as find a sale in our Australian Colonies. The company has made a special study of the requirements of this particular market. It will be remembered that one of the directors recently made a tour of the Colonies in the company's interests, and such visits are exceedingly helpful in enabling a company to follow a line likely to fit in with the desires of our kith and kin. The stocks at Melbourne are being added to continually as new lines come along. The photograph shows such familiar lines as luminous radiators, Bastian heaters, fans, and Holophane glassware. There is not the slightest doubt that the demand for British electrical manufactures in Australia is very large at present, and the company



Ediswan Showrooms at Melbourne.

has chosen the right moment for extending its activities in that market. The anti-German movement there is so strong, and writers and statesmen alike have been so thorough-going in their dealing with enemy companies, that the opportunity for our firms to do increasing trade is bound to be better than it has ever been before. Many of our electrical and allied firms already have branches in Australia, &c., and the Edison & Swan Co. has branches in Melbourne (368, Little Collins Street), Sydney (58, Clarence Street), Brisbane (32-4, Adelaide Street), and sub-agencies in Adelaide and Perth, as well as agents in seven towns in New Zealand (Wellington, Napier, Auckland, Gisborne, Christchurch, Invercargill and Dunedin), where Ediswan branded or agency goods may be obtained. The company also has its agents in Johannesburg, Malay and the Straits Settlements, and in India and Burmah.

Trade Announcements.—Mr. J. Martin Blair has removed to Central House, Kingsway, W.C.

The offices of the E. I. Hill Advertising Service have been removed to 26, Stanton Road, Wimbledon, S.W.

Messrs. Ernest G. Denner & Co., electrical engineers, of Sheffield, have removed from 150, West Street, to 284, Glossop Road.

Messrs. W. M. Wilson & Co., 19, Waterloo Street, Glasgow, have been appointed sole selling agents in Scotland for the Wells Electrical Co., London, who represent in the U.K. the Compagnie Française de Charbons pour L'Electricité.

Prices Advance.—The Benjamin Electric, Ltd., of Rosebery Avenue, E.C., have issued a notice respecting further advances in prices of a number of their manufactures.

For Sale.—Walsall Electricity Supply Department has for disposal two Bumstead & Chandler 250-h.p. steam engines, direct coupled to d.c. generators; one ditto 14 b h.p. engine, coupled to forced draught fan; glass accumulator cells; four switchgear panels and three transformer panels. See our advertisement pages to-day.

LIGHTING AND POWER NOTES.

Aberdeen.—The engineer's monthly statement shows that during January 1,366,600 units were generated, an increase of 135,990 units, as compared with the corresponding month last year.

Argentina.—The Electric Light Co., of Mar del Plata, recently threatened to suspend the service owing to the municipality having dishonoured a promissory note in its favour for $50,000 m/a.

The inhabitants of San Jenaro (Province of Santa Fé) are contemplating the establishment of an electric lighting service in that town.—*Review of River Plate.*

Australia.—The Bundaberg (Queensland) Gas and Coke Co., Ltd., has been authorised to supply electricity for a period of 25 years within an area in the shire of Woongarra.—*Tenders.*

Aylesbury.—L.G.B. Inquiry.—The L.G.B. has informed the U.D.C. that an inquiry will be held into the application for sanction to a loan of £325 for electricity purposes.

Barton-on-Humber. — Street Lighting. — The Council has declined to pay the electric supply company's account for the past half-year's lighting amounting to £140, as owing to the lighting restrictions the lamps have not been lit for some time. The Council offers 50 per cent. in settlement, but this the company has refused, demanding 90 per cent. and threatening proceedings. The Council has decided to ask the L.G.B. for advice on the subject, and suggested that legislation should be introduced to deal with such matters. It is interesting to note that the Clerk to the Council is also secretary to the Electric Supply Co.—*Yorkshire Post.*

Bellingham.—Proposed E.L. Scheme.—The Council has approved of a proposed electric lighting scheme for the district.

Bingley.—The question of increasing the price of electricity for lighting has been deferred for 12 months.

The electrical engineer has been instructed to proceed with the wiring of the firemen's bells, in accordance with his estimate and the agreement with the Bradford Corporation as to the use of the tramway posts.

Birmingham.—Rate Aid.—The Electricity Supply Committee's contribution to the rate fund, for the year ending March 31st next, is to be £25,000, as against £35 000 last year, due to the increased price of materials and labour; the Tramways Committee will contribute £50,000, as against £30,000 last year.

Coal Shortage.—According to the *Morning Post*, the Corporation generating station practically ran out of coal on Monday, and as a result it was found necessary to suspend the tramway service for an hour or two, the cars being left standing in the streets pending the resumption of supply.

Blackpool.—The aggregate output of the electricity supply department during the past 10 months was 4,077,170 units, a decrease of 322,090 units, as compared with the same period last year. The effect of the lighting restrictions is shown by the great decrease during January in the amount of electricity supplied for public lighting. Last month the output under this head was only 2,000 units, compared with 15,868 units in January, 1915; 214 new consumers have been added during the last 10 months.

Bolton.—Owing to the numerous applications received for electricity for power, a Special Committee has been appointed to consider the whole question of capital expenditure with the Finance Committee.

Bradford.—The Electricity Committee has authorised an extension of mains from Apperley Bridge transformer chamber, across the bridge to the city boundary (including additions to the transformer chamber), at a cost of £400, and the sealing of an agreement for bulk supply to the Yorkshire Electric Power Co. through this extension. The Committee has approved a supplemental agreement with Messrs. Roby, Clifford & Co. and Mr. Wilfred Turner for the continuance of a bulk supply to Station Mill, Wyke. The Committee has also decided that the system at present in operation for obtaining cables from the British Insulated and Helsby Cables, Ltd., be continued for a further 12 months from April 1st next, and thereafter until further instructions are given in the matter.

Continental.—Italy.—The Government is making efforts to extend the use of water-power for the production of electrical energy in substitution for coal, for the supplies of which Italy is entirely dependent on importation; and a decree has been issued authorising the Minister of Finance to extend concessions for the diversion of watercourses without the formality of submitting the question to technical authorities for report, provided the rights of third parties are respected.—*B. of T. Journal.*

Experiments are being made on Italian railways with electrically-driven cranes for loading coal into engine-tenders. At Florence an Italian-built crane was employed in these trials, and at Naples a crane similar to those used on Prussian railways. The cranes are mounted on trucks and are each worked by two motors. The coal is brought in small trucks holding between 500 and 750 kg., and these latter are lifted bodily and their contents emptied into the tenders. The time taken in this operation is between four and eight minutes, three men being employed, the current required being 0·08 kw.-hour per ton.—*Industria e Invenciones.*

Dublin.—Cottage Lighting.—Reports of the Corporation Housing Committee contain estimates for the lighting of proposed working men's dwelling houses by electricity. In the North Lotts area the estimate for 201 houses (847 points) in the first section, is £1,143; second section, 245 houses (933 points), £1,259; and third section, 91 houses (387 points), £522. In the Newfoundland Street area the estimate for 125 houses (355 points) is £479; second section, 61 houses (305 points), £411; and third section (449 points), £673.

Epsom.—The U.D.C. on February 22nd decided to increase its charges for current as under:—Private houses and business premises, 7d. per unit; power, flat rate of 3½d. and on the sliding scale with a minimum of 1½d. for 3,000 units; public lighting, 4½d. per unit.

Heston and Isleworth.—Loan Application.—Application is to be made to the L.G.B. by the District Council for sanction to borrow £175 for mains extensions.

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Huntingdon.—Refuse Destructor.—A L.G.B. inquiry was held, on February 22nd, into the application of the T.C. for sanction to a loan of £1,800 for the provision of a refuse destructor, which, it is estimated, will effect a saving of £100 a year. There was opposition only with regard to the proposed site, but the Inspector intimated that a loan would not be granted unless the Board was convinced that the destructor was an absolute necessity.

Ilford.—New Tariffs.—The Council proposes to adopt revised tariffs for electricity supply, which will be subject to the war increase of 12½ per cent. Included are a rateable value tariff of 12½ per cent. per annum, plus ¾d. a unit, flat and maximum demand rates, a sliding scale for power and special rates.

India.—Electrical Pumping.—The Bangalore Municipal Commissioners have decided to electrify the pumping plant at the waterworks, for which purpose electricity is to be taken from the Cauvery Falls power station.—*Indian Engineering.*

Ipswich.—Price Increase.—The T.C. has increased the price of current for lighting from 4½d. to 5d. per unit, and the tariff for heating, cooking, power, &c., by 15 per cent., making 25 per cent. advance since June, 1915, while rebates in connection with the charges for supply through prepayment meters have been abolished.

Kingston-on-Thames.—The T.C. has increased the price of current supplied to the Thatched House, Richmond Park from 7½d. to 8d. per unit.

Leeds.—Proposed Price Increase.—An increase of 10 per cent. in the charges for the supply of electricity, as from March 31st to the end of March 31st, 1917, is to be proposed at the next meeting of the City Council.

Leigh.—Proposed Loan.—The T.C. has decided to apply to the L.G.B. for sanction to the borrowing of £18,300 for extensions to the electricity undertaking; £65,713 has already been expended on the undertaking.

London.—Woolwich.—A letter has been received from the L.C.C., with regard to the B.C.'s application for a loan of £8,622 for mains, transformers, switchgear and apparatus, stating that the Finance Committee had agreed to recommend sanction to the borrowing of £3,290 only subject to Treasury approval, deducting certain expenditure which has taken place since restrictions were imposed. The Finance Committee has considered the borough electrical engineer's report as to the deficiency on the undertaking for 1914-15, and has asked for the observations of the B.C. upon the financial condition of the undertaking as disclosed by the accounts. The B.C. has decided to accept the reduced sanction, and to charge the £332 to revenue account.

The Charing Cross, West End, and City Electric Supply Co. is applying to the Board of Trade for its consent to an increase of 10 per cent. on the charges for lighting during the period of the war and for 12 months afterwards or for such period as the Board may determine.—*Standard.*

Londonderry.—According to the *Londonderry Sentinel*, at a mayoral luncheon held last week, in the course of the speeches, it was announced that the profit on the electricity department this year would be probably £2,000. The chairman of the Lighting Committee announced that the output had increased by 21 per cent. and the revenue by over 30 per cent. in 1915, as compared with 1914. The L.G.B. had sanctioned a loan for new plant, which would result in a saving of £750 a year on coal, and enable them to increase the output by 70 per cent. Through the action of a small Committee a saving of £800 had been effected in purchasing coal recently.

Maidstone.—Price Reduction.—From April 1st the charge for current for heating purposes will be reduced to 1d. per unit by the T.C.

Plymouth.—Quarterly Return.—The return of the electricity undertaking for the quarter ended December last shows that on the Prince Rock section 1,044,834 units were sold, producing an estimated revenue of £11,136 as against 888,996 units and £9,297 in the corresponding period of the previous year. At the Newport Street works 785,089 units were sold, producing £7,469, as against 718,545 units and £6,587 in the last quarter of 1914.

Portishead.—The Clevedon, Portishead and District Electric Supply Co. has applied to the B. of T. for consent to use overhead lines at Long Ashton.

Salford.—The T.C. is making application to the L.G.B. for further sanction to borrow £2,016 to cover capital expenditure in connection with the electricity undertaking in respect of loans sanctioned by the Board prior to March 12th last. Agreements are to be entered into with four firms for the supply of current. The Electricity Committee has accepted the offer of Messrs. Maden and McKeen to purchase and remove two of the existing old engine generating sets at the Frederick Road station for £2,500, also the offer of Messrs. Andrew Knowles & Sons to supply 500 tons of Trencherbune slack at 16s. 8d. per ton.

Shipley.—Price Increase.—In consequence of the increased prices of materials which are being paid by the electricity department, it has been decided that from April 1st next all charges for electricity for power purposes, not covered by special agreement, shall be advanced 10 per cent.

Stirling.—A further sum of £1,000 is to be borrowed for the purpose of defraying capital expenditure in connection with the electric lighting undertaking. The Corporation already possesses the necessary powers to borrow this sum.

Sunderland.—Price Increase.—The Electricity Committee has decided to recommend the Council to advance the charge for electricity for lighting purposes by the equivalent of a farthing per unit, commencing from April 1st.

Tasmania.—The Hobart City Council has adopted the following schedule of charges for electric power. Under Schedule A, 4s. per month per B.H.P. installed plus 1d. per unit used, with a discount of 0·4d. per unit for prompt payment; under Schedule B, 4d. per unit for the first 25 units per quarter, and 3d. per unit for all over 25 units, with a discount of 1d. per unit. Under Schedule C, the charge for connected loads of 100 H.P. up to 500 H.P., to be 4s. per month per B.H.P. installed, plus ½d. per unit used, with a discount of ¼d. per unit. The chief engineer of the hydroelectric department wrote, stating that the Government proposed for the purpose of encouraging the establishment of new industries in Tasmania, to charge half the schedule rates for electric power supplied to any new enterprises for the first 12 months, and asked if the Council was prepared to make a similar concession.—*Hobart Mercury.*

Todmorden.—Proposed Loan.—The T.C. has decided to apply for sanction to spend £2,200 on boiler plant for the electricity works.

Uruguay.—The new electric light service at Punta del Este, a seaside resort, was formally inaugurated last month.

Wimbledon.—The Electricity Committee has authorised an arrangement with Messrs. E. Brook, Ltd., for the hire-purchase of motors which might be hired to consumers in the Council's area.

The Council has approved of revised agreements for supply to the Foster Engineering Co. and Messrs. Stevenson & Sons, a coal clause being incorporated.

TRAMWAY and RAILWAY NOTES.

Australia.—A progress report by the Railway Commissioners, on the suburban railway electrification, mentions that No. 1 boiler house, with 12 boilers, stoking, ash and coal-handling appliances, are expected to be completed in a few months; a section of the condensing plant, manufactured locally, is finished, and two turbo-alternator sets are well in hand. A portion of the 20,000-volt transmission cable is in position; the Jolimont car-shed is practically complete; the rolling-stock equipment is being carried out, and a commencement has been made in equipping sub-stations. The Commissioners are unable to give any idea as to when the scheme will approach completion.

Blackpool.—It is proposed to discontinue the parcels express service on the tramway cars as from April 1st, the service, which has had 12 months' trial, not being a success.

Bradford.—As an outcome of consideration of recommendations of the Executive Council of the Municipal Tramways Association regarding the question of the indispensability of certain sections of employés on tramways, the Tramways Committee has passed a resolution: "That having regard to the severe gradients on certain sections of the Bradford tramway system the Committee deem it necessary, in the interests of public safety, that not less than one-third of the staff of male conductors be retained in the service of the department." After somewhat protracted negotiations the employés of the tramway department have accepted the offer of a war bonus equal to an increase of about 3s. a week on the old rates, but have done so under protest. The 20 women conductors are giving satisfaction, and the manager has been given authority to engage 40 more women as conductors.

Brighton Railway Electrification.—The chairman, at the recent annual meeting of the company, referred to the progress of the electrically worked suburban lines of the company, new work on which, he pointed out, had been temporarily suspended for a time, but was now being steadily carried on with a view to completing at least a part of the scheme by the time normal conditions returned.

He stated that the existing electrical services were working most satisfactorily and giving excellent results. Recent statistics showed that last year there was an increase in the number of passengers carried by those services of nearly 70 per cent. over those carried in the last years of steam traction, and since their inauguration five years ago over 40 millions more passengers had been carried by them. The increase still continued as was demonstrated by the fact that the number carried last year was 15 per cent. higher than in 1914; this meant that there was a considerable addition to the daily suburban traffic. The contract for electrification was now in the hands of the Metropolitan Carriage and Waggon Co., and Messrs. R. W. Blackwell & Co.

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Burnley.—Plant Inauguration.—To-morrow the new 6,600-volt three-phase plant, including turbine plant and a rotary converter sub-station, installed at a cost of £26,000, is to be officially started up.

Continental.—Spain.—The small horse-tramway system uniting Irun and Fuenterrabia, 5,100 metres in length, is to be electrified. The two towns have together a population of 18,000 only, but the latter town is much frequented by foreigners in the summer season.—*Industria e Invenciones.*

Croydon.—Wages.—The Tramways Committee has received a letter from the Chief Industrial Commissioner respecting an application made by the Union of Licensed Vehicle Workers in regard to wages and working conditions, asking whether the Corporation is willing to concur in the reference of the matter to arbitration. The Tramway Committee estimates that these requests would involve an additional payment in wages amounting to close on £10,000 a year. Under the circumstances, the Committee has now recommended the Corporation to inform the Commissioner that it is not willing to agree to his proposal.

Dublin.—At the annual meeting of the Dublin and South-Eastern Railway Co., Mr. P. H. Grierson suggested that negotiations be opened with the Dublin United Tramways Co., with a view to the electrification of the railway line between Dublin and Bray (Wicklow).

Glasgow.—Electric Vehicles.—It is proposed that a deputation of the Cleansing Committee of the T.C. shall visit Birmingham, Sheffield and Dover for the purpose of inspecting at work the electric vehicles now in use in those towns for refuse collection, before submitting a final proposal to the T.C.

There are now 1,180 women conductors and 25 women drivers on the Corporation tramway cars.

Leeds.—Wages.—The General Purposes Committee has decided not to recommend any further increase of the war bonus to tramway workers except in special cases; it has also decided not to alter the terms of employment of women conductors.

London.—The Board of Trade has extended the period for the exercise of compulsory purchase of lands, &c., under the London Electric Railway Act, 1913, by one year.

Newcastle-on-Tyne.—An extension of the Corporation tramway system to Benton was opened on Friday, last week, and a ten-minutes' service will be given. In connection with the above, a motor-'bus service will run from Benton to Annitsford Bridge.

North London Electrification.—Lord Rathmore, at the annual meeting of the North London Railway, stated that it was hoped by September next to work the present service between Broad Street and Kew and Richmond by means of electric trains, but probably not the more frequent service they intended ultimately to supply. The scheme forms part of the greater suburban electrification scheme of the North-Western Railway.

North Staffordshire Railway.—In the course of his speech at the annual general meeting of the above company, the chairman mentioned that the electric haulage in the Harecastle tunnel, on the company's canal system, had been working very satisfactorily indeed. The average number of boats towed by the tug was eight, and it was a question whether they would not provide a duplicate tug to ensure that traffic should not suffer from a breakdown.

South-Western Railway Electrification.—At the annual meeting of this company it was stated that the expenditure on the electrification of the suburban lines, up to the end of 1915, was £970,000. It was hoped to commence the Hounslow service early in March. Owing to the delay in the delivery of the machinery for the completion of the power house, it would probably be three or four months before the service to Hampton Court and Claygate was electrified, thus completing the present scheme. Comparing the week just prior to the opening of the "roundabout" electric service with the second week after the service commenced, there was shown an increase of 16 per cent. in the bookings.

Wolverhampton.—On Friday last, owing to the shortage of street labour, the services of the recently-formed Women's Volunteer Reserve were obtained to dig out the tramway cars which were snowed up during the previous night and day.

TELEGRAPH and TELEPHONE NOTES.

Aeroplane for Line Repairs.—An aeroplane was employed in the restoration of telephone service destroyed by the recent floods at San Diego, Cal. It carried a rope across the flooded district, and with the rope a telephone cable was hauled through the water, thus enabling a connection to be made between the broken lines.—*T. and T. Age.*

Canada and U.S.A.—Marconi's Wireless Telegraph Co. announces that deferred plain language telegrams, night, and week-end telegrams can now again be accepted for Canada and the United States.

Spain.—The Spanish authorities have seized a secret wireless station at San Felix de Guixols, in Catalonia.—*The Times.*

United States.—The Federal District Court of New York upheld on January 7th the Atlantic Communication Co., the German-American concern operating the wireless station at Sayville, L. I., in its contention that it was not infringing upon patent rights held by the National Electric Signaling Co. The suit begun against the German company was dismissed. The National Electric Signaling Co. holds patent rights to radio inventions by Prof. R. A. Fessenden, and in his opinion Judge Mayer held that certain claims in the Fessenden patents were invalid. The Court declared that Dr. Lee de Forest had worked out the musical-toned receiver to a commercial possibility, and was operating stations in New York while Fessenden was still experimenting.—*Electrical World.*

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—March 11th. U.D.C. Electrical stores for 12 months. See "Official Notices" February 18th.

Australia.—Sydney.—May 1st. Two 300-kw. turbo-alternators, condensers, switchboard, &c., for the pumping station at Ryde, for the Metropolitan Board of Water Supply and Sewerage at Sydney.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-kw. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.*

Barrow-in-Furness.—March 6th. Corporation. Electrical stores for 12 months. Borough Electrical Engineer.

Belfast.—March 15th. Tramways and Electricity Committee. Stores, including a number of electrical items. See "Official Notices" February 25th.

Birkenhead.—March 6th. Corporation. Cable and two rotary converters with switchgear. See "Official Notices" February 1st.

Bolton.—March 6th. Tramways Committee. Stores, including lamps, carbons, &c. See "Official Notices" Feb. 25th.

Burnley.—March 20th. Electricians' work, for the B. of G. Mr. J. S. Horn, Clerk.

Dundalk.—March 21st. U.D.C. Engine-room stores, cables, lamps, &c., for the Electricity Department. See "Official Notices" February 25th.

East Ham.—March 10th. Corporation. Twelve months' supply of engineers' sundries, for the Electric Lighting and Tramways Department. Town Clerk.

Edinburgh.—March 13th. Corporation. Structural steelwork at the new electric generating station, Portobello. Sir Alexander B. W. Kennedy, 17, Victoria Street, S.W.

Heston and Isleworth.—March 11th. U.D.C. Electrical supplies, including cables, meters, &c. See "Official Notices" February 25th.

Heywood.—March 15th. Electricity Committee. Stores, including some electrical items, for 12 months. See "Official Notices" February 25th.

Ilford.—The Tramways Manager does not think it advisable to obtain tenders this year for annual supplies. He suggests obtaining one or two prices as and when articles are required and accepting the most favourable, excepting cases where the amount exceeds £50.

London.—Kensington.—March 8th. B. of G. Six months' supply of electric fittings, lamps, &c. Clerk, Guardians' Offices, Marloes Road, W.

L.C.C.—March 10th. Asylums and Mental Deficiency Committee. Electrical sundries. Mr. H. F. Keene, Clerk, 6, Waterloo Place, S.W.

Manchester.—March 7th. Electricity Committee. Additional tanks for feed-water softener, Stuart Street station. Chief Electrical Engineer, Dickinson Street.

Newport (Mon.).—March 4th. Corporation. Twelve months' supply of stores and materials for the Electricity Committee. Mr. A. N. Moore, Borough Electrical Engineer.

New Zealand.—Dunedin.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.*

Pontypridd.—March 13th. U.D.C. Twelve months' supply of electrical stores for the Electric Light and Tramways Department. See "Official Notices" February 18th.

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Salford.—March 4th. T.C. Two 1,000-KW. and one 500-KW. rotary converters and two water-tube boilers. Borough Electrical Engineer.

Spain.—The municipal authorities of Alcublas (Province of Valencia) have lately invited tenders for the concession for the electric lighting of the town during a period of 20 years.

Swansea.—March 6th. Education Committee. Electric lighting installation at Brynmill and Cwmbwrla Council Schools. See "Official Notices" February 18th.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Australia.—The following tenders have been accepted :—

P.M.G.'s DEPARTMENT, SYDNEY.

200 miles of twisted-pair distributing wire, £3,800.—Western Electric Co. (Aust.), Ltd.
50 miles of rubber-insulated conductor wire, £478.—W. T. Henley's Telegraph Works Co., Ltd.

P.M.G.'s DEPARTMENT, SOUTH AUSTRALIA.

30 miles of rubber-insulated tinned-copper wire, £278.—W. T. Henley's Telegraph Works Co., Ltd.

METROPOLITAN BOARD OF WATER SUPPLY AND SEWERAGE, SYDNEY.

Centrifugal pumps and electric motors at Marrickville, £3,614.—Gibson, Battle & Co. —*Australian Mining Standard.*

VICTORIAN RAILWAYS.

50-ton electric overhead travelling crane, including longitudinal conductors, for Ballarat workshops, £2,160; ditto, for Bendigo workshops, £2,160; 50-ton ditto, for Ballarat workshops, £1,575; 10-ton ditto, £922; ditto, for Bendigo workshops, £927; ditto, for Ballarat workshops, £927.—Stothert & Pitt.
Half-watt lamps, lanterns, &c.—Aust. General Electric Co., and I.R., G.P. and Telegraph Works Co., at rates. —*Tenders.*

Aylesbury.—U.D.C. Fuel oil (22 tons) for the electricity works : Anglo-American Oil Co., Ltd.

Bexhill-on-Sea.—T.C. Accepted tenders :—

Fan-housing for induced-draught plant at the electricity works.—Sturtevant Eng. Co., £155.
Pump.—G. & J. Weir, £82.

Bradford.—Guardians. Recommended tender : Maintenance of electrical installation at the Hospital, £15 a quarter, Mr. Chas. Bell.

Derby.—T.C. Tenders accepted :—

Two electric omnibuses, £2,266.—Edison Accumulators, Ltd.
Coal for the electricity works.—Parr & Sons ; Mr. T. Walker ; Brookhouse, Johnson, Ltd. ; Derby Coal Co., Ltd. ; Hall's Collieries, Ltd.

Ilford.—The D.C. Electricity Committee is extending the present contracts for annual supplies for 12 months as follows :—

House-service fuse-boxes.—W. Lucy & Co., Ltd., 25 per cent. increase.
Joint-boxes.—W. Lucy & Co., Ltd., 4 per cent. increase or decrease with every 10 per cent. variation in the ruling price of pig-iron.
Incandescent lamps.—Cryselco, Ltd. ; Electrical Mfg. & Supplies ; and London and Rugby Engineering Co., Ltd , on present terms.
Meters.—Ferranti, Ltd., and Electrical Apparatus Co., Ltd., at present ruling prices as quoted. The B.T.H. Co. decline to enter into a contract for 12 months ; orders will therefore be placed for their type of meter as required.
As regards house-service fuse boxes, no reply has as yet been received from J. H. Tucker & Co. as to whether they are willing to continue the contract or not.
Messrs. Foster & Co. are to supply 5,400 tons of Ibstock medium peas coal at 20s. 2d. per ton, and 1,500 tons each of Ibstock D.S. nuts and slack at an average price of 18s. 0½d. per ton, over a period of 12 months.

Glasgow.—The Tramways Committee recommends acceptance of the following offers :—

Galvanised-steel wire.—John Stewart & Co., Ltd.
91/18 cab tire cable.—St. Helens Cable Co., Ltd.
Tubes for canopy rods.—Stewarts & Lloyds, Ltd.
Three-core cable, ozone-proof cable, and asbestos-covered wire.—B.I. and Helsby Cables, Ltd.

Liverpool.—Recommended tenders for supply of materials for the Electric Supply Department :—

Insulated cables and wires.—Liverpool Electric Cable Co. ; St. Helens Cable & Rubber Co.
Electric meters.—Ferranti, Ltd.
Carbon-filament lamps.—Edison & Swan Co.
Metallic-filament lamps.—Pope's Electric Lamp Co.
Stoneware troughing, insulators, &c.—Middleton Fireclay Works : Doulton and Co. ; J. G. Beard & Co., Ltd. ; Callender's Cable Co. ; J. Bourne and Sons ; J. Evans (Liverpool) ; Liverpool Building Material and Cement Co., Ltd.
Electric fittings and sundries.—Sykes & Sugden, Ltd. ; British Electric Calibrated Fuse Co.
Cables and accessories for street mains.—Callender's Cable Co.
Cast iron troughs and boxes for street mains.—Whyman's Foundry Co.
Lubricating oils.—Spurrier, Glazebrook & Co., Ltd. ; Vacuum Oil Co.

For the Tramways Department :—

Iron castings.—Moston Malleable Castings Co. ; National Rail & Tramway Appliances Co. ; Interchangeable Brake Block Co. ; Jas. Allan, sen., and Son ; John Needham & Sons.
Steel gears and pinions.—F. W. Rowlands & Co.
Lubricating oils and greases.—Vacuum Oil Co. ; C. C. Wakefield & Co.

London.—ISLINGTON.—Lighting Committee. Accepted tenders for annual supplies :—

Cable terminal service and network boxes, tapes, and iron castings.—Callender's Cable Co. ; Lucy & Co. ; Sykes & Sugden ; J. Gibb & Co. ; Dussek Bitumen Co. ; Henley's Tel. Works Co. ; I.R., G.P. and Tel. Works Co , Ltd.
Electrical sundries, lamps, &c.—Goodman & Co. ; Cryselco Co. ; Edison and Swan Co.
Cables.—B.I. and Helsby Cables, Ltd.
Meters.—Chamberlain & Hookham ; British Westinghouse Co.
Earthenware pipes, insulators, troughs, fire bricks, &c.—Young & Sons ; Turner & Lisney, Ltd. ; Knowles & Co. ; Doulton & Co.
Transformers and c.i. tanks.—British Electric Transformer Co. ; Sheepbridge Coal & Iron Co.
Arc lamp globes.—Goodwin & Co.
Oils and lubricants.—Vacuum Oil Co., Ltd.

Manchester.—Tenders accepted by the Tramways Committee :—

J. Mackie & Son (agents for the Cornish Tin Smelting Co., Ltd.).—Block tin.
Daimler Co., Ltd.—Four motor-'bus chassis.

By the Electricity Committee :—

Strachan & Henshaw, Ltd.—One Telpher ash-handling plant.
W. T. Glover & Co., Ltd. ; Chas. Macintosh & Co., Ltd. ; and B.I. and Helsby Cables, Ltd.—Supplies of cable.
Newton, Chambers & Co., Ltd.—Hot-well tank and water piping.

The E.C. has consented to the substitution of the name of the British Westinghouse Electric and Manufacturing Co., Ltd., for that of Brown, Boveri & Co., Ltd. (London), as sub-contractors for a 15,000-KW. alternator.

The Gas Committee has accepted the tender of Mr. R. Carlyle, Manchester, for the erection of a power house for electrical plant.

Midland Railway Co.—Pope's Electric Lamp Co., Ltd., has secured a renewal of its contract for the supply of "Elasta" wire lamps and carbon-filament lamps to this company.

New Zealand.—The following tenders have been accepted by the Public Works Department, Wellington :—

Transformers.—Section 53, £949, India-Rubber, G.P. and Telegraph Works Co., Ltd. ; Section 54, £705, and Section 55, £572, Tolley & Sons.
Insulators.—Section 56, £474, National Electrical and Engineering Co. ; Section 57, £210, and Section 58, £210, India-Rubber, G.P. and Telegraph Works Co. —*N.Z. Shipping and Commerce.*

Salford.—Messrs. Maden & McKee, Liverpool, are to purchase and remove two of the old generating sets at the Frederick Road station for £2,500. Messrs. Andrew Knowles and Sons are to supply 500 tons of Trencherbone slack, at 16s. 8d. per ton, delivered.

FORTHCOMING EVENTS.

Greenock Electrical Society.—Friday, March 3rd. At 7.45 p.m. At the Temperance Institute, 19, West Stewart Street. Paper on "The Life of Sir Charles Wheatstone," by Mr. A. R. Macaulay.
Saturday, March 11th. Visit to Greenock Gas Works.

Royal Institution of Great Britain.—Friday, March 3rd. At 5.30 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Corona and other Forms of Electric Discharge," by Prof. Silvanus P. Thompson, F.R.S.
Saturday, March 11th. At 3 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Radiations from Atoms and Electrons," by Prof. Sir J. J. Thomson.

Salford Technical and Engineering Association.—Saturday, March 4th. At 7 p.m. At the Royal Technical Institute. Paper on "Arrangement and Efficiency of Boiler Plants," by Mr. P. D. Kirkman.

Institution of Civil Engineers.—Tuesday, March 7th. At 5.30 p.m. At the Institution, Gt. George Street, S.W. Address on "Industrial Development," by Mr. Harold Cox.

Röntgen Society.—Tuesday, March 7th. At 8.15 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Discussion on "The Injurious Effects produced by X-rays." Paper on "The use of Inverse Current," by Mr. A. C. Gunstone.

Association of Engineers-in-Charge.—Wednesday, March 8th. At 8 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Lubrication in Practice," by Mr. H. W. Pretty.

Royal Society of Arts.—Wednesday, March 8th. At 4.30 p.m. At John Street, Adelphi, W.C. Paper on "Optical Appliances in Warfare," by Mr. C. R. Darling.

Institution of Electrical Engineers.—Thursday, March 9th. At 8 p.m. At Victoria Embankment, W.C. Paper on "Continuous-current Railway Motors," by Mr. E. V. Pannell.

(**Manchester Local Section**).—Wednesday, March 8th. Joint meeting with the Liverpool Engineering Society. At the Royal Institution, Colquitt Street, Liverpool. Paper on "The Modernising of an Electric Power Supply Undertaking," by Mr. E. M. Hollingsworth.

(**Yorkshire Local Section**).—Wednesday, March 8th. At 7 p.m. At the Philosophical Hall, Leeds. Paper on "Hire and Maintenance of Continuous-current Motors," by Mr. H. Joseph.

Manchester Association of Engineers.—Saturday, March 11th. At the Grand Hotel, Aytoun Street. Paper on "India-rubber and Balata Belting as Conveyer and Power-transmission Belts," by Mr. J. Tinto.

NOTES.

The Batti-Wallahs' Society.—In spite of the bad weather, a hundred Batti-Wallahs and their friends gathered together at the Victoria Mansions Restaurant for an informal evening on Friday last. Lieut. Haydn T. Harrison (president) was in the chair, and Mr. W. Riggs (past president) was deputy chairman. A large proportion of the assembly were clad in either blue or khaki. One of the party, Major Spittle, late of the G.W.R. electrical department, had only the previous evening returned from Flanders on short leave. One of the chief features of the programme was the Batti-Wallah Band, an original turn arranged by Mr. F. J. Collis, assisted by Messrs. Ireland, Beevor and Hornby.

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Institution and Lecture Notes.—Petrol, Steam and Electric Vehicles.—A paper on the above subject was read recently by Mr. G. Martin Gamble before the Yorkshire Association of Students of the Institution of Civil Engineers, at Sheffield. The author referred to the increased daily radius of motor as compared with horse transport, pointing out the saving in handling of goods by the use of the latter in preference to the railway for short distances. As regards steam traction, he mentioned that the time taken in raising steam, withdrawing or banking fires and replenishing water tanks was equal to 50 10-hour days a year.

The paper contained statistics showing comparative estimated running costs, the figures including standing charges, interest 5 per cent. per annum, depreciation and insurance, but not management and establishment charges. Thus a rubber-tired petrol wagon of 2 tons capacity, on the basis of 40 miles a day would cost 8·7d. per mile run; a 3-ton wagon, 40 M.P.D., 11·2d.; a 4-ton wagon, 40 M.P.D., 11·7d.; a 5-ton wagon, 40 M.P.D., 12·8d. A rubber-tired steam wagon of 3 tons capacity, 35 M.P.D., would cost 10·6d. per mile run; and a 5-ton wagon, 30 M.P.D., would cost 13·9d. As against these figures, the author estimates the cost of operating a 2-ton electric vehicle 30 and 50 miles per day at 10·1d. and 7·8d. per mile run respectively; a 3½-ton vehicle, 45 M.P.D., at 10d.; and a 5-ton vehicle, 35 M.P.D., at 12·8d. per mile run.

Electric vehicle makers' estimates, comparable with the foregoing, show, for a 1½-ton vehicle, 32 M.P.D., 8·8d. per mile run; 2-ton vehicle, 40 M.P.D., 5·7d. and 5·1d. (two makers); 3½-ton vehicle, 40 M.P.D., 7·13d., and 45 M.P.D., 6·69d. (two makers); 5-ton vehicle, 35 M.P.D., 9·5d., and 40 M.P.D., 8·45d. per mile run (two makers). Figures of cost per ton-mile were also given, based on the data given above. The author admits the difficulty of producing really comparative data.

Institution of Electrical Engineers.—The special general meeting of corporate members, to consider the proposed alteration of the articles of association, for the purpose of excluding alien enemy members, was held on Wednesday last; the attendance was unexpectedly large, and included many members from provincial centres. The President moved the resolution, which was seconded by Mr. C. A. Baker. An amendment extending the scope of the resolution to all members of alien enemy origin was ruled out of order, on the advice of the hon. solicitor; other questions were raised with regard to the case of naturalised aliens who had not denaturalised themselves in their native country, with regard to the possibility of giving every member an opportunity to vote by means of a postal ballot, and with regard to the permanency of the exclusion after the war. The adjournment of the meeting was also moved, but not accepted by the President, and complaints were made that the meeting was farcical if no amendments could be considered. The President, who emphatically repudiated a suggestion that the Council was pro-German, explained that any change in the articles must first receive the approval of the Board of Trade, hence the impracticability of dealing with amendments to the resolution, which had been approved by the Board. The discussion was very animated, and several members who supported the resolution intimated that if it did not apply to naturalised aliens who had omitted to become denaturalised at home they would vote against it. On the other hand, it was pointed out that if the resolution were rejected a totally erroneous impression would be created outside the Institution, as the sense of the meeting was unmistakably in favour of the exclusion of alien enemy members. Eventually it was decided that the resolution should not be put to the meeting, but that a new meeting should be called, at which the resolution and amendments could be fully considered and a satisfactory resolution formulated, which would then be submitted to the Board of Trade for approval. The session occupied about 1½ hours.

Institution of Civil Engineers.—On Tuesday next the members will receive an address on "Industrial Development," by Mr. Harold Cox. In inviting Mr. Cox to address the Institution on this subject, the Council states, it considered that the present time calls for some earnest attention on the part of engineers to the economic issues which, after the war, must influence profoundly the future of engineering, as well as the industrial and commercial enterprises which are vital to its progress, both in this country and abroad.

Association of Mining Electrical Engineers.—In the course of a paper on "Some Coal-Cutting Difficulties," read at a meeting in Glasgow of the West of Scotland Branch of the Association, Mr. H. T. Mackinnon suggested that as coal-cutters demanded intelligence and experience in their operation, machine men when first engaged should be brought to the electrical engineer-in-charge for examination as to their ability to discharge the work. Experience had shown that there was no other class of machinery more certain to yield a return for its proper maintenance or to exact so severe a penalty for its neglect than the coal-cutter of the modern type. He emphasised the necessity for standardising plugs for machines and gate-end boxes.

The Yorkshire Branch of the Association, on Saturday last, paid a visit to the Frickley Colliery, South Elmsall, by permission of the Carlton Main Colliery Co., whose engineer, Mr. H. Elliott, prepared a paper describing the colliery and its plant.

Tramways and Light Railways Association.—The Association has decided to hold its Congress on Friday, June 30th, in order not to clash with the annual Conference of the I.M.E.A., which is provisionally fixed for Thursday and Friday, June 22nd and 23rd.

Volunteer Notes.—Engineering Institutions' V.E.C.—Orders for week commencing March 6th, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, March 6th.—Sections 1 and 2, Technical; Sections 3 and 4, Lashings and Trestle Bridging, Signalling Class and Recruits.

Tuesday, March 7th.—School of Arms, 6 to 7 p.m.

Thursday, March 9th.—Shooting for Sections 1 and 2, and Signalling Class.

Friday, March 10th.—Sections 3 and 4, Technical; Sections 1 and 2, Lashings and Trestle Bridging; Signalling Class and Recruits.

Saturday, March 11th.—Uniform Parade, 2.45 p.m.

At the Parade on Saturday, March 11th, members will parade with the 4th Batt. Central London Regiment, and will proceed by train to Woldingham, where they will be given an opportunity of inspecting the trench digging now being carried on there.

Members wishing to stay in camp on March 11th at Woldingham must give in their names at once.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, March 2nd, 1916:—

Week-end Parades.—Saturday.—The Battalion will parade at Wembley Park at 3.15 p.m. under Company Commanders.

Sunday.—First Sunday in the month—The Battalion, less North London Platoon, will parade at Wembley Park, at 10.45 a.m. for Field Operations. The North London Platoon will be attached to the 4th Batt. Herts. Volunteer Regiment, for these operations.

Mr. W. Ridd will be in command of the Battalion for these manœuvres. The Commandant and Adjutant are appointed Umpires.

Musketry.—There will be shooting at Bisley on Saturday next, the 4th inst. Members to Parade, in uniform, at 12.45 p.m., Waterloo Station, Platform No. 6, and to report themselves to Sergeant Cotter.

There will be no shooting at Acton.

A. G. Joiner, *Major and Adjutant*, O.B.C.

Appointments Vacant.—Chief assistant engineer (£200), for the Wallasey Corporation electricity department; shift engineer (£2), Borough of Rawtenstall electricity department. See our advertisement pages to-day.

Cedes Electric Traction, Ltd.—The petition of the Tudor Accumulator Co., Ltd., for the winding up of this company has been allowed to stand over for a fortnight.

A 2,000-KW. Motor-Generator.—There has recently been installed at station C of the Pacific Gas and Electric Co., Oakland, Cal., a 2,000-KW. motor-generator set, consisting of an 11,000-volt, three-phase, 60-cycle synchronous motor and a 275-volt, 2,000-KW. shunt-wound, commutating-pole generator.

To carry the full-load current, which is about 8,000 amperes and provide sufficient radiating surface, the commutating field poles were wound with soft annealed copper strips wound on edge and connected in parallel. It was impracticable to use solid conductors, because a cross-section of 8 sq. in. was required. On account of the current which had to be commutated and the high peripheral speed of the commutator the bars had to be arch-bound midway between each end by three shrink rings of high tensile strength. Both ends of the commutator, are bored to a slight taper and rest on similarly tapered steel rings held together by bolts. This construction allows the commutator bars to expand lengthwise when heated without distorting the shape of the commutator. On account of the length of the commutator a brush-holder yoke is placed midway of it and the brush forks are attached so that they extend towards each end. Even with this construction they are relatively long, so the forks were made of cast-iron to give rigidity and copper-plated to improve their conductivity.

All parts of the brush rigging are made comparatively heavy to absorb the small vibrations set up by the 250 brushes in the commutator. Box-type brush-holders are employed, which are split through the centre and hinged on one side, so that any holder can be removed without disturbing the others.

Each armature conductor consists of eight square wires in parallel, insulated from each other to reduce eddy current loss, which would be considerable with solid conductors of the cross-section required. The coils are insulated with mica, fish paper and cotton tape, which are hot-pressed and impregnated with an oil-proof and moisture-proof compound. Deflectors are attached to the front end of the commutator and the rear ends of the armature to force air past the current-carrying parts.

Although the rotating element of the set weighs 46 tons, only two bearings are used. Each pedestal is provided with a large oil reservoir, with openings to permit the circulation of air for cooling. The bearings are ring-oiled, but to ensure an adequate supply of oil the flooding system is used. Small gear pumps, belted to the shaft, carry oil from the reservoirs in the pedestals to the tops of the bearings.

This motor-generator set, while rated at 2,000 KW., occupies a floor space of only 13½ ft. by 21 ft., which is but slightly more than the space occupied by the 1,000-KW. sets of the same speed previously installed in the same station.—*Electrical World.*

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Swansea Electrical Showroom.—Through the courtesy of Mr. Burr, the borough electrical engineer, we are enabled to illustrate the palatial showroom recently opened by the Swansea Corporation electricity department. The premises which face the gas company's showrooms in the centre of the town, were originally used as a bank, and contain three large rooms, one of which—the showroom—we illustrate, while the others are used as a demonstration room and inquiry office respectively. It is proposed to hold weekly demonstrations in cooking, for which object

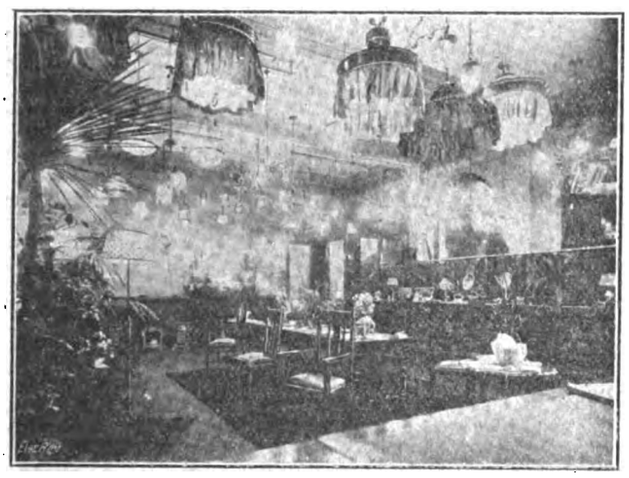


Photo: Chapman, [*Swansea.*

Swansea Electrical Showroom.

two lady assistants have been engaged; the room for this purpose accommodates 60 people. As stated in a previous issue, the showroom was opened by Col. Sinclair, chairman of the Electricity Committee, who pointed out that the chief object to be attained was to demonstrate to consumers, existing and prospective, the advantages of electricity in its various applications.

Re Adnil Electric Co., Ltd.—The creditors and shareholders of the Adnil Electric Co., Ltd., Adnil Building, Artillery Lane, Bishopsgate, E.C., against which a winding up order was made in October last, met on February 29th, at the Carey Street offices of the Board of Trade, Lincoln's Inn, W.C. Mr. H. E. Burgess, Official Receiver, reported that the company was registered in 1909, and was really a revival or reconstruction of a previous concern, entitled Marples, Leach & Co., Ltd.; it was formed for the purpose of picking up that business, then in the hands of a liquidator. It appeared that Marples, Leach & Co., Ltd., had been in existence for five years, but then failed owing some £7,500 on debentures and £24,000 to unsecured creditors. The greater part of the debts were due to the Bergmann Elektricitäts Werke, of Berlin, and under the liquidation of Marples, Leach and Co., the Bergmann Co. provided cash with which to pay off the debentures in full and to give the unsecured creditors a dividend of 7s. 9d. in the £. The Adnil Co. was then registered and purchased the stock of Marples, Leach & Co. from the liquidator. There was also some talk of a contract to purchase the goodwill of that business, and in the books of this company the Bergmann Co. was credited with £6,000 in respect of such goodwill, for the reason, apparently, that the Bergmann Co. were almost the only creditors of Marples, Leach & Co., Ltd. That sum of £6,000 was included in the present liabilities of this company, but in the absence of any contract or supporting document it could not be admitted to rank with the other debts. The nominal capital of the Adnil Co. was £10,000, divided into £1 shares; the whole of it had been issued, and with the exception of two holders of one share each the lot was held by the Bergmann Co., who accepted 7,300 shares in payment for goods supplied, and provided cash in return for the remainder. The company traded during the first two years of its existence at a small loss, but since then at a profit. During the year ended June, 1912, a profit of £638 was made, and in the following year the profit was £1,025, out of which a dividend of 5 per cent. was paid. Only a small profit was made during the year ended June, 1914.

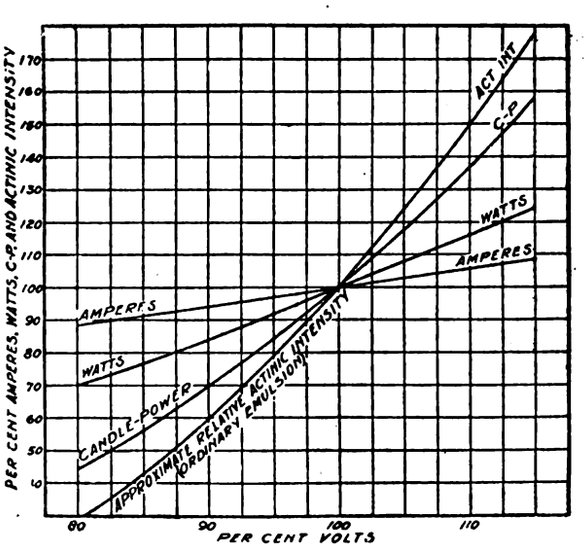
The chairman added that this company was really an agency in England for the Bergmann Co., and it followed that, as soon as war was declared, supplies from the parent company were stopped, and no valid reason remained for the existence of the Adnil Co. The trading and business automatically stopped, but certain of the creditors intimated that they were prepared to continue operations on certain lines. Accordingly, Messrs. Marples & Leach, who had acted as managers, undertook the responsibility of the future trading, and were to take stock from the Adnil Co., and pay them one-third of the gross profits on the further trading, the other two-thirds going to Messrs. Marples & Leach respectively. The company had, however, received the whole of the profits, and Messrs. Marples & Leach had a claim in respect of their shares thereof. The winding-up order was not made against the company until October, 1915, although the petition was filed in the preceding July, and a provisional order was made for the Official Receiver to take charge of the concern and protect the assets of the company pending the hearing of the petition. Soon after that order was made, with a view to carrying on the business, and collecting the large amount of book debts, Mr. J. H. Stephens, chartered accountant, 6, Clement's Lane, Lombard Street, E.C., was appointed special manager. He had previously been appointed, under the Trading with the Enemy Act, to supervise the business. An offer was received by Mr. Stephens from Mr. Leach to take over the stock at the price of £4,843, payable by instalments extending over two years. It followed that the liquidation must extend over that period. A statement of affairs had been drafted showing liabilities of £33,000, but from that had to be deducted the £6,000 before referred to as owing to the Bergmann Co. in respect of the goodwill, thus reducing the indebtedness to £27,000. Then, with regard to assets, Mr. Stephens had collected altogether £16,949, and after deducting necessary payments for carrying on the business, he had a balance of £12,092 now in hand. There were further book debts, amounting to £10,000, to be collected, and they were expected to fetch £4,500; there was also a balance of £4,200 to come from Mr. Leach for the stock, so that the total realisation could be estimated at £20,792, or, roughly, after deducting expenses, at £20,000, to be distributed amongst creditors for £27,000, who would probably receive rather more than 13s. 4d. in the £.

A creditor inquired whether a considerable sum was owing to alien creditors, and in the event of those claims being disregarded, the English creditors would not receive 20s. in the £.

The Official Receiver pointed out that although it was the usual custom abroad to settle with home creditors in full before taking English claims into account, the law in England provided that all creditors, whether home or abroad, should share alike. In this case the moneys due to German or other alien creditors would be handed over to the Public Trustee, who would hold them until the conclusion of the war.

A resolution was passed for Mr. J. H. Stephens to remain in charge of the liquidation.

Over-Run Gas-Filled Lamps in Photographic Work.—As shown by the accompanying performance curves for gas-filled tungsten lamps, the C.P. and the actinic intensity of the light increase much faster than the power demand when the voltage across a given lamp is increased above the normal operating pressure. For instance, with a 10 per cent. increase in voltage above the rated value, the actinic intensity increases 50 per cent. Con-



Performance of Gas-Filled Lamps, Showing Effect of Voltage on C.P. and Actinic Intensity.

tinuous operation at such an over-voltage would decrease the lamp's life from 1,000 hours to about 300 hours, but momentary over-voltage operation may not be objectionable in portrait or motion-picture photography, as the posing may be performed at reduced intensity, and the lamp later flashed to 110 per cent. of its rated voltage only at the time of film or plate exposure.—*Electrical World.*

Supply Companies in France.—Apart from the dearness of other raw materials, the supply companies in France, which depend upon the use of coal, are seriously affected by the high price of the latter, owing to the national production being largely in enemy possession, and the enormous rise in freight rates since the outbreak of war having caused imported coal to reach an unprecedented level. At the recent meeting of the Société d'Electricité de Paris, the chairman mentioned that the company had to arrange contracts for English coal months in advance, in order to endeavour to obtain regular deliveries, that the company had to keep stocks amounting to about 30,000 tons, and that the present cost of the coal was from £2 16s. to £3 4s. per ton. Naturally, the augmentation brings about automatically a similar increase in the charges made per KW.-hour where it is possible to secure it. But it is asserted that certain supply companies are specially affected through the dearness of coal, as their contracts with consumers are for the sale of energy at a fixed price, that is, at the same rate as prior to the war, and, as prices are already low, many supply companies are now declared to be working at a loss at the present time. This state of affairs, however, does not prevail in the case of

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the Société d'Electricité de Paris, whose principal customers are the Metropolitan Railway, the Nord-Sud Railway, the Compagnie des Tramways de Paris et du Departement de la Seine, and the Compagnie des Omnibus. The contracts with these customers and the large industrial consumers are arranged on a double basis. In the first place, the price is fixed according to the consumption of energy, and it is based upon the average price of coal in the previous year. Later on, when it is possible to ascertain the average prices of coal in the current year, the accounts are adjusted accordingly. In normal times the variations in the prices of coal are only slight, and the adjustments of accounts are consequently limited to sums amounting to a few thousands of francs; but at present the variations in coal prices are enormous, and the adjustments represent several millions of francs which customers will have to pay to the company. The necessity for accumulating large stocks of English coal, which has to be paid for in cash, imposes a great charge upon the financial resources, and in order to keep adequate funds in hand the date for the payment of the company's dividend for 1914-15 has been left to the discretion of the directors. In Italy, where in times of peace imported coal cost £1 4s. per ton, the rate rose recently to £8 per ton, but since then a slight decline has taken place. The supply companies and the tramway authorities are particularly affected detrimentally not only on account of the high price of coal, but also owing to its scarcity. Some of the tramway companies are restricting their services, whilst others will be compelled to stop working altogether if the situation is not speedily remedied. A meeting of representatives of the tramway and lighting companies has just been held, when it was decided again to impress upon the Government the urgent necessity for taking action in the matter, especially as the State is a very large purchaser of English coal for the railways and other purposes.

Engineers' Wages.—The *Manchester Guardian* states that the Joint Committee of Engineering and Kindred Trades representing the Manchester district met in Manchester on 23rd February. Mr. T. J. Holt, district secretary of the Amalgamated Society of Engineers, presented the figures of the ballot dealing with the decision of the Government Productions Committee regarding the application for an increase of wages to engineers in the district. The result showed an overwhelming majority in favour of carrying the question forward. Another application is to be made to the Manchester Engineering Employers' Federation. The original application was for a wages advance of 6s. per week. The local conference and the central conference declined to accede to the claim, and the Government Productions Committee took the same course. It is stated that an amended application is now being forwarded to the Employers' Federation, as the men are determined that the Manchester district shall be brought up to the standard of other centres. For the men it is stated:—"Hitherto we have been one of the highest-paid engineering centres in the country, but to-day we are one of the lowest. The wages of the past have drawn the cream of the craftsmen to this area, and, naturally, the prestige must be maintained. In Manchester we have only had a 3s. wages advance since the war began. Other towns have received from 5s. to 7s. of a wages advance, and others again a 4s. wages advance with a 3s. war bonus."

Inquiry.—Makers of "Metite" brushes for slip-rings are asked for.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The following increases of salary to officials in the Manchester electricity department were to be brought before the City Council on Wednesday of this week:—

Mr. T. Baxendale, constructional engineer and assistant resident engineer at Stuart Street, from £270 to £300 per annum; Mr. J. R. Davidson, boiler-house superintendent, running staff, £200 to £225; Mr. H. W. Smith, engineer-in-charge, Stuart Street, £200 to £225; Mr. W. H. Woods, engineer-in-charge, Stuart Street, £200 to £220; Mr. W. H. Simpson, engineer-in-charge, Stuart Street, £200 to £220; Mr. A. L. Lunn, engineer-in-charge, Stuart Street, £175 to £200; Mr. J. G. Thomson, boiler-house superintendent, repairs staff, £175 to £200; Mr. W. Baxter, superintendent of electrical repairs at all stations and sub-stations, £156 to £175; Mr. W. Kidd, assistant constructional engineer, £163 16s. to £200.

Out of 52 applicants, five of whom were interviewed, Mr. T. E. Boothby, of Wembley, Middlesex, has been appointed as charge engineer at the Southwark electricity works, at a salary of £3 a week. Mr. W. E. Buckingham has been appointed junior engineer. There were 15 applicants for this post, five being selected for interview, but two only putting in an appearance.

Mr. E. W. Martin, assistant distribution engineer at Woolwich, is to be promoted to the position of distribution engineer (a post formerly filled by Mr. Penning, the present deputy electrical engineer) at a commencing salary of £170 a year. It is proposed to increase Mr. Penning's salary from £235 to £250.

Mr. J. S. Hollinrake, electrical engineer to Bispham-with-Norbreck U.D.C., has been appointed manager to the Weaverham Electricity Supply Co., Ltd., Cheshire.

The employés at the Kilmarnock Corporation electricity works have presented Mr. E. J. Walsh, chief assistant engineer, with a purse of sovereigns on his departure to take up the duties of resident engineer to the Musselburgh Electric Light & Tramway Co. The presentation took place at a function held last Friday, presided over by Mr. Neil Clark, works superintendent, and Mr. W. E. Upton, assistant engineer.

Mr. R. W. Klitz, assistant electrical engineer of the Wimbledon B.C., has been granted a commission as Lieutenant in the Army Ordnance Department.

General.—On Saturday evening about fifty employés and friends of the firm of G. R. Marson gathered at the "Craven Arms" Hotel, Coventry, for a social evening at the invitation of the firm. The manager, Mr. J. Marson, was in the chair. During the evening Mr. W. Chatwin, an employé of the firm for 20 years, on behalf of the other employés of the firm, presented to Mr. J. Marson a gold match-box for himself, a gold chain and pendant for Mrs. Marson. A musical programme followed.

The India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd., of Silvertown, have lost another of their old servants in the person of Mr. Robert Stables, who recently retired on account of ill-health after 43 years' service. Mr. Stables who was born in 1850, joined the India-Rubber Co. in 1873, and in two or three years was made engineer-foreman. In 1884 he was appointed manager of the rubber department, which eventually came under the control of Mr. C. H. Gray, one of the present managing directors. Mr. Stables took a great interest in local affairs, and a few years ago was elected Deputy-Mayor of West Ham. An artistic illuminated address (into which a rubber tree and the Silvertown Co.'s house flag were introduced), together with a cheque, was presented to Mr. Stables as a token of the high esteem in which he is held by his many friends at the works, at Cannon Street, and at the branches. Owing to the present state of Mr. Stables's health, two of his former colleagues, Messrs. G. Stoat and J. Hipwell made the presentation at his home at the Garden City of Letchworth, Herts., to which he recently removed.

Mr. M. A. McLean, of the British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park, is serving on the Stretford Appeal Tribunal.

Amongst the candidates selected by the Council of the Royal Society to be recommended for election into the Society is Mr. S. G. Brown.

Mr. Ewart V. Baldwin, for the past eight years with the Newcastle Electric Supply Co., has secured a commission in the Royal Engineers, and has joined the Electrical Section.

At St. John's Church, Chatham, on February 24th, the marriage took place of Mr. Leonard Wallis, of the electrical engineering staff at the shipbuilding yard of Messrs. Palmer, Newcastle-on-Tyne, and Miss Margaret T. Coltman.

Mr. D. A. Walker, draughtsman in the Wimbledon B.C. electricity department, who joined the London Scottish Regiment at the outbreak of the war, and was wounded in France, losing one of his eyes, returned to his duties in the department on January 31st, on his discharge from the Army. He has now resigned his position, having obtained another appointment.

Roll of Honour.—Second-Lieutenant R. B. Dunlop, Royal Engineers, reported a second time wounded, was formerly in the service of Messrs. Siemens at Glasgow.

Mr. J. Bayldon, late of the 2nd Battalion Scots Guards, electrical storekeeper at Northfleet Engineering Works, died on February 17th. He took part in much fighting until wounded at Ypres, and was invalided out of the Army.

Private Andrew Quick, late of the staff of the Gravesend and Northfleet Electric Tramways, Ltd., and of the 2nd Bedfordshire Regiment, has been killed in action in France.

Sergeant Francis L. Cater, who was gazetted Second-Lieutenant on February 18th, returned home ill, and is in hospital at Hastings.

Second-Lieutenant E. A. F. Goodfellow, 3rd Connaught Rangers, who was killed on February 20th, was the only son of Mr. and Mrs. A. T. Goodfellow; he was educated at Eton and the Central Technical College, South Kensington, where he was Siemens medallist and David Salomons scholar, and obtained diplomas in electrical engineering and in civil and mechanical engineering. He graduated B.Sc.Eng. (hons.) at London University, and became assistant engineer of the Burma Railways, but came home in April last and obtained a commission. He was said to be "a tremendous worker."

Wills.—The late Colonel T. E. Vickers (Vickers, Ltd.) left unsettled net personalty amounting to £106,899.

The late Mr. Thomas Parker left £13,380 gross and £6,096 net personalty.

The late Mr. J. H. Lane, a director of the Indian Government Telegraph Department, left £28,842 gross and £26,307 net personalty.

NEW COMPANIES REGISTERED.

Baughan and Co., Ltd. (143,116).—This company was registered on February 25th, with a capital of £2,500 in £1 shares, to carry on the business of electrical, general, and consulting engineers, as formerly carried on by A. H. V. Baughan at London Street, Reading, as Baughan and Co. The subscribers (with one share each) are: G. B. Hextall, 36, King Street, Cheapside, E.C., solicitor; F. Sawyer, 46, Fairmile Avenue, Streatham, S.W., clerk. Private company. A. H. V. Baughan is first permanent governing director. Registered office: 8 and 10, London Street, Reading.

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OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Musselburgh and District Electric Light and Traction Co., Ltd.—A memorandum of satisfaction to the extent of £600 on December 15th, 1915, of charge dated November 13th, 1905, and May 11th, 1909, securing £90,000, has been filed.

Rugby Lamp Co., Ltd.—Issue, on January 26th, 1916, of £500 debentures, part of a series of which particulars have already been filed.

White, Jacoby and Co., Ltd. (52,494).—Capital, £4,000 in £1 shares. Return dated December 23rd, 1915. 3,207 shares taken up; £1 per share called up on 850 shares; £850 paid; £2,357 considered as paid on 2,357 shares. Mortgages and charges: £1,380.

British Electrical Export Co., Ltd. (138,028).—Capital, £2,000 in £1 shares. Return dated January 5th, 1916. 103 shares taken up; £103 paid. Mortgages and charges: Nil.

City of Freetown (Sierra Leone) Electricity Co., Ltd. (138,058).—Capital, £1,000 in £5 shares. Return dated January 31st, 1916. All shares taken up; £1,000 paid. Mortgages and charges: Nil.

National Electric Engineering Co., Ltd.—Capital, £5,000 in £1 shares. Return dated January 3rd, 1916. 2,659 shares taken up; £654 paid; £2,005 considered as paid. Mortgages and charges: Nil.

Bogota Telephone Co., Ltd. (69,059).—Capital, £45,000 in £1 shares (20,000 pref. and 25,000 def.). Return dated November 26th, 1915. 18,200 pref. and 18,607 def. shares taken up; £1 per share called up on 9,200 pref. and 18,607 def. shares; £27,807 paid; £9,000 considered as paid on 9,000 pref. shares. Mortgages and charges: Nil.

Bourne End Electric Installation Co., Ltd. (98,428).—Capital, £5,000 in £1 shares. Return dated December 30th, 1915. 1,000 shares taken up; £7 paid; £993 considered as paid. Mortgages and charges: £2,000.

CITY NOTES.

French Electrical Companies.

The Compagnie Générale Francaise de Tramways proposes to pay a dividend of £1 per share for 1915, as compared with 16s. in 1914; the Tramways de Rouen £1 4s. per share, or 6 per cent., for 1915; and the Tramways d'Amiens 5 per cent., as against 4 per cent. in 1914.

The accounts of the *Société Hydro-Electrique des Basses Pyrénées* for 1914 show an increase in the receipts as compared with the preceding year, but the inconsiderable profits have not permitted of the payment of a dividend. The situation of the undertaking improved in 1915, owing to the demands for power on the part of local works engaged on the production of war materials.

The *Société Est-Lumière, of Paris*, reports that the receipts in 1914-15 experienced a decrease simultaneously with a growth in the working expenses owing to the war, and the number of new consumers, which exceeded 23,000 in 1913-14, increased by scarcely 2,000 in the past year; whilst the consumption of old customers was much less than formerly. After several years of progressive expansion, the gross receipts in 1913-14 reached £215,000, and the gross profits £89,000, the figures for the past year being £182,000 and £49,000 respectively. The net profits receded from £74,000 in 1913-14 to £29,000, but no dividend has been paid for either year, as the company is reserving its funds for the purpose of development works.

The report of the *Société d'Electricité de Paris* for the year ended with June 30th, 1915, states that the period included the first 11 months of the war, when industrial depression was the most marked, and it only experienced slightly the effects of the resumption which is growing month by month, and is tending to increase the sales of energy to the transport companies and large manufacturers in the vicinity of Paris. Under the prevailing circumstances, the works carried out at the Saint-Denis station were of little importance, and no addition was made to the supplementary installations and accessories. The sales amounted to 85,510,000 KW.-hours, as contrasted with 145,213,000 KW.-hours in 1913-14, and the net profits reached £105,000, permitting of the payment of a dividend of 8 per cent., or 16s. per share.

The *Société L'Ouest-Lumière*, which made regular progress year by year down to the outbreak of the war, suffered from this event and the advance in the cost of coal and of other raw materials. While the number of new customers increased by 16,000 in 1913-14, that in the following year scarcely rose by 2,000, but the company has the good fortune of possessing in its area of supply many industries which are working for the national defence, and which are expected to be transformed after the war, especially in the case of the many new works, so as to produce articles formerly procured from Germany. The gross receipts in 1914-15 amounted to £240,000, as compared with £335,000 in the previous year, and the net profits were £65,000 and £124,000 respectively. A dividend at the rate of 2s. 9d. per share has now been declared for each of the past two years, this contrasting with 5s. 7d. per share in 1912-13.

The directors of the *Société L'Eclairage Electrique, of Paris*, report that the Lecourbe works, which was disorganised at the beginning of the war through the withdrawal of mobilised workers, was not brought to a standstill, but continued the construction of machinery and executed important deliveries either from stock or from manufacturing. The work carried out at the cable factory at the Jarville works was the production of wire, whilst conductors and cables were made at the works in the Rue Bolivar. In the case of the Colombes works, which was closed on the opening of the war, work on copper was resumed in October, 1914, together with the production of tubes and small appliances, which were in great demand. The works in the Avenue de Choisy was very actively occupied, and received large orders for electrical plant and lathes. The net profits realised in 1914-15 amounted to £42,000, and a dividend at the rate of 5 per cent. has been declared.

Chelsea Electricity Supply Co., Ltd.

The profit for 1915 was £34,955, plus £3,111 brought forward and £2,312 for interest. After paying debenture interest and redemption fund, putting £14,720 to credit of reserve for renewals, depreciation, and contingencies, writing off £1,089 for cost of extinction of founders' shares, writing £1,000 off investments, paying 6 per cent. on the preference shares, and 4 per cent. on the ordinary for the year, £3,293 is to be carried forward. 5,564 lamps (equiv.) were added during the year, making the total 319,840. The units sold were 4,192,892, a decrease of 149,290 for the year. Annual meeting: March 8th.

Underground Electric Railways Co. of London, Ltd.

The net revenue from investments, &c., in 1915, after deducting general expenses, and including the amount brought forward, was £707,370. After paying 4½ per cent. on the bonds due 1933 and on the three-year secured notes due 1917, the surplus is £580,618. This is dealt with thus:—Payment under the guarantee on Central London Railway assented stocks, £26,931; interest at 6 per cent. on first cumulative income debenture stock due 1945, £76,380; interest at 6 per cent., plus income-tax, on 6 per cent. income bonds due 1948, £438,731, leaving £38,576. The income from investments was £680,741, as against £684,626 for 1914, a decrease of £3,884, or .57 per cent. Notwithstanding the abnormal conditions resulting from the war, the aggregate income from all sources was well maintained. Annual meeting: March 10th.

British L. M. Ericsson Manufacturing Co., Ltd.

During 1915 the business of the company continued to show most satisfactory results. The net profit, after charging £11,882 for depreciation, and £2,500 for debenture interest, is £22,593, plus £7,023 brought forward. After paying the preference dividend, £9,000 is to be put to reserve, 8 per cent. (free of income-tax) is to be paid on the ordinary shares, the same as for 1914, carrying forward £6,616. The death is recorded of Mr. P. G. Wayne, a director, but the vacancy is not to be filled up at present. Annual meeting: March 15th.

Davis & Timmins, Ltd.

Sir Henry Mance, addressing the annual meeting on February 24th, said that the report from the financial point of view was highly satisfactory, but the results were in a great measure due to abnormal conditions due to the war. They must not expect that at the conclusion of hostilities they would immediately return to the normal state of things existing before the war. Business relations would take some time to re-adjust themselves. In regard to the Excess Profits Tax, the exact amount that they would have to pay was not yet ascertained, as no doubt the Government would require to see that the accounts were prepared in exact accordance with their views. It was, however, certain to exceed £10,000. Mr. G. E. Davis, the managing director, who followed, said that they had had to work hard and long to secure the year's results. A year ago he said that no man could tell what the difficulties of obtaining supplies of metal, &c., used in their manufactures might be in the near future, and that applied even more so to the conditions that obtained to-day. No supplies could be obtained except against cash in advance, and that meant that a big bank balance was needed. Their order-book was naturally congested, and they were anxious to cause their regular customers as little inconvenience as possible.

Charing Cross, West End & City Electricity Supply Co., Ltd.

The directors report to the following effect for 1915 (the figures in parentheses are for 1914):—

West End Undertaking.—Gross earnings, £138,964 (£142,086); expenses, excluding depreciation, £70,068 (£69,677); net earnings, £68,895 (£72,409), plus £18,000 brought forward, interest accrued for 1915 £2,978, and transferred from general reserve (income) £6,000. The available total is £95,873. Out of this, debenture interest requires £17,829, depreciation £22,000, preference dividend £18,000, and 5 per cent. is paid on the ordinary shares, the same as for 1914, carrying forward £18,044. There are now connected to the mains in the West End 718,028 (equiv.) lamps, as follows: Lighting, 458,345; heating, 36,572; 223,111 (8,982 H.P.) in motive power. Units generated, 5,934,552; bought, 8,454,628; sold, 11,440,835; used on works and in transmission and distribution, 2,948,345. Public lamps, 303; units sold for public lighting, 313,638.

City Undertaking.—Gross earnings, £158,357 (£153,689); expenses, £94,590 (£86,983); net earnings, £63,767 (£66,706), plus £18,000 brought forward. The available total is £81,767. Out of this, £30,459 is required for interest on debenture

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stock, loans, and advances, the preference dividend absorbs £18,000, £15,308 is put to general reserve (income) account, leaving £18,000 to carry forward. There are now connected to the city mains 722,700 (equiv.) lamps, as follows: Lighting, 321,675; heating, 57,516; motive power, 343,509 (13,814 H.P.). Units generated, 29,631,120; bought, 172,554; sold, 24,034,857; used on works, &c., 5,768,817.

Oxford Electric Co., Ltd.

The profit for 1915 was £13,340, including £1,055 brought forward. Debenture and other interest requires £2,016, there is written off hire-purchase installations £686, 5 per cent. is paid on the pref. shares, and 6 per cent., less income-tax, on the ordinary, £1,000 is put to reserve and plant renewal account, and £968 is carried forward. The demand for light decreased owing to the war, and the heavy cost of fuel also adversely affected the revenue. Mr. E. A. Beavers has been elected a director in place of the late Prof. T. L. Bullock. Annual meeting: March 7th.

Torquay Tramways Co., Ltd.

For 1915 the profit was £13,691, and after deducting debenture charges there remains £6,511, plus £897 brought forward. To reserve and renewals £2,500 is put, 3½ per cent. (the same as last year) is paid on the ordinary shares, and £914 is carried forward. The traffic revenue fell from £28,414 to £28,070, the passengers carried from 4,366,227 to 4,293,177, and the car miles run from 627,140 to 620,756. The average receipts per car mile fell from 10.87d. to 10.85d., but the average receipts per passenger increased from 1.56d. to 1.57d., and the cost of energy per car mile from 1.83d. to 1.91d. At the annual meeting held on February 11th, the chairman, Mr. W. B. Cownie (who presided in the absence of Mr Schlesinger through illness) said that the result was a good testimony to the stability of the undertaking. The receipts this year so far showed an increase of £253 over those to the same date last year. Under the agreement with the Corporation it was provided that when the market price of suitable coal exceeded 20s. per ton, the price of current could be increased by agreement, or by an amount to be settled by arbitration. The Corporation had intimated that they intended to charge an extra ¼d. per unit, which they considered grossly excessive; arbitration would, therefore, probably be resorted to. If the price awarded by the arbitrator materially affected their costs, they would have to re-arrange their services and stages. The total operating cost per car mile run was 6.09d., against 6.36d. in 1914. The chairman expressed appreciation of the services of the manager, Mr. H. J. Nisbett, and his staff. A number of women conductors were at work and giving entire satisfaction.

Newcastle-on-Tyne & District Electric Lighting Co., Ltd.

At the annual meeting on February 25th, Dr. J. B. Simpson said that during the year third mortgage debentures for £30,000 were issued to provide for the erection of new plant at Newburn, which came into operation at the beginning of the year; that plant had enabled them to reduce the works costs. Loans had increased by £39,395, the money having been expended in erecting plant to supply energy for power purposes. This plant had only recently been put into commission, and it would further reduce the works costs. The capital expenditure during the year was £48,817. As they were unable to obtain delivery of full quantities of coal contracted for, they had to purchase coal in the open market, and it had adversely affected the profits. To meet the additional costs the price for energy supplied to ordinary customers was raised as from the June quarter meter readings. The total gross receipts for electrical energy showed an increase of £9,301 over 1914. The loss of receipts due to lighting restrictions was £3,700, but this had been compensated for by the increased demand for power. The net profit for the year was £15,965, an increase of £555. In view of the exceptional circumstances due to the war, and the uncertainty of what was before them, the directors decided that it would not be wise to recommend the payment of a dividend, believing that in these times a cautious and conservative policy was essential.

London Electric Supply Corporation, Ltd.

Mr. R. H. Benson, presiding at the annual meeting on February 24th, said that after his warning of last year regarding the setback which was inevitable during war-time owing to the price of coal and restricted lighting, they would not be surprised to see that, while the gross revenue broke the record at £213,964 against £191,196, the net revenue was only £77,687, against £93,234. Owing to the higher coal and wages costs, the cost per unit sold was nearly ¼d. instead of ⅛d. The present net revenue had only been twice exceeded. This year the amount put to reserve was double the amount paid in dividend. He wished it were more, but it was a substantial amount against the risk of purchase in 1931. In anxious time when there was less profit, the work and responsibility of the staff were hardest. They could realise what a trying thing it had been to generate and sell 50,757,584 units, against 46,343,065 in 1914, under war conditions, with depleted staff and irregular supplies of indifferent coal, requiring careful selection and sorting. Special thanks were due to Mr. Partridge and the staff, and to the managing director. But for the war they would have had a record year—£20,000 more net revenue, or even more. He must not predict now as to the future; they had just got to keep things together as best they could, and so be ready when peace came to supply their customers as usual. Mr. R. Stewart Bain, the managing director, followed with the usual technical particulars. The capital expenditure of the year was chiefly for a new battery of boilers and accessories, and the laying of five miles of new mains, principally for industrial power, which continued satisfactorily to increase. The total H.P. of motors connected was 15,683 H.P., and contracts for a further 1,500 H.P. had been received. The receipts were up by nearly £23,000, and the expenditure by over £38,000 (coal accounted for over £30,000 of that, and the balance was increased wages, both due to the war). They consumed 90,000 tons of coal at 19s. 9d. per ton, as against 73,000 tons at 14s. 1d. in the previous year. There had been great difficulty in getting deliveries owing to shortage of steamers, and the bulk had been delivered by rail. It had been of an inferior quality, which meant larger quantities at greatly increased prices. The difficulty of obtaining an adequate supply of coal had not diminished since the last meeting. While the cost per unit sold increased from 0.50d. to 0.64d., the average selling price advanced from 0.94d. to 0.96d.

Westminster Electric Supply Corporation, Ltd.

Mr. J. Browne Martin, presiding at the annual meeting on February 23rd, said that they had had to contend with many adverse causes, and shareholders would be prepared for reduced profits. The normal expansion of business had naturally been checked, and they had suffered considerably from the lighting restrictions. Rigid lighting economy had been practised by many consumers. The total output showed a slight increase, but the revenue decreased by £4,080. This was due to the large increase of 1,040,000 in units sold for power, heating, and cooking, whilst those sold for lighting were less by 750,000. Some of the generating costs had risen appreciably; distribution costs were much the same as last year. Carbons for street lighting cost more by £700, as before the war they came from Germany. Fortunately, the company held a large stock, so that the full effect was not felt in 1915. This year there would be at least a further £1,000 increase. An increase of £738 in management expenses was due to extra wages owing to enlistment of so many of the staff. They had set aside £23,500 to depreciation, as against £30,868 in 1914, in accordance with the recommendation of Sir A. B. W. Kennedy, the engineer-in-chief, who reported to the board on the matter some time ago. In the early days of the company they put very little aside to depreciation, but as soon as the revenue was sufficient they increased the sum to make up for the deficiency in the early years. This had now been made good, and they would henceforth be able to reduce the rate. The fund now amounted to £316,000, the whole of which had been provided out of revenue. They had reviewed the whole of their investments, and set aside out of revenue £2,500 to provide against losses on realisation. That practically agreed with the ascertained loss on the investments realised during the past year. They had sold some of their American securities, and offered others on loan to the Treasury. The proceeds had been invested in War Loan and Treasury Bills, which together aggregated upwards of £70,000. In December, 1914, and March, 1915, they considered the question of raising charges to consumers, but decided not to do so then. In June last, however, they received a notice increasing the assessment, and they were faced with much heavier charges for coal and increased wages, and reluctantly they raised the price by 10 per cent., so that the shareholders should not carry the whole of the burden. The increase took effect in the last quarter of the year only. Owing to the uncertainty of the coal supply, special arrangements were made for storing large quantities, and this had increased the cost per unit generated. Having failed to obtain any substantial relief from the Assessment Committee, they were appealing to Quarter Sessions. Their chief assistant engineer, Mr. C. O. Grimshaw, had been occupied with important duties under the Metropolitan Munitions Committee. They had lost a colleague from the board in Mr. Hayes Fisher, who had been appointed to the post of Parliamentary Secretary to the Local Government Board. They did not propose at present to fill the vacancy. Mr. Hordern, their manager, was serving as a Commander in the Royal Navy. Their mains superintendent, Mr. W. A. Jones, was with the Forces in Egypt, and nearly all eligible men had been attested. They had 97 employés (roughly one-third) on active service—one had been killed, another was missing, ten had been wounded, and three were sick in hospital. It had been difficult at times to carry on the work of the company efficiently in all departments. The Chairman alluded to the death of Mr. Frank Iago, who resigned the secretaryship after 27 years' service last August. Mr. W. A. Pearman, who had been their accountant for 20 years, had been appointed to succeed him. The meeting passed a vote of thanks to the special constables who had guarded the company's premises.

Jarrow & District Electric Traction Co., Ltd.—The revenue for 1915 was £8,855, an increase of £986. After deducting expenses, also debenture charges, putting £800 to renewals, there remained £2,911, plus £1,026 brought forward. Of this, £900 is to be put to reserve, 4 per cent. is to be paid on the ordinary shares, and £1,040 carried forward. Annual meeting: March 6th.

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Fife Tramway, Light and Power Co. At the annual meeting, in Edinburgh, Mr. Wm. Low said the Dunfermline and District Tramways Co. had paid over to this company by way of dividend and management fees £13,650, compared with £15,250 for 1914. An extension of time in which to build certain tramways had, after a very stiff opposition, been granted. Regarding the power and lighting business, the growth had been quite satisfactory, but all properties of this kind had been hard hit by increased costs, particularly in fuel. Fortunately, they carried out large extensions during 1913 and 1914, which enabled consumers to be supplied and current to be generated more economically. The total revenue received from the Fife Electric Power Co. and the electric lighting undertakings as dividends, profits, and fees amounted to £13,567, an increase of £2,291, which was satisfactory. The additions to the power station plant had been completed. Regarding the revenue to be anticipated from the combined properties during the current year, short of some entirely unforeseen contingency, there should be a net result rather better than that of last year.

South London Electric Supply Corporation, Ltd.—The gross receipts in 1915 were £54,782, and the expenditure was £27,553. Including £2,899 brought forward, £30,127 is available. After placing £6,248 to depreciation, paying debenture and other interest, also 6 per cent. pref. dividend, 5 per cent. is to be paid on the ordinary shares, leaving £3,010 to be carried forward. There were added 25,652 new lamps (900 kw.), making the total 366,518 (12,820 kw.). The units sold were 6,318,140, an increase of 164,899. Units generated, 7,926,950. Annual meeting: March 7th.

Tyneside Electrical Development Co., Ltd.—For the year ended January 31st the profit was £2,602, plus £3,427 brought forward. After paying 6 per cent. per annum on the preferred ordinary shares, 10 per cent. on the deferred ordinary shares, and transferring to general reserve £1,000, £3,654 is to be carried forward. The balance of the amount now unpaid on the preferred ordinary shares during 1916 is to be called up.

New York Telephone Co.—Year 1915: Telephone earnings, $77,748,217 ($3,836,159 inc.); telephone expenses, $60,114,877 ($2,372,479 inc.); net telephone earnings, $17,633,340 ($1,463,680 inc.); other income, $1,877,200 ($7,806 inc.); total net earnings, $19,510,540 ($1,471,486 inc.); interest charges, $4,049,103 ($21,971 inc.); balance, $15,461,437 ($1,449,515 inc.); dividends declared (8 per cent.), $10,008,579; balance to surplus and reserves, $5,452,858 ($1,449,515 inc.). —*Financial News.*

Telegraph Construction and Maintenance Co., Ltd.—The accounts for 1915 show a net profit of £108,707, after charging the interest on the debentures, plus £111,406 brought forward, making £220,114. In addition to the interim dividend of 5 per cent., the directors propose to distribute a further dividend of 10 per cent., together with a bonus of 12s. per share, free of income-tax, and to put to reserve fund £20,000, leaving £110,474 to be carried forward.

Stock Exchange Notice.—The Committee has ordered the undermentioned to be quoted in the official list:—

Bombay Electric Supply & Tramways Co., Ltd.—Further issue of 12,000 ordinary shares of £10 each, fully paid, Nos. 120,001 to 132,000; and £10,000 5 per cent. second mortgage debentures of £100 each, Nos. 2,001 to 2,100.

County of London Electric Supply Co., Ltd.—The directors recommend a final dividend on the ordinary shares at the rate of 9 per cent. per annum, less income-tax, making 7 per cent. for the year, the same as for 1914. £40,000 has been placed to reserve for depreciation, leaving £14,000 to carry forward.

Northallerton Electric Light and Power Co., Ltd.—At the annual meeting on February 23rd, the directors reported a net profit of £496, which is to be credited to reserve. £500 was written off plant for depreciation.

City of London Electric Lighting Co., Ltd.—After placing £50,000 to reserve and paying 6 per cent. on the preference shares, and 8 per cent. on the ordinary shares (as against 9 per cent. for 1914), £17,500 is to be carried forward.

Metropolitan Electric Supply Co., Ltd.—The directors recommend a final dividend at the rate of 2 per cent., making a total of 3 per cent. for 1915, as against 3½ per cent. for 1914, placing £27,000 to reserve, and carrying forward £4,978.

Calcutta Electric Supply Corporation, Ltd.—The units sold to consumers during the four weeks ended January 28th were 1,354,635, compared with 1,022,022 in the corresponding four weeks of 1915.

Tramways, Light and Power Co., Ltd.—Including £1,712 brought forward, the receipts for 1915 were £32,213. After meeting debenture charges and paying 6 per cent. pref. dividend, £3,348 is to be carried forward.

Automatic Telephone Manufacturing Co., Ltd.—A dividend of 4 per cent. on the ordinary shares for 1915, writing off £11,500 and carrying £6,774 forward, is announced. For 1914 the dividend was 3 per cent.

Lancashire United Tramways, Ltd.—For 1915 the traffic receipts were £90,578; miscellaneous receipts and electrical energy sold produced £6,249. Less working expenses £54,933, cost of generating electrical energy sold £4,096, general charges, £5,240, rent of leased lines £5,191. Add dividend on holding in New St. Helens and District Tramways Co., Ltd., £1,534, making profit of combined undertaking £28,901. The interest and dividends received from the operating companies together with sundry receipts, amounted to £14,017. After deducting interest on prior lien debenture stock and expenses, there remains £198, which has been carried to depreciation account. There is also a balance on the year's working of the operating companies, after payment of interest and dividends beforementioned, of £16,203.—*Financier.*

Electro Bleach and By-Products, Ltd.—For 1915 the profits, after allowing for depreciation, &c., are £25,574. After charging debenture interest and writing 20 per cent. off the preliminary expenses a net profit of £22,924 remains. The directors recommend a dividend of 7 per cent. on the ordinary shares, placing £4,000 to reserve, and carrying forward £722. The profit is below expectations owing to the war and failure to obtain delivery of new plant.—*Financial Times.*

Mackay Companies.—Quarterly dividend of 1¼ per cent. on the common shares is announced.

STOCKS AND SHARES.

Tuesday Evening.

Until the new War Loan is out, markets are bound to be more or less under the shadow of its coming. The buying of the 4½ per cent. issue has ceased, and there is a general slackening of prices in other investment departments. At the same time, the tone round the markets is one of confidence and steadiness. The frenzied battles round Verdun are taken as an omen of the German onslaught at its apex; and, this having been repulsed, there is much satisfaction at the result of a movement which must have cost the enemy terrible toll in life and munitions. So that where dulness is perceptible in prices, it may be ascribed to the coming of the new War Loan, a King Charles' Head that will probably have a knack of getting into Stock Exchange reports until the terms of the issue are actually known.

The City of London Electric Lighting Co. has declared a dividend of 10s. a share, making 8 per cent. for the year, as against 9 per cent. paid for 1914. This is a slight disappointment, because most people had been expecting the company to repeat its previous performance. There was a small decline in the price of the shares upon the announcement; it is argued, however, that 8 per cent. in these difficult days is an achievement by no means despicable.

The County of London Electric Supply Co. declares a dividend of 9 per cent., making 7 per cent. for the year, and so maintaining its previous rate. This came up to expectation, as foreshadowed here already; the price of the shares has risen ½ to 10⅜. There is not a great deal doing in the other Metropolitan issues; but, the dividends being out and the worst known, it seems that there is rather a tendency for people to buy electric lighting shares again, and quite possibly the market may now slowly recover.

Gossip has it that matters are none too peaceful on the board of one of the electric light companies concerned with the supply of current for power and lighting purposes. One section of the board is understood to favour the adoption of such a price for current as would probably check any widespread demand for it, while others take a more liberal view and point to the prices being obtained by kindred companies as the best criterion to measure what customers would be likely to pay. There may be lively scenes at one of the meetings to be held in the near future, and the outcome is awaited with a good deal of interest.

In the railway market there is very little fresh of interest. If anything, the tone is heavy as a whole. The reports have now been issued by the various companies concerned in the Underground group; and while they mostly show good results, progressive in character, there is nothing sufficiently startling in them to attract the attention that leads to buying. Underground Electric income bonds are amongst the popular stocks for the time being, no doubt in consequence partly of the fact that the present quotation carries £3 net interest; the price will be ex this interest on Wednesday. The shares fluctuate spasmodically, and both kinds show improvements this week.

Globe Telegraph ordinary strengthened ½ on the declaration of the usual quartely dividends of 3s. on the preference and 2s. on the ordinary, payable on March 31st. The market for telegraph issues as a whole is steady, falls of ½ in Western Telegraph ordinary and ½ in Anglo-American preferred being associated with a little selling on behalf of deceased accounts. Eastern ordinary lost ½, but Great Northern Telegraphs are an equal amount to the good. The Government's price for New York Telephone bonds is lower at 100¼, or 104 for dollar bonds. Callenders lost their 5s. rise of last week, and Henley preference were marked down to 4.

Mexican industrial issues are lower, and further falls have occurred of two or three points in the common shares and the bonds of the Mexico Tramways and the Mexican Light

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and Power Companies. Curiously enough, there is still a demand for Mexican Railway issues; but the utility descriptions some of the holders are trying to sell, rather than join the committee that has been formed for the protection of the bondholders, the obvious reason for such attempted selling being that the proprietors have lost both hope and patience. Anglo-Argentine Tramway 5 per cent. debenture stock is easier, and Brazil Tractions fell to 51 on the course of the exchange being unfavourable to holders. British Columbia Electrics are dull.

The Public Trustee, as executor for a deceased holder of £12,960 income securities of the British Electric Traction Co., has appealed against a reduction of the B.E.T. capital; and the case came before the Court on Monday. The counsel in support of the appeal pointed out that the resolutions in favour of the reduction in capital had been validly passed, and demurred to the statement of the Master of the Rolls that the company appeared to have had a disastrous record. The hearing was adjourned for further evidence on behalf of the company.

Copper shares are a little irregular, after having been in the ascendant in consequence of the sensational rise in the price of metal. The rubber share market is one of the best in the Stock Exchange, as it is certainly the busiest. Upon a recovery in the price of the material to 3s. 9d. per lb., a fresh impetus was given to buying of the shares; and the appetite of the public for investment varieties appears to be as keen as ever.

The following is our representative list of securities connected with the various electric markets:—

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Feb. 29, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	—	7½	—	£6 18 4
Charing Cross Ordinary	5	5	8¾	—	7 2 10
do. do. do. 4½ Pref.	4½	4½	8⅞ xd	—	6 18 4
Chelsea	5	4	8⅞	—	6 18 4
City of London	9	8	11⅞	— ⅛	6 14 9
do. do. 6 per cent. Pref.	6	6	10⅛	— ¼	6 14 8
County of London	7	7	10⅜	+ ¼	6 15 0
do. 6 per cent. Pref.	6	6	10½	—	5 17 8
Kensington Ordinary	9	7	6	—	7 10 0
London Electric	4	3	1⅛	— ⅛	7 18 0
do. do. 6 per cent. Pref.	6	6	4½	—	7 1 2
Metropolitan	8½	8	9⅜	— ¼	8 4 8
do. 4½ per cent. Pref.	4½	4½	8	—	7 10 0
St. James' and Pall Mall	10	8	5⅞ xd	—	8 18 10
South London	5	5	8¼	—	6 8 0
South Metropolitan Pref.	7	7	1⅛	—	6 14 0
Westminster Ordinary	9	7	5½ xd	—	6 1 9
Telegraphs and Telephones.	Dividend, 1914.				
Anglo-Am. Tel. Pref.	6		100	— ¼	6 0 0
do. Def.	33/6		21⅜	—	7 14 3
Chile Telephone	8		6⅜	—	6 5 6
Cuba Sub. Ord.	5		7⅜	—	6 9 0
Eastern Extension	7		12⅜	—	*6 5 0
Eastern Tel. Ord.	7		1 7/8	— ⅛	*6 5 6
Globe Tel. and T. Ord.	6		10⅜	+ ⅛	*6 10 6
do. Pref.	6		10	—	6 0 0
Great Northern Tel.	22		34½	+ ½	6 7 6
Indo-European	18		49	—	6 15 4
Marconi	5		1 1/8	—	5 8 1
New York Tel. 4½	4½		100⅜	+ ⅜	4 9 4
Oriental Telephone Ord.	10		1 1/8	—	5 18 6
United R. Plate Tel.	8		5⅛	—	*7 19 0
West India and Pan.	1		1 1/16	—	9 10 6
Western Telegraph	7		12⅛	— ⅛	*6 5 0
Home Rails.					
Central London, Ord. Assented	4		68	—1	5 17 8
Metropolitan	1½		22½	— ½	4 7 0
do. District	Nil		16⅝	+ ⅛	Nil
Underground Electric Ordinary	Nil		1 3/8	+ 1/16	Nil
do. do. "A"	Nil		6/8	+ 9d.	Nil
do. do. Income	6		86	+ ½	*8 2 0
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6		4⅞ xd	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½		8½	—	6 13 6
do. 2nd Pref.	5½		8½	—	7 17 3
do. 5 Deb.	5		78½	—1	6 7 6
Brazil Tractions	4		51	—1	6 17 3
Bombay Electric Pref.	6		10 xd	—	6 0 0
British Columbia Elec. Ry. Pfce.	5		55	—	9 1 10
do. do. Preferred	—		37	—	Nil
do. do. Deferred	—		34	—	Nil
do. do. Deb.	4½		64	—	6 13 10
Mexico Trams 5 per cent. Bonds	—		40	—2	Nil
do. 6 per cent. Bonds	—		35	—2	Nil
Mexican Light Common	Nil		22	—3	Nil
do. Pref.	Nil		35	—3	Nil
do. 1st Bonds	—		42	—	—
Manufacturing Companies.					
Babcock & Wilcox	14		9⅜	—	5 6 8
British Aluminium Ord.	5		22/-	—	4 10 0
British Insulated Ord.	15		10⅜	—	6 19 6
British Westinghouse Pref.	7½		44/-	—	6 16 4
Callenders	15		11⅛	— ½	6 10 5
do. 5 Pref.	5		4½	—	5 17 8
Castner-Kellner	20		5⅛	—	6 8 0
Edison & Swan, £3 paid	Nil		7/-	—	Nil
do. do. fully paid	Nil		1½	—	Nil
do. do. 5 per cent. Deb.	5		60	—	8 6 8
Electric Construction	6		14/9	—3d.	8 1 6
Gen. Elec. Pref.	6		9⅜	—	6 4 8
Henley	20		14	—	*8 3 0
do. 4½ Pref.	4½		4	— ½	6 12 6
India-Rubber	10		9½	—	*12 19 0
Telegraph Con.	20		87	—	*7 8 6

* Allowance made for dividends being paid free

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, March 1st.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/4	..
a Ammoniac Sal	,,	£70	..
a Ammonia, Muriate (large crystal)	per ton	£54	..
a Bisulphide of Carbon	,,	£23	..
a Borax	,,	£28	£3 inc.
a Copper Sulphate	,,	£48	£3 inc.
a Potash, Chlorate	per lb.	1/8	..
a ,, Perchlorate	,,	2/-	6d. inc.
a Shellac	per cwt.	95/-	20/- inc.
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	,,	£14	£1 inc.
a ,, Lump	,,	£9	..
a Soda, Chlorate	per lb.	1/4½	..
a ,, Crystals	per ton	60/-	..
a Sodium Bichromate, casks	per lb.	10d.	1d. inc.
METALS, &c.			
c Brass (rolled metal 9" to 12" basis)	per lb.	1/4⅛ to 1/4⅜	⅛d. inc.
c ,, Tubes (solid drawn)	,,	1/5 to 1/5¼	⅛d. inc.
c ,, Wire, basis	,,	1/4⅜ to 1/4⅝	⅛d. inc.
c Copper Tubes (solid drawn)	,,	1/6½ to 1/7	..
g ,, Bars (best selected)	per ton	£148	£5 inc.
g ,, Sheet	,,	£148	£5 inc.
g ,, Rod	,,	£148	£5 inc.
d ,, (Electrolytic) Bars	,,	£157	£2 inc.
d ,, ,, Sheets	,,	£155	£2 inc.
d ,, ,, Rods	,,	£144	£2 inc.
d ,, ,, H.C. Wire	per lb.	1/5	1/32d. inc.
f Ebonite Rod	,,	8/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/2	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	3/3	¼d. dec.
i Iron Pig (Cleveland warrants)	per ton	83/-	11/5 dec.
l ,, Wire, galv. No. 8, P.O. qual.	,,	£23	£2 inc.
g Lead, English Pig	,,	£23 15	£1 inc.
g Mercury	per bot.	£16 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e ,, ,, ,, medium	,,	8/6 to 6/-	..
e ,, ,, ,, large	,,	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/8½	2½d. inc.
r Steel, Magnet, in bars	per ton	£85	..
g Tin, Block (English)	,,	£192	£8 inc.
n ,, Wire, Nos. 1 to 16	per lb.	2/9	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Rule-of-Thumb in Percentages.—A contributor to the *Electrical World* has made the remarkable discovery that the approximate rule that "the resistance of copper increases 1 per cent. for each 2½° C. of temperature increase" works only one way—*i.e.*, given the resistance hot, you cannot find the resistance cold by *deducting* 1 per cent. per 2½° C. of temperature drop—and hammers the point home to the readers of our contemporary in some 50 odd lines. Similarly we may point out, in illustration of the same discovery, that if his article had been 100 per cent. longer, it would merely have been doubled in length, whereas if the double-length article were made 100 per cent. shorter, nothing would be left of it but the headlines!

We may suggest that the interesting fact that $-a$ squared is always $+ a^2$, whilst the square root of $+ a^2$ is not necessarily $- a$, might usefully form the subject of a further contribution to our contemporary's pages.

Miners' Safety Lamps.—The Home Secretary has called the attention of makers of miners' electric safety lamps to two accidents with electric lamps of an approved type which occurred in December last, due to ignition of celluloid. While the lamps were in use underground, a quantity of dense smoke was evolved inside them, and in one case such pressure was developed as to burst the lamp open. In the other case the lamp did not burst, as it was not tightly screwed up, and the pressure was relieved by the gas escaping. On subsequent examination and experiment it appeared that the accidents were due to the loose spring terminals with which the lamps were fitted. These had been accidentally bent over, and had come into contact, with the result that the accumulator was short-circuited, and the heat thus generated was sufficient to decompose the celluloid of the accumulator case. In order to prevent the occurrence of accidents of this kind in future, the Secretary of State has decided to prohibit the use in approved miners' electric safety lamps of spring terminals liable to be bent over, and a general provision to this effect will be included in the next Safety Lamp Order to be made shortly. Any electric lamps at present in use which are fitted with such terminals should accordingly be refitted at once with rigid terminals. This has already been done by the maker of the type of lamp with which the accidents occurred.—*Colliery Guardian.*

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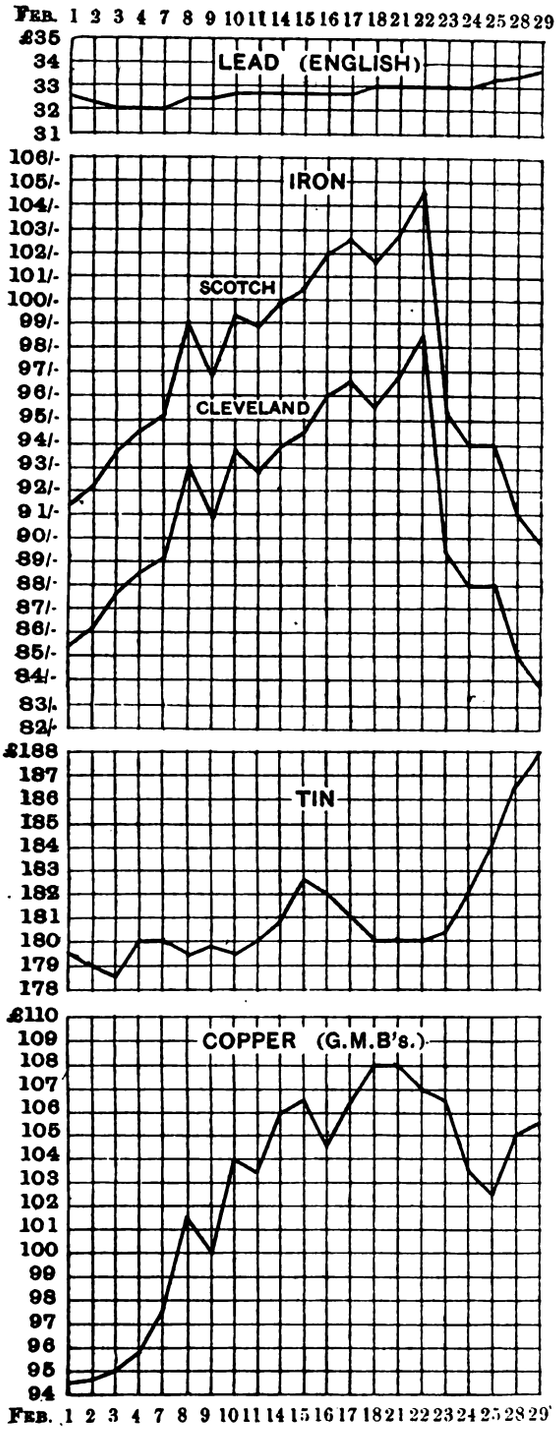
METAL MARKET.

Fluctuations in February.



Electrolytic Zinc Plant.—The success of Anaconda's experiments in the production of electrolytic zinc is definitely settled by the announcement that a $2,000,000 plant is to be constructed at Great Falls, where cheap electric power is available. Research on this subject has been under way for months, and will now culminate in a plant that is to be in operation about September of this year. The reported capacity is 70,000,000 lb. per annum, and the power requirement 30,000 H.P. Zinc concentrate will be roasted and leached with sulphuric acid; the solution will then be purified by precipitating iron by means of limestone and copper and cadmium by zinc. The purified zinc sulphate solution will then be electrolised with insoluble lead anodes and either aluminium or zinc cathodes.—*Met. and Chem. Engineering.*

Electric Steel.—The Apollo Electric Steel Co., U.S.A., which has just been organised, has ordered from the Snyder Electric Furnace Co., of Chicago, two 12-ton single-phase furnaces, each of which will have a daily output capacity of 100 tons of steel. The new steel concern plans to market high-grade steel in the shape of bars, billets and special products. Electrical energy from the lines of a near-by central station company will be used to operate most of the company's machinery.—*Electrical World.*

THE RESISTANCE OF A CUBE.

By A. J. Makower, M.A.

In the issue of February 4th, of the Electrical Review, a reference is made to the indeterminate nature of the problem of finding the resistance between diagonally opposite corners of a cube made of sheets having a resistance of one ohm a side. It was suggested that as the resistance of a side depends on the manner in which the current enters and leaves, the resistance of the side should be defined as referring to the case in which the current flows uniformly from edge to edge. The following considerations show that a more convenient assumption is that the resistance of each side should be defined as the resistance of a side from corner to corner.

If a square sheet be connected by its corners to a source of electric current the stream lines will be of the nature shown in fig. 1. The symmetry shows that the resistance of the square between A and B is the same as the resistance, under the conditions of

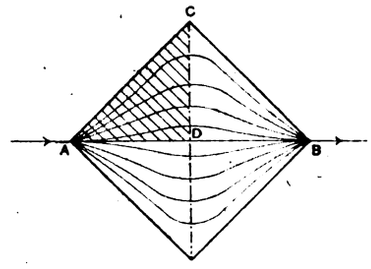


Fig. 1.

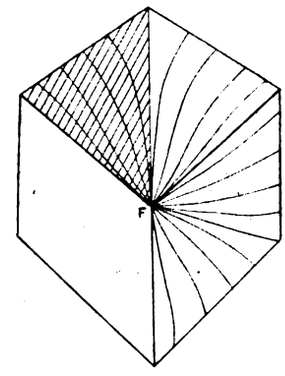


Fig. 2.

flow, of the shaded area between the point A and the side C D, as the complete resistance is made of a parallel arrangement of two circuits each consisting of two areas in series similar to the shaded area. If we now consider the case of the cube and look at it from a feed-point F, as shown in fig. 2, it will be seen by symmetry that the stream lines in every face will be the same, and that the stream lines in the shaded areas of figs. 1 and 2 will correspond. Now, the resistance of a given shape of a given sheet-metal is independent of its actual size, and thus we may

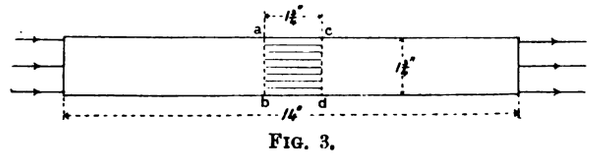


Fig. 3.

determine the resistance of a cube in terms of the resistance of a square sheet of the metal between corners as defined in fig. 1, or, what is the same thing, in terms of the resistance of the shaded area of fig. 1. The cube consists of two portions, similar to the portion viewed in fig. 2, connected in series. Each of these portions consists of six areas similar to the shaded area in parallel. Thus the cube will have a resistance of two-sixths or one-third of the resistance of one of the shaded areas, or, in other words, *the cube will have between its diagonally opposed corners a resistance of one-third the resistance of a square sheet of the metal measured between its diagonals.*

The simplicity of this rule follows from the fact that the stream lines are similar in the two cases compared, but if the resistance of the cube were referred to that of a square between its edges, the different nature of the stream lines in the two cases would cause the relation to be much more difficult to determine.

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In order to corroborate the above reasoning, a cube with 6-in. sides was made of a sheet of tin of No. 22 S.W.G. gauge. Before cutting up the sheet the resistance of an 18-in. square, measured between corners as in fig. 1, was found to be 0.00174 ohm. The sheet was then cut up and formed into a cube, and the resistance was found to be 0.000546 ohm, which is near enough to one-third of the value, 0.00174 ohm, to confirm the law given.

It is interesting, in view of the reference made above to the resistance between opposite edges, to state that the resistance of a square sheet of the material used was determined between its edges by feeding a strip at six points, as shown in fig. 3, and measuring the current taken and the voltage drop between the lines *ab* and *cd*. In this arrangement, the stream lines in the small central square are practically uniform, as shown by the lines drawn. The resistance of the square was found to be 0.00026 ohm, or 0.15 times that of the square fed at its corners. Using this figure, we see that the resistance of the cube between diagonally opposed corners will be $2\frac{1}{4}$ times that of one of its sides measured between opposite edges, instead of two-thirds of that resistance, as given in the issue referred to.

It is not simple to solve the problem of the diagonally fed square mathematically, but very close results may be obtained by graphical methods. If the stream lines be drawn in directions that seem to be reasonable, and the area be divided up into a number of nearly rectangular areas by the stream lines and the equipotential lines normal thereto, the resistance of the area can be predetermined with a fair degree of accuracy. The writer has obtained a value agreeing with the test values within 10 per cent. by dividing the area into about 120 small rectangles in the above-described manner.

ELECTRIC SMELTING OF IRON ORES IN SCANDINAVIA.

(*Concluded from page* 235.)

The Tinfos Furnace.—Apart from an experimental 5,000-H.P. Helfenstein furnace at Domnarvet, of which particulars are available, the only experience so far gained with this type of furnace is from the operation of small units at Notodden, so it cannot be said to have yet had the opportunities of development that have favoured the Elektrometall type.

The furnace is shown diagrammatically in fig. 1. The smelting chamber A is long and rectangular, having one carbon electrode, B, embedded at its base. There are three upper electrodes, C, and these are movable. The charge of ore, limestone, and coke is fed through the rectangular chutes *d*, *e*, extending right along the furnace. Two hollow water-cooled beams, F and G, support the roof and the chutes. The pig-iron and slag are tapped from one end.

Three-phase current is used to operate the three furnaces at Notodden, each taking about 1,600 H.P. at 35-55 volts, 50 cycles.

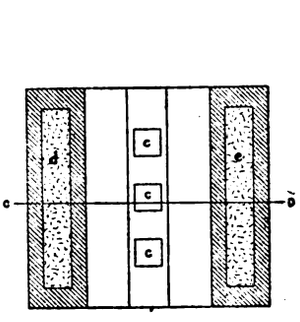
The arrangement by which the electrodes are in the middle and the supply of ore lateral is said to favour economy of heat. The furnace gases pass up the chutes, and help to heat the incoming material. For the rest, the gases could be utilised in other ways, but at present that is not done. An advantageous feature of the furnace is that it uses coke, and not charcoal, but coke containing 1·2 per cent. sulphur can be made to yield pig-iron with a content as low as 0·01 per cent. The furnace uses purer ores than the Elektrometall furnaces, and, the units being smaller, no useful comparisons can be made. In some tests recorded the consumption of energy in the furnace itself was 2,800 KW.-hours per ton of white pig-iron and about 3,000 per ton of grey pig, using a 44 per cent. ore.

The chief disadvantage of this type of furnace, compared with the Elektrometall, is that it uses single-phase current, so that on a three-phase circuit three furnaces have to be coupled together. On the other hand, the bottom electrode ensures all the current passing through the whole mass of molten iron, and the regulation of the height of the electrodes required in the three-phase Elektrometall, to ensure even distribution of current, is here unnecessary. The single-phase furnace has, however, the disadvantage of using a lower voltage, so that the losses in transmission and transformation are proportionally higher.

The Rennerfelt Furnace.—This is a new type of melting and refining furnace, invented in 1912. Up to the present, as many as some 20 furnaces have been built for Sweden, Norway, England and Russia, the largest having a capacity of 3 tons. It has been very successful in these small units, and the users are said to be most enthusiastic in regard to them. Mr. Rennerfelt hopes to be able to build units up to 50 tons capacity, or even more.

The furnace resembles the Stassano, in that it is of the "independent arc" type, but instead of the heat of the arc being merely reflected, or radiated down on to the charge, the arcs are so arranged as to be deflected themselves down upon the metal to be melted. The method is made clear from fig. 2, from which it will be seen that there are three electrodes, two horizontal and one vertical. They are supplied with two-phase current, the vertical electrode being the common return. The arc produced forms a flame extending vertically from the central electrode, and forced downwards by the magnetic force produced by the current itself. Fig. 2 also shows how the low-voltage two-phase current is transformed from high-voltage three-phase.

The furnace itself consists of a cylindrical steel shell, mounted on trunnions, so that it can be tilted. It is lined first with 1½-in. asbestos board, and then with fire-bricks, with an inner lining of magnesite bricks. Magnesite bricks line the roof, too, and thus a very high temperature can be maintained. The furnace's cavity is egg-shaped, as shown in fig. 3. In the larger furnace the cylinder is extended and several sets of arcs are used. A 40-ton furnace would have four sets of electrodes of 6 in. and 7 in. diameter. Graphitised electrodes are employed; they are smaller than amorphous carbon, so that the size of the openings is kept down. The consumption of electrode is only 3 kg. per ton of steel, and in the smallest furnaces the energy consumed does not exceed the moderate figure of 1,000 KW.-hours per ton of steel for castings. The power required for a 600-kg. furnace is 125 KW at 80 volts. For larger sizes it would decrease to about 120 KW per ton capacity. The furnace has been successfully used for melting ferro-manganese for use in Bessemer and open-hearth furnaces, as well as for melting steel for castings, which is its normal function.



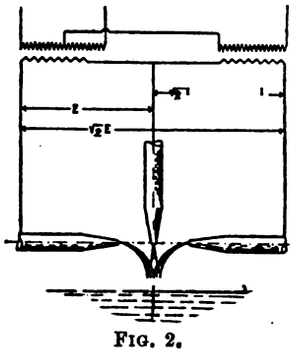


FIG. 2.

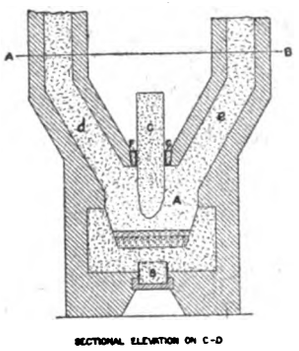


FIG. 1.—THE TINFOS FURNACE.

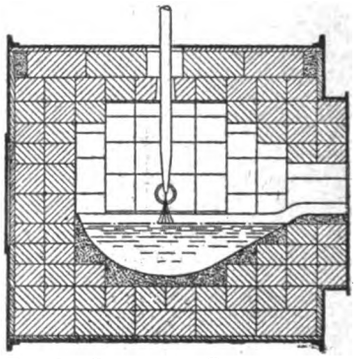


FIG. 3.—SECTION OF RENNERFELT FURNACE.

Conclusions.—Dr. Stansfield, from his study of Scandinavian conditions, arrives at the conclusion that although electric iron smelting cannot at present hope to compete generally with the blast furnace, in certain localities where pure iron, charcoal, and cheap water power can be obtained, it should be possible to produce economically a high-grade charcoal pig-iron, for the manufacture of special qualities of steel and wrought iron. Dr. Stansfield's interest is, of course, chiefly in Canada, and he points out that Canadian ores are not nearly so pure as Swedish ores. Nevertheless, impurities like sulphur are eliminated very thoroughly in the electric furnace, and it seems possible, so he concludes, using ores of moderate purity and a cheap fuel such as charred wood refuse or gas coke, that a good quality of iron suitable for car wheels could be made at a profit in one or other of the electric furnaces at present in use. This is more likely to be the case if a furnace such as the Elektrometall type were to do away with its shaft and its circulating system, and instead utilise the heat of its gases outside the furnace in heating open-hearth furnaces for turning the pig-iron into steel. It is noteworthy that the gas produced in making a ton of pig-iron in the electric furnace would almost suffice for the production of 1 ton of steel in the open-hearth furnace.

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NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Triumph Hand Lamp.

We have received from Messrs. Ward & Goldstone, of Sampson Works, Salford, particulars of their Triumph electric hand lamp or torch, for which exceptionally long hours of burning are claimed.

When fitted with the firm's "Volex Duo" dry battery, which measures 6½ in. long by 2¼ in. wide, about 150 burning hours are obtained, using a 2½-volt metal lamp.

An accumulator giving the same burning hours would be much heavier and larger, and we understand that the "Volex Duo" dry

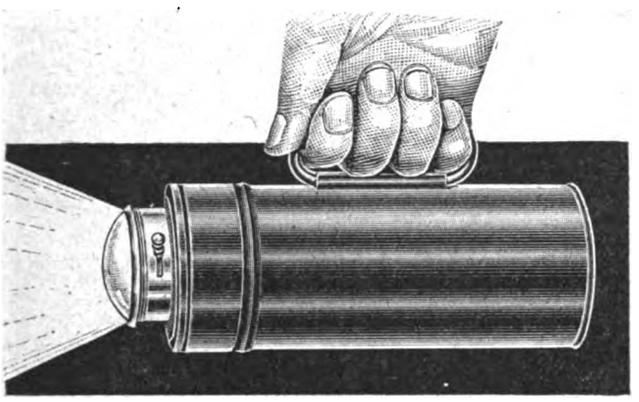

Fig. 1.—Triumph Electric Hand Lamp.

cell will hold up in stock for several years. On account of its long-burning hours, this lamp is recommended for use in factories, warehouses, &c., as a safeguard against the inconvenience of sudden extinction of the ordinary lighting.

The Arora Electric Fires.

The Arora Co., of Loughborough, which was started in the summer of 1915, marks a distinct advance in this branch of the electrical industry, under most propitious circumstances. Mr. Eric W. G. Burder, a keen member of the Loughborough Electricity Committee, who had an engineering works and foundry at his disposal, appreciated the great progress that electric heating and cooking was making; he met Mr. F. S. Grogan, who had patents pending, and possessed an exceptionally complete knowledge of what the public required, and their experience and resources were combined with the intention of providing, direct from the foundry, solidly built and reliable apparatus for heating and cooking at popular prices. The works extend over many acres on the outskirts of Loughborough, and have a private railway siding; goods can also be dispatched on two main railways, ensuring prompt delivery to all parts of England.

The "Arora" fires, one of which is illustrated herewith, are fitted with an element built of an extra-heavy section of wire, which under ordinary circumstances would not glow, but owing to the patented form of construction, a pleasing glow is obtained at

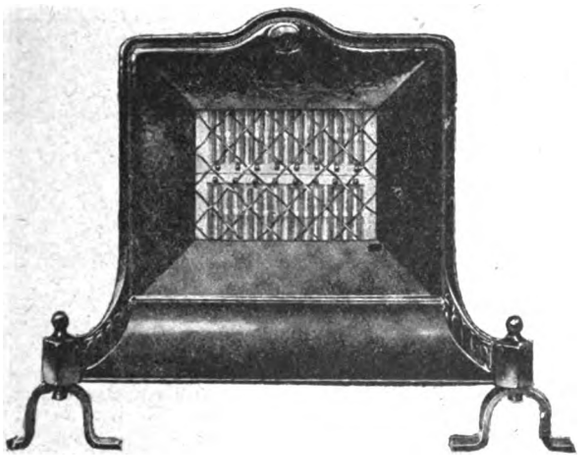

Fig. 2.—The "Arora" Electric Fire.

quite a low current density, and a maximum of radiant heat is produced. Elements of the most non-oxidisable metal have in the past oxidised sufficiently to reduce the consumption materially and consequently the heat produced. With the Arora heavy elements, this defect is reduced to a minimum. The elements are mounted on fire clay of exceptional strength. The frame-work is of cast iron throughout, in two main parts, the fire box and the front. The former is a complete unit forming a standard part, which is interchangeable with any front of the three finishes listed. It contains two 750-watt bars, two switches, and two heavy terminals complete with two yards of 70/36 S.W.G. flexible cord, and is attached to the front frames by means of two bolts only. The fire bars are also interchangeable, and may be obtained at a very low cost. The solid frame-work and parts are practically indestructible, and may at any time be made equal to new stock for a few shillings The total weight of the fire is 19 lb.

Arora fires Nos. 1, 2 and 3 (as illustrated in fig. 2) were put on the market in the middle of January this year, and we are informed that within a month orders were executed for over 40 corporations. Many repeat orders for large numbers have since been received, and strong approval has been expressed with regard to the particularly pleasing high-temperature effect and the remarkably low prices. We understand that Nos. 11, 12 and 13 are now coming through the works; they are similar to that illustrated, but 3 in. higher, to allow of the addition of a third fire bar. We also learn that very shortly a boiling plate of the open type will be put on the market, to meet the demands of the public and many central-station engineers for a quick, reliable boiler at low price.

Mr Grogan's many friends will be glad to hear of his new venture, and will join with us in wishing him success; few men have done more than he to develop the employment of electricity for cooking, and we believe he is working on the right lines—radiant heat and low prices.

Ediswan Dry Cells, &c.

We have received from the Edison & Swan United Electric Light Co., Ltd., of Ponders End, Middlesex, a sample of their Ediswan "O.K." dry cells, which they are making in their own works. The cell measures about 6 in. high and 2¼ in. in diameter; short-circuited through an ammeter for a moment, it gave 3½ amperes, and when put on discharge through a resistance of 5 ohms at 0·2 ampere, it stood up well to the heavy demand upon it, for nearly eight hours a day, four days in succession. During that period the output was 4 A.H., and the current had fallen to 0·12 ampere, but recovered to 0·15 after a rest. Later on, when short-circuited, it gave nearly one ampere for an hour and a half. So

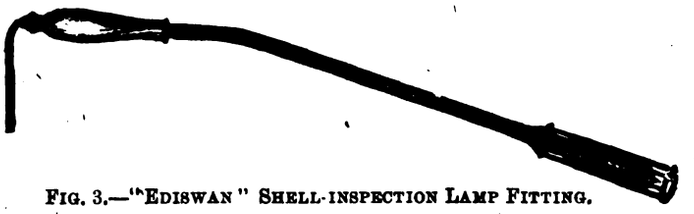

Fig. 3.—"Ediswan" Shell-inspection Lamp Fitting.

far as we can judge from these rather haphazard tests, and the appearance of the cell, it ought to do good service in connection with bells, telephones, fire-alarms, &c.

We have also received from the company particulars of their "Ediswan" shell-inspection lamp fitting, which is provided with an earthing device, and is sent out wired complete with lamp holder, and three yards of 3-way flexible cord, the latter including the earthing wire. The fitting, which is shown in fig. 3, is extra strong, with a view to hard factory use, and is very cheap.

New Burglar and Fire Alarm.

Mr. Arthur Julian, of Bank Chambers, Reading, noticing whilst he was in the United States the remarkable frequency with which safes were dynamited by thieves, conceived the idea that a combination of a pneumatic and an electric alarm would form a considerable improvement upon the existing system (winding a great length of insulated wire round the safe, and keeping a current continuously flowing in the circuit, any interruption of the current giving an alarm). His plan is to include in the design of the safe a double lining of thin metal, either inside the walls and door or sandwiched between the plates of which the walls and door are built up, and to connect the cavity with a U-tube containing mercury and a platinum contact wire. The air in the cavity is under a slight compression, forcing the mercury out of contact with the platinum wire, and the ends of a circuit containing a bell and battery are connected with the mercury and platinum. Under normal conditions, the circuit is kept open, thus avoiding the expensive renewal of batteries incurred with the closed-circuit system; variations of atmospheric temperature, if not negligible, can easily be compensated for. Should the air-pressure drop, owing to the wall or safe being drilled through or to other unlawful tampering with it, the mercury column at once would close the alarm circuit; the same result would follow if an accidental leak took place, the device, therefore, being self-testing. There is no difficulty in connecting the door of the safe to the alarm system. To guard against tampering with the pipe which connects the safe with the alarm apparatus, the inventor inserts into the tube three steel wires, which render it practically impossible to close the pipe by hammering, melting, or other means without allowing the air to escape and give the alarm.

Another application of the invention is to fire alarms. A system is already in operation in which a small-bore metal tube attached to a contact device is led round the ceiling of the room to be protected, the expansion of the air contained in it immediately giving warning of the outbreak of fire; Mr. Julian would put the air in this tube under slight pressure, so that the occurrence of a leak would instantly betray itself. In this case two platinum contacts would be required, one to announce a leak, the other to give an alarm in case of fire. He has also devised a burglar-proof bell to mount on the outside wall of a building in connection with a burglar alarm inside, the same principle being employed. Mr. Julian has patented the device in Great Britain and elsewhere,

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and has provided for the apparatus being operated either on the plenum system, as above described, or on the vacuum system, which of course is an obvious alternative. We understand that he is open to negotiate with firms desirous of adopting the system.

Liquid Starting Switches and Controllers.

A novel type of throw-over automatic liquid starting switch has recently been invented and patented by Mr. J. H. Woolliscroft, A.M.I.E.E., general manager of Messrs. H. T. Boothroyd & Co., of Liverpool. One of the best-known types of liquid starter is the Woolliscroft automatic liquid drum starter and controller, which is in extensive use; the new arrangement, however, possesses distinct advantages even over this satisfactory instrument.

The new switch has been designed to start up automatically motors, &c., at a predetermined speed, irrespective of the manipulations of the operator, and can be justly termed "fool-proof." The

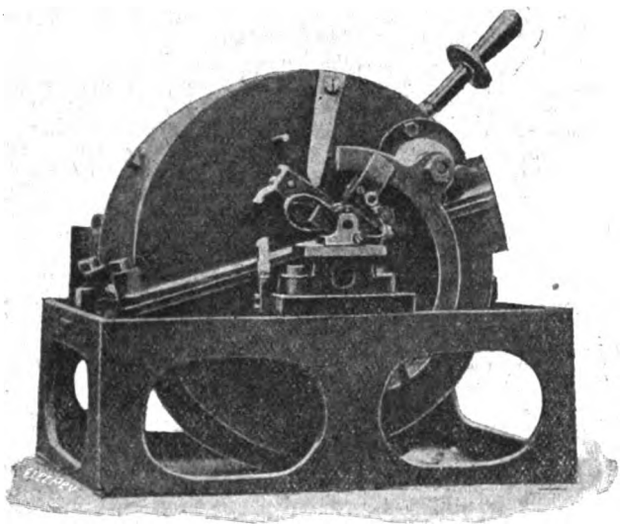

Fig. 4.—Starter in "Off" Position; Automatically Starting, and Held in Position with N.V. Coil.

device (fig. 4) consists of a circular drum divided axially, the halves being separated by a diaphragm, which is fitted with a two-way unbalanced valve. When the drum is rotated about 120°, it brings the electrodes to the bottom, the liquid being taken to the top and held suspended until it has leaked through the valve to the bottom half containing the electrodes. As the liquid is closing the path of resistance, the air in the electrode chamber, and the gases

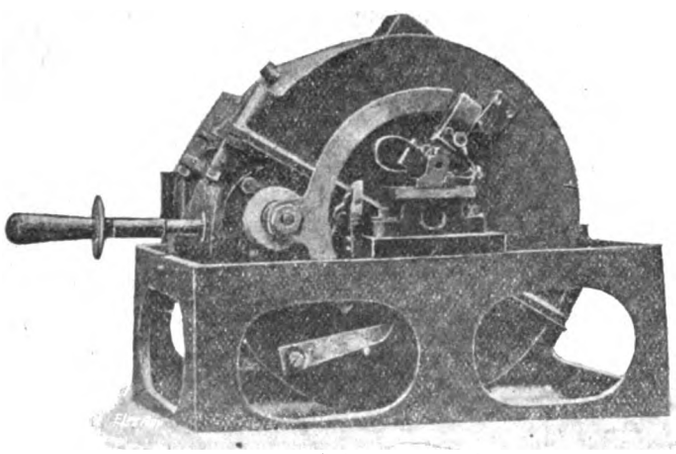

Fig. 5.—Starter in "On" Position; Automatically Short-circuited. Protective Covers are not shown in the Illustrations.

formed when starting up, are expelled through a special outlet vent, by the liquid acting as a water piston. Also to obviate any vacuum in the top half, from which the liquid descends, this chamber is fitted with a suitable intake vent hole. These vents are essential for practical working.

The switch is fitted with the usual no-volt and overload releases, and, being of the free-handle type, cannot be held in on a short circuit or overload. When the switch returns automatically to the off position, the liquid passes *en bloc* to the lower half without any disturbance or churning, and the air displaced passes unrestricted through the second valve arranged for the special purpose, which is part and parcel of the flap valve; the circuit is immediately opened, and the switch ready to be thrown over at once to the starting position again. This is a valuable feature, especially with reversing motors that require to be tickled rapidly in either direction of rotation. Another feature is that when the whole of the liquid has passed to the electrode chamber when starting up, the switch automatically short-circuits itself only after opening the electrode circuit and not merely shunting the paths as is usual, which latter method permits gases to be formed and electrolysis to take place, both of which are objectionable. The switch is short-circuited by the action of the two-way unbalanced valve, which when released from the weight of liquid, mechanically trips the contact brush to the short-circuited position with all resistance cut out (see fig. 5). With this arrangement there is not any waste or small currents passing continually, as is usual with solenoid-operated devices, &c.

Should any fault occur with any of the automatic devices (which is hardly possible), the starter can always be used as a plain dipper-type liquid switch, and can keep things going until opportunity occurs for inspection. The original type of Woolliscroft automatic liquid starting gears successfully got over the objection against the use of the early type of liquid starters (which were non-automatic and messy); the new pattern will be most useful for starting motors against heavy starting torque, doing away with expensive friction couplings, loose-belt arrangements, &c.

Being totally enclosed with the exception of the two small breathing or vent holes, which are effectually covered with fine gauze, the switches will fill the requirements for dusty, dangerous and explosive atmospheres.

Lead Melting Furnaces.

The Monometer Manufacturing Co., Ltd., of Whitehouse Street, Aston, Birmingham, has introduced a patent lead melting furnace, specially designed for the feeding of presses used in the manufacture of cable and compo pipe. Amongst the special features of the furnace are the automatic control of temperature by the firm's patent self-acting adjustable heat controller; the prevention of oxidation by turning the inert gases from the burners into the closed chamber covering the melting pot; the billet charging apparatus; telescopic outlet pipe; low-pressure burners fed from a gas equalising reservoir, &c.

Many of the leading cable makers use this furnace, and recently one firm has decided to equip its entire lead plant with a battery of these furnaces.

Electric Fire Pump.

Messrs. Mather & Platt, Ltd, of Park Works, Manchester, have recently issued a catalogue of fire fighting appliances, containing information to assist the shipowner to comply with the Merchant Shipping (Convention) Act, 1914, the provisions of which are about to come into operation.

It has been usual to install reciprocating steam pumps for fire duty, but Messrs. Mather & Platt draw attention to the possible alternative of an electrically-driven turbine pump, which has, comparatively, a greater output for its weight and size than the steam pump.

A two-chamber turbine pump running at 1,400 R.P.M., as supplied by the firm, will throw two jets horizontally about 60 ft., the water being supplied through 50 ft. of 2½-in. canvas hose with ¾-in. nozzle. This absorbs about 23 H.P., and a motor of about 28 H.P. would be suitable for driving it. A motor-driven turbine pump of this type is illustrated in fig. 6.

Current would normally be drawn for the ship's lighting and power installation, but provision should be made for connection to the emergency set which is now usually carried on deck to permit of some amount

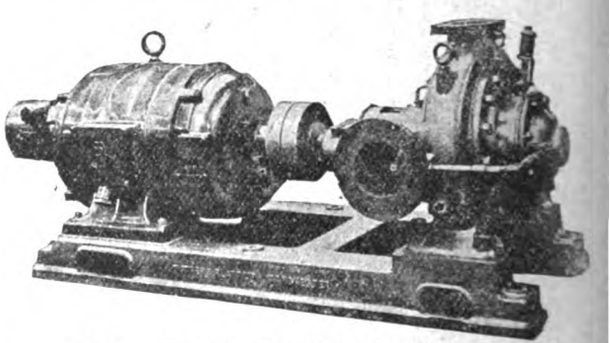

Fig. 6.—Turbine Fire Pump for Ships' use.

of lighting being maintained and a supply given for wireless purposes, in the event of the main sets being put out of gear.

The Miner's "Scout."

This is a patent mechanical device, which is intended to indicate the slightest movement of ground, when adjusted in a stope or tunnel, and thus to give warning of impending falls of roof. Instant intimation is given to a watchman or to the mine manager's office by the completion of a circuit through the instrument; or the ringing of a bell and the showing of a red light on the device itself may serve, where the instrument is in sight of, or near, the miners. The Mining Commissioners in the South African Gold Mines, and also in Australia, state that there is need for such an instrument, and in the latter country legislation for its use in dangerous mines is about to be introduced.

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The patentees are practical miners who have found the use of such an instrument of vital moment to them, as, in many mines in the countries mentioned, the number of accidents through falls of ground or rock exceeds 60 per cent. of the total. They claim that there is no sudden fall of ground without some slight movement some time before, and that this instrument indicates the slightest movement in time to enable the necessary measures to be taken to prevent accidents.

The instrument being inexpensive and of a portable nature, it can easily be carried and used in various parts of a mine. It is of very simple construction, consisting of two brass tubes telescoping together, but kept extended by a long spring inside them, and a box is fixed to the upper tube, containing a battery, bell and red lamp. Contacts on the outside of the box are closed when the tubes are pushed together, by a disk clamped on the lower tube. The outer ends of the tubes are shod with iron, and the instrument is applied by pushing the tubes together until they fit between the roof and floor of the tunnel, against which they are firmly held by the spring; the disk is then clamped close to the contacts, so that any movement of ground which brings the roof and floor nearer together by, say, ¼ in., or less if desired, will cause the bell to ring and the lamp to light up. Further information can be obtained from the SLOAN ELECTRICAL CO., LTD., of 12, Golden Lane, E.C.

"WIRELESS WIRING" AT THE FRONT.

THE following is an extract from a letter written by a G.E.C. man at the Front (Corporal Watts) to a friend in Walthamstow, Mr. F. Miller, who kindly forwarded it to us:—

"I must first of all ask you to thank all my pals at the G.E.C. for their kindness to me at Christmas. Indeed, it was good of you all to remember me and to express such kind wishes. The parcel arrived on the very day, but I couldn't say much then as my heart like my mouth was too full. I have never had such a Christmas, and, in many ways, I do not wish for another similar one. A week previous I was working hard for the review. We were successful in obtaining a large hall of a local woollen factory, and as it has only been built about two years it consisted only of the four walls (brick) and a cinder floor. We built a stage and arranged all the seating, and I took charge of the electric lighting. After a chat with the owner we persuaded him to supply us with current from his plant, so that was a great help. Well, I started in on what looked like an impossible job, as it was impossible to obtain any insulated wire or accessories from any of the large towns near. I then had a 'brain wave,' and collected two old inner tubes of a private car and a little rubber gas tubing. I commandeered some No. 8 bare copper wires and slung them across the river from the factory to the hall, insulating by pieces of inner tube nailed to woodwork. As I had no straining instruments, I took up the slack by forcing strips of wood between the leads. I brought the leads right outside the hall for safety's sake, and only brought them in on the stage. The next to tackle was

FIG. 1.

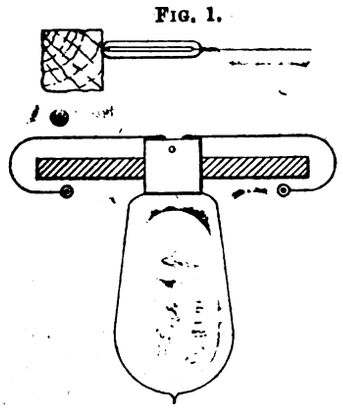

FIG. 2.

the hall, which I wired in bare No. 20 copper, which we had in stock as binding wire. As with the mains, the insulation was inner tube pieces, 1 in. × 1 in., under a wire staple. Where dead ends were attached, rubber bands were cut and formed globe strain insulators. [Fig. 1].

"All wires were run on the top joists far overhead, so I made pendants with two live wires, separated by 6-in. strips of wood, and 6 in. of flex to enter the lampholder. This made a very satisfactory job, and at night was invisible by the artificial light. In fact, it was christened 'the wireless wiring.'

"Next I tackled the dressing-room, which was directly behind the stage, and as I was not allowed to cut a hole through the wall, I had to take my leads under the top of the door, which consisted of an iron girder, and was easily touched by the face of the artistes as they came off the stage—especially in 'black outs.' To safeguard this bend I ran the wires through two lengths of rubber gas tube, and labelled the position 'Danger à mort'—danger of death. The lighting of the dressing-room was carried out as the hall, but the leads were fixed to wooden brackets, and the drops were workshop flex. Next the stage. Now the fun started. I found I had used up all my holders and all I had scrounged from neighbouring columns. Here was a problem—how to bring the lamps into position of utility and out of the way of scene-shifters. Luck is a big factor, so I backed my fancy, and chanced it. My footlights and three lines of battens were all made by drilling holes to take the lamp-cap and soldering two pieces of wire to the contacts, and attaching them to the two leads stretched along the front of the batten by bringing the wires round to the front kept the lamp in position thus [Fig. 2]:—

"One of the staff-sergeants of our neighbours made two stage arcs for us, and they were a work of art. These I had to run for with $\frac{4}{20}$ insulated which was 'scrounged.'

"Now my total was made up as follows:—

Hall.	7 pendants (1 light); 1 cluster (5 lights).
Outside.	1 illuminated sign REVIEW. (2 lights).
Dressing Room.	6 pendants (1 light).
Orchestra.	2 pendants (1 light).
	1 signal light (1 light).
Stage.	2 projector arcs (10 amps.).
	18 footlights.
	56 battens.
	1 pilot lamp at switchboard, worked off accumulator, 4 volts, 8 C.P.

"Not a bad load, considering the voltage was 115 D.C. Now came the trouble of the switchboard. Here was a problem indeed. I had obtained 1 D.P. 10 amp., 1 S.P. 5-amp. knife, 3 5-amp. tumbler, 1 3-amp. tumbler, 1 dock plug, but no fuses. We made the board of 2 9-in. planks, 18 in. square, and mounted on two battens, 4 in. × 2 in. My fuse bridges were ¼ in. steel bolts (main, ⅜ in.) and bus-bars, copper wire bound zig-zag round the bolts. Fuse wire strand of No. 40 copper taken out of flex. Behind each fuse was fixed a piece of mica to prevent fire. With the help of Pte. W. Hossick, of the 18th A.S.P., who worked like the Scotsman he is, we were able to switch on half-an-hour before the dress rehearsal, to which were invited the invalids from the Hospital. As luck would have it, the only main fuses we could get on the switchboard in the mill were German cartridge type, and they only had one pair, 60 amps. You will see we were on the brink all the time, but, I am glad to say, all was well. My fuses were only just sufficient, as I dared not blow the cartridges. You can imagine what a relief it was to us electricians to see 'all on.' I won't say the fuses weren't warm—they were hot.

"Our dress rehearsal was Christmas Eve, and we had until Monday night to put the finishing touches, and we were at it to a packed house (average 800) every night of the week. Everything a great success. During the week of showing I had my ordinary work to do as well, so I was not idle. Three times that week I had to go up to the line to fix up a broken-down lorry. My part in the review was not hard, but I had to keep changing. One lot four times in 10 minutes. . . . . On the following Sunday we (A.S.C.) gave the kiddies of the village a bun-fight, cinema and concert. This entailed a lot of extra work as the mill was shut down, and I had to divide my lighting into halves and use two of our travelling workshops. On the following day we cleared everything away."

The occasion of the installation above described was the 5th and 18th A.S.P.'s Christmas, 1915, revue, entitled "Yes, I Think So!" The revue was written and produced by Private R. Douglas, assisted by Private L. Bartleet and Lance-Corporal Topham, while Private L. Bartleet arranged the music. The scenic effects were arranged by C.Q.M.S. Dearden, and the electricians were 5th A.S.P. Corporal Watts and 18th A.S.P. Private W. Hossick. The scenes were laid in "A Middle-Class English Home—Christmas, 1914," and "Grove Park Barracks—January, 1915," "Somewhere in England, July, 1915," and "Somewhere in France—Present Time." The last scene was as the first, but at Christmas, 1934; one scene was entitled, "Recruit's Dream—Horatio Tatus in Automobiling." Corporal Watts figured as a raw recruit, and "a lounger and policeman"—whether the last two parts were identical or not is left unstated. Corporal Watts was also responsible for a conjuring turn. The cast included many non-commissioned officers and privates, and one second lieutenant, who appeared in the *rôle* of "the dude." The entertainment appears to have been most carefully and ably planned and carried out, and illustrates the unquenchable good spirits and enterprise of our comrades in France.

A Substitute for Platinum.—An alloy for use in contact and spark devices to replace platinum has been patented by Mr. Paul R. Heyl, of New Rochelle, N.Y. (assigned to Commercial Research Co., of New York City). This alloy consists of silver and palladium, in varying proportions according to the conditions under which it is to be used. An alloy of silver with 2 per cent. of palladium has been found to give satisfactory results under many circumstances. When the contacts or spark points are exposed to sulphur compounds, 5 per cent. or more of palladium should be used. The alloy which was found to give the greatest resistance to spark erosion was that of 60 per cent. palladium and 40 per cent. silver. Additions of palladium to silver raise the melting point and lower the thermal conductivity. It has been found that, on account of the high thermal conductivity of silver, the heat from the spark will be conducted away fast enough to prevent melting of the silver. In view of this fact, silver-palladium alloys with very high percentages of silver can be used in a great many cases.—*Met. and Chem. Engineering.*

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FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

BRITISH INDIA.—A Customs Circular has been issued by the Department of Commerce and Industry fixing, with effect from January 1st, 1916, the tariff valuations on various articles imported into British India. These valuations differ in many instances from those which were previously in operation. The duty, however, on instruments, apparatus and appliances, and parts thereof—electric, electric lighting, galvanic, telegraphic and telephonic, remains the same, viz., 5 per cent. *ad valorem;* while electrical machinery and component parts thereof (including belting of all materials for driving machinery) remain free of duty. Among the articles for which the tariff valuations have been amended are the following, duty being charged at the rate of 5 per cent. in each case:—

	Former valuation.		New valuation.	
	Rs.	Ans.	Rs.	Ans.
Sal ammoniac ..... cwt.	31	0	36	0
Brass, patent or yellow metal, sheets and sheathing, weighing 1 lb. or above per sq. ft., and braziers and plates ..... cwt.	54	0	65	0
Copper, braziers, sheets, plates and sheathing ..... cwt.	62	0	65	0
Copper, pigs, tiles, ingots, cakes, bricks and slabs ..... cwt.	58	0	62	0
Copper, china, white, copperware ... lb.	2	2	2	4
Copper foil or dankpana, white, 10 in. to 11 in. by 4 in. to 5 in. ... 100 leaves	1	14	3	8
Ditto, ditto, coloured, 10 in. to 11 in. by 4 in. to 5 in. ..... 100 leaves	2	0	3	12
Quicksilver ..... lb.	1	8	3	0
Zinc or spelter, tiles or slabs, soft, cwt.	25	0	50	0
Zinc or spelter, tiles or slabs, hard, cwt.	20	0	40	0

16 annas = 1 rupee = 1s. 4d. (at par).

NORWAY.—Information has been received at the Board of Trade to the effect that the prohibition imposed in September last on the exportation of tool steel and turning steel from Norway has now been replaced by a prohibition on the exportation of tools and tool steel. The prohibition does not, however, apply to such articles produced in Norway and accompanied by certificate of origin.

UNITED STATES OF AMERICA.—A decision has been given by the Board of General Appraisers regarding the rate of import duty leviable under the United States Tariff Act of 1913 on power-transmitting tables for sewing machines. These tables, it is decided, being composed in chief value of metal, and capable of operating at the same time from 5 to 20 sewing machines, are properly dutiable as manufactures of metal not specially provided for, at the rate of 20 per cent. *ad. val.*

COLOMBIA.—A Colombian Decree of November 5th provides that when articles liable to Customs duty are sent to the Republic by ordinary or registered letter post, the same duty shall be levied thereon as if the articles were imported by parcels post (*i.e.*, the full duties prescribed by the Colombian Customs Tariff), and that, in addition, a fine of ½ peso shall be levied for each letter. Packets of books are, however, excepted from this provision, Customs duty only being levied thereon.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

2,164. "Telephone transmitter." H. Burge. February 14th.

2,176. "Electric switches or couplings." R. W. L. Phillips. February 14th.

2,179. "Electric torches or pocket lamps." A. A. King. February 14th.

2,201. "Systems for distributing electric energy." C. H. Wordingham. February 14th.

2,212. "Device for automatically effecting release of electrically-operated mine signals, &c." D. Pearse. February 15th.

2,242. "Telephonic receiver." A. Williams & L. D. Williams. February 15th.

2,244. "Electrically-operated intermittent motion in kinematograph apparatus, &c." A. C. Moll & A. D. Moll. February 15th.

2,249. "Passing through the human body currents derived from the ordinary town main electrical supply." E. E. Greville. February 15th.

2,253. "Automatic electric driving engine." F. Knight. February 15th.

2,254. "Method of electro-mechanically operating colour effects for theatres, &c." W. E. Grant. February 15th.

2,256. "Electric batteries." R. S. Baxter. February 15th.

2,261. "Regulation of induction motors." British Thomson-Houston Co., Ltd., & N. Shuttleworth. February 15th.

2,266. "Electrically-operated indicating apparatus for signalling apparatus on railways." J. P. O'Donnell. February 15th.

2,283. "Dynamo-electric machines." M-L Magneto Syndicate & E. A. Watson. February 15th.

2,287. "Electrical aids for deaf persons." C. W. Hawksley. February 15th.

2,293. "Electrical fire and burglar alarm." A. Julian. February 16th.

2,312. "Heavy current relay key." J. Gell. February 16th.

2,328. "Electrical discharge devices." S. Dushman. February 16th. (U.S.A., February 20th, 1915.)

2,329. "Means for producing alternating currents." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). February 16th.

2,339. "Telegraphy and apparatus therefor." A. C. Fuller. February 16th.

2,345. "Electric heat radiators." A. F. Berry. February 16th.

2,346. "Air purifying or conditioning apparatus." A. F. Berry. February 16th.

2,347. "Oil-cooled transformers." A. F. Berry. February 16th.

2,350. "Electric pocket lamps." F. E. Kuhn & A. Weinmann. February 16th.

2,375. "Combined plug, socket, and switch devices for electric circuits." V. Hope. February 17th.

2,384. "Accumulator-charging systems for vehicles." R. Russell. February 17th.

2,388. "Electro-magnetic apparatus." J. E. Pollak (Soc. Anon. des Etablissements L. Bleriot). February 17th.

2,400. "Electric buzzers, &c." A. W. Gamage, Ltd., & G. H. J. Horan. February 17th.

2,402. "Signalling by electro-magnetic waves." A. Arton. February 17th.

2,405. "Electric switches." C. W. Gray. February 17th.

2,443. "Fluid-operated electrical switches." J. F. Barr. February 18th.

2,444. "Electro-magnetic overload circuit breakers." H. E. Turney. February 18th.

2,464. "Electrostatic machines." Morris & Lister and D. K. Morris, and E. A. Watson. February 18th.

2,468. "Telephony." S. G. Brown. February 18th.

2,478. "Electric conductor grips for relieving the connection of such conductors with electric fittings from pulling strain." S. Fildes. February 19th.

2,491. "Electrical fuses or cut-outs." H. W. Cox. February 19th.

2,524. "Transforming motion into electrical waves or impulses." T. B. Dixon. February 19th. (U.S.A., July 19th, 1915.)

PUBLISHED SPECIFICATIONS.

1913.

20,856. Telephone Exchange Systems. Zivnostenska Banka (firm of). September 16th. (October 28th, 1912.)

1915.

1,087. Telephone Systems. J. E. Cooley. January 22nd. (January 23rd, 1914.)

1,435. Dynamo-electric Machines and Electrical Systems connected therewith. J. Stone & Co. and A. H. Darker. (January 28th.)

1,471. Automatic and Semi-automatic Telephone Systems. Relay Automatic Telephone Co. (formerly Betulander Automatic Telephone Co.) and L. C. Bygrave. January 29th.

1,500. Lamp Supports and Casings, particularly designed for use with Electric Incandescent Lamps. B. J. Grigsby. January 29th.

1,857. Submarine Electric Leakage Telegraphy. Signal G.m.b.H. February 5th. (February 5th, 1914. Addition to 13,919/13.)

2,078. Coin-freed Electric Illuminating Apparatus. H. F. Stiles and A. H. F. Perl. February 9th.

2,343. Telegraph or like systems and apparatus therefor. Automatic Telephone Manufacturing Co. & S. R. Smith. February 13th.

2,624. Rotors of Dynamo-electric Machines. Sunderland Forge & Engineering Co., R. G. Scott and A. T. Robertson. February 18th.

2,687. Electric Batteries. J. Sutton & G. J. Sutton (trading as Stuart and Moore). February 19th.

3,442. Manufacture of Carbon Electrodes. Georg Mendheim (firm of). March 3rd. (March 4th, 1914.)

4,046. Electrical Switches. A. P. Lundberg, G. C. Lundberg, P. A. Lundberg, and G. Pegg. March 15th.

4,209. Rheostats. Igranic Electric Co. (Cutler-Hammer Manufacturing Co.). March 17th.

4,348. Telegraphy Eastern Telegraph Co. & A. C. Gardiner. March 19th.

5,076. Electric Signalling Systems for use on Railways. J. Boot & W. E. Scourfield. April 1st.

5,224. Electrically-operated Reversing Mechanism for Planing Machines and the like. R. McK. Robertson & J. Lennox. April 7th.

5,261. Device for Testing the actual available Working Current in Electric Batteries or Cells. A. A. Lyon. April 7th.

5,513. Miners' Electric Safety Lamps. O. Oldham. April 12th.

5,768. Electric Lighting. I. Frankenburg & Sons, Ltd., and E. Fleming. April 17th.

6,807. Stereoscopic X-ray Apparatus. British Thomson-Houston Co. (General Electric Co., U.S.A.). May 6th.

6,898. Electrical Connectors. A. P. Lundberg, G. C. Lundberg, P. A. Lundberg & G. Pegg. May 8th.

7,006. Electrical Toasting Devices. E. C. R. Marks (Landers, Frary and Clark). May 10th.

7,433. Electric Air Heater. F. L. McKinnon. May 18th.

7,554. Combined Electric Switches and Plugs. A. H. Ralling, C. C. Garrard & A. F. Searle. May 20th.

8,099. Means for adjusting the Height of Electric Lamps. R. E. Taffinder. June 1st.

9,915. Brake for Electrically-propelled Vehicles. Rt. Hon. H. L. Samuel, W. Slingo, H. C. Gunton & C. H. Douglas. July 7th. (Divided application on 15,539/14. January 28th, 1915.)

10,334. Electric Bells. M. Suwa. July 15th.

10,983. Method and Apparatus for Isochronising and Synchronising Rotatable Members, particularly applicable for Multiplex Telegraphy. P. M. Rainey. July 29th. (August 18th, 1914.)

11,375. Means for the Production of Sound by Electro-magnetically-operated Diaphragms. E. A. Graham. August 6th.

12,340. Electric Motor Control Systems. British Westinghouse Electric and Manufacturing Co. August 27th. (September 25th, 1914.)

13,837. Regulators for X-ray Bulbs and like apparatus. C. G. Roch. September 29th.

15,113. Dynamo-electric Machines adapted for Synchronous Working. L. J. Hunt & Sandycroft, Ltd. October 26th. (Addition to 24,838/14.)

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THE

ELECTRICAL REVIEW.

VOL. LXXVIII. MARCH 10, 1916. No. 1,998.

ELECTRICAL REVIEW.

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NOTICE.

IN view of the recent Increase in the Postal Charges, our Subscription Rates for Great Britain and Canada will until further notice be increased to £1 1s. 8d. and £1 3s. 10d. respectively.

IN THE MELTING POT.

IN discussing the subject of organisation in our last issue we touched upon a number of ways in which our national industries may be strengthened by effort from within themselves. While that article was being written a number of leaders to whom we look for a certain amount of direction in these days, were delivering speeches in London on another and by no means less important aspect of the great question of after-the-war trade. We do not agree that discussion of such matters in any degree weakens the nation's effort to speedily bring the war to a victorious conclusion, and we are glad that two very busy members of the Cabinet were able to find time to attend part of the proceedings of the Association of Chambers of Commerce for the purpose of making speeches concerning the relation of trade to the war and the essential nature of the service that traders are rendering to the Empire and the Allies, also to reveal, though only in some small way, what is happening in the minds of members of the Government respecting what assistance the nation should render to industry after the war. Mr. McKenna, the Chancellor of the Exchequer, and Mr. Bonar Law, the Colonial Secretary, a few years ago might not have been credited with the desire to sleep in the same bed, but their presence in the same Cabinet in a period of national crisis, and the consciousness that the position that now confronts us is totally different from any that we have ever known before, have led them to turn their swords into ploughshares, and they are together preparing the ground for a compromise respecting what they formerly regarded as vital differences. Mark first the words of Mr. McKenna:—"We must learn by the experience of the past. . . . We have found ourselves dependent upon that nation (Germany) for many essential matters of our own trade. I do not think that, as a nation, whether by the individual efforts of our traders or with the necessary assistance of Government, we ought ever to allow ourselves to be placed in that position again." He proceeded to show that there was a very large field for common agreement between those who still stood for or against certain principles, but he added what we have said on many occasions: "It does not follow, though trade may be free, that the help of the Government should not be given to assist our traders." Our regret is that the Government did not see it so in days gone by and render a greater measure of assistance, but, as Mr. McKenna says, the Government has learned "by the experience of the past," and it is now about to act. What is to be the course of that action? The most significant and hopeful part of the speech, though somewhat enshrouded in mystery, was this:—

"We are prepared, and we have already shown, in a way which I am not yet able to state to you, that we are prepared to give the assistance of the Government to the development of foreign trade in order to ensure that those rivals who are now our bitter enemies, shall not have the control of the foreign trade which they have enjoyed in the past. . . . In the past there has been some complaint that Government has not given that assistance in distant parts of the world which was rendered by other Governments in similar circumstances. Well, it may be that a policy which is right at one time is not right at another, and it may be that we have to learn that a policy of Government assistance becomes necessary to secure the development of what we might term the master trades, and to secure the extension of our commercial influence through neutral countries."

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Here we must leave the Chancellor. We must not venture to probe the inner recesses of the governmental brain, though we confess that we shall await with pleasure the further draught which is so necessary to satisfy our thirst for information.

The attitude assumed by the Colonial Secretary on the following day is in marked similarity to that of Mr. McKenna. "Everything is changed," said Mr. Bonar Law. He is not arguing to convert Manchester electors now, all that is a matter of the dead past—"Everything is changed. We must begin on a new basis; we must put aside all preconceived ideas . . . . the problem is not at all the same as we used to discuss, and it must be considered from a new point of view by those who held my views and those who were opposed to them." The probability that after the war there will be special trade relations between those who are now our Allies "completely alters the basis of the problem." As Colonial Secretary he turned from the question of trade with the Allies to the future of our trade within the Empire. "Whether it pays us or not we shall not forget these things (war horrors), and whatever else happens the resources of the British Empire will never again be exploited as in the past by our German enemies." Further, "I do not believe that the people of this country will be satisfied with any system which makes us dependent for the key industries of our trade and for our supplies for war on any nation, least of all on the German nation." We shall all desire to re-echo the tributes which Mr. Law paid to the magnificent service rendered by the Colonies throughout the war. "We could not have won this war, we could not win it now, but for the strength which we have got from the great Dominions." In presence of such a conviction, after the utterance of so momentous a statement, there will surely be none to deny the Dominions a voice in regard to what the after-the-war policy of the Empire shall be, and in that policy the question of trade and industry occupies a large place. Some of the Colonies are already dealing with the matter, so far as they can, endeavouring to exclude German influence both now and after the war. Mr. Andrew Fisher and Mr. Hughes are now in this country. They are both highly charged with messages from the Australian people urging that we adopt no half-hearted measures which will permit of cancerous growth again occurring in vital industries of the British Empire. Mr. Law had all of these circumstances in mind when he said that the problem of the future must be considered in conjunction with the great Dominions as well as in conference with our splendid Allies. He announced that arrangements were being made for an economic conference of the Allies to be held in Paris, at which will be considered both the fuller use of the economic forces of the Allies in the prosecution of the war itself, and the problem of what will happen after the war, when Russia and Italy want to be free from the influence with which German financiers and business men have permeated their industries in recent years. Mr. Bonar Law confessed that he could not fix his mind on "after-the-war" problems at that meeting, and so much depends upon the conference at Paris, that Mr. Asquith on Tuesday was in the same position. As a matter of fact, we all feel how immense these problems are, and how vast will be the attention that they will have to receive before the details can be settled point by point, but apart from the consideration of the details, we can find a common ground in the speeches of these dissimilar men—a definite desire for, and a move in the direction of, a compromise which will bury the controversies of the past and lead us all to adopt some policy or other which shall enable the Home Country, the Empire, and the Allies, so to act in harmony for generations to come as to bring happiness and prosperity, and freedom from external menace, to all the nations that have been so terribly mangled in their efforts to prevent the domination of the world by Prussian militarism. As there will be no separate Peace, so will there be no separate commercial treaties made with the Enemy, by any one of the Allies. The prospect of an Economic Pact is already giving German traders "furiously to think."

One other speech delivered last week has a close relation to the two referred to above—we mean that of Sir E. Holden, who also appeared before the Chambers of Commerce gathering. His remarks were devoted to the subject of banking, and in our efforts to secure the co-operation of the banks in assisting our industrial development we shall do well to keep his speech in mind. We believe that at heart most people share his admiration for the excellent work that British banks have rendered in the past. It is obvious from his speech that he urges British traders and industrial men to pursue the idea of forming, with the assistance of the Government, a big "additional" banking institution, perhaps on the familiar industrial bank lines, with branches or allied small banks in different countries abroad. By establishing such an organisation Sir Edward holds that "we should be pretty successful in turning the tables on our German banking competitors in foreign countries."

Copper. THERE has been no great change in fundamental conditions in copper within the last few weeks, although events in all metals have been the subject of the closest attention on the part of the authorities, whose efforts for some time were directed towards the elimination of gambling operations in the metals more particularly required for munition work. Although a warning to that effect had already been given recently in the case of pig-lead, the drastic action taken last week to prohibit speculation in war metals as indicated by the Proclamation came rather as a surprise, and naturally caused some consternation in metal circles, because of its far-reaching effects, also having regard to the difficulties involved in conducting *bonâ fide* business. Official dealings in copper, as in other metals, barring tin, which was excluded from the Proclamation, were brought to a standstill. Through the representation made to the Ministry of Munitions by a deputation from the Metal Exchange, however, a satisfactory understanding, was arrived at by which it was possible to resume official operations on the Metal Exchange on Monday last. These operations, of course, are now proceeding under the new regulations, or in accordance with the spirit of the Proclamation intended to prohibit speculation with no intention of interfering with the course of legitimate business. A more comfortable feeling has thus been brought about, although the liquidation of outstanding speculative engagements has now to be proceeded with. So far as copper is concerned, the modified aspect of the London official trading can hardly have any important bearing on the course of the general market under present exceptional conditions of scarcity due to the magnitude of the outlet not only in connection with the huge requirements of munition factories in warring nations, but also to the phenomenal extension of industrial enterprise across the Atlantic. There is no blinking the fact that these two factors combined have been for some time past more than sufficient to take care of the whole of the world's output in spite of the considerable increase in the American production to new high records. The American brass industry is now consuming much heavier quantities, the melting of the American Brass Co. alone being at the present time roughly estimated to be at the rate of well over ½ million tons per annum. There has been, too, a notable expansion of electrical enterprise in the United States, partly in connection with important schemes of railway electrification. Very large quantities of copper have been shipped from America to the Allies in the last few months, but these appear to be rapidly swallowed up by the intense pressure of munition work, while it is rather significant that the unsold warehouse stocks of raw and finished metal in this country have been reduced to vanishing point. Sulphate makers now find considerable difficulty in covering their needs in rough bar copper, while the

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demand for this material has been very keen at the relatively low prices ruling as compared with the value of American fine copper in the neighbourhood of £136. At the highly inflated level of prices at which their copper has been selling for some time past, American producers have been accumulating enormous profits, and this is not unlikely to continue so long as the war lasts. The bulk of their output has been sold for months ahead, therefore enabling them to be quite independent of adverse movements in the price of standard copper, such as have again been experienced lately amidst the disturbed surroundings. The market is admittedly held at a dangerously high level, but it is hardly likely that American control will be relaxed in view of the present exceptional opportunities.

The I.E.E. and Alien Enemy Members.

The special meeting which was held last week to "consider" this question presented many unexpected features, not only to the Council and members of the Institution, but also to the interested onlooker. The large and punctual attendance of members at 5 o'clock was in itself surprising, and the intensity of feeling evinced in the course of the proceedings bore additional testimony to the importance attached to the question by them; moreover, the attendance was by no means confined to members resident in the London area—many well-known engineers had come to town expressly to take part in the proceedings. It is easy to understand, therefore, their disappointment when they found that, under the stress of "legal technicalities," it was not competent for them to propose and discuss amendments to the resolution which had received the sanction of the Board of Trade. As we pointed out some weeks ago, a fortnight's notice must be given of the nature of the business to be transacted at a special general meeting, and as barely a fortnight intervened between the calling of the meeting and the date on which it was to be held, it was obviously impossible for members to take any effective action towards varying the terms of the resolution.

Writing after the event, no doubt it is easy to reproach the Council for lack of foresight in approaching the Board of Trade first and the members afterwards; in the absence of a similar experience we might hesitate to criticise the Council on this ground. It happens, however, that the sequence of events closely resembles the procedure which was followed by the Council in 1911, when one week's notice was given of a meeting at which alterations in the Articles of the first importance were to be "considered," with the result that the members claimed their right to a voice in their own affairs, the meeting became a fiasco, and the whole question had to be reopened. The present Council cannot have forgotten those incidents, and, therefore, criticism is justified. On that occasion, writing before the meeting took place, we pointed out that the whole proceeding had an air of precipitation and autocracy, and that the wiser course would have been to allow plenty of time for mature consideration of the new proposals; precisely the same remarks apply to the present situation.

We have no doubt that the wisest course, under the circumstances, was that which was ultimately decided upon—namely, to consult the members first and the Board of Trade afterwards. This is also the routine that would be dictated by common sense, and why it was not adopted in the first instance we are at a loss to understand.

American Lamp Patents.

Those of our readers who recall the circumstances which attended the establishment of the Edison & Swan patents for carbon-filament lamps in this country, and their overthrow in Germany, will be interested to learn of the situation which has now arisen with regard to the tungsten lamp patents of Just & Hanaman. In December last we recorded the judgment of the Court of Appeal, according to which the judgment of Mr. Justice Joyce (that the plaintiffs' patent was not for making filaments of tungsten, but only for making them by the particular process specified) was substantially confirmed, the judgments of both tribunals being directed entirely to the process and not to the material used. The result of the action, subject to appeal to the House of Lords, is at present to throw open the manufacture of tungsten filaments of the "squirted" type in this country, for the process employed for this purpose by the defendants, which was declared not to be an infringement of the plaintiffs' patent, is, we believe, unprotected by letters patent.

On the other hand, we have just received particulars of the decision of the United States District Court, Southern District of New York, in an action brought by the General Electric Co. (U.S.A.) against the Laco-Philips Co., to restrain the latter from infringing the American patent of Just and Hanaman. The defendant company imported into the United States lamps with "squirted" and drawn-wire filaments of tungsten. The U.S. patent specification contained a broad claim for an incandescent lamp filament consisting of tungsten in a coherent metallic state and homogeneous throughout.

The Judge held that the lamps imported by the defendant company infringed the claims of the patent, and he also declared the patent valid. The application was filed in 1905, but the issue was delayed through interferences between four parties, one of whom, with the connivance of one of the Patent Office examiners, had fraudulently introduced into one of his own specifications matter derived from the Just & Hanaman application. In the end, priority of invention was awarded to Just & Hanaman, and the patent was issued on February 27th, 1912, so that it will run until 1929, and if the decision stands, the control of the tungsten lamp situation in the United States will until that date be entirely in the hands of the General Electric Co. and its licensees.

A striking feature of the decision is the fact that the claim of the American patent *for a product and not a process* (though two processes were described in the specification) has been upheld by the U.S. Court, while in this country the whole question turned upon the process and not upon the product.

Repairs to Street Mains and the Law of Negligence.

The case of Crane *v.* South Suburban Gas Co., which is reported in a recent number of the *Law Reports*, draws attention to an important point relating to the liability of gas and electric lighting companies whose mains must be repaired *in situ*. Workmen employed by the defendants, a gas company, for the purpose of carrying out repairs to a gas main in a highway, placed a fire pail, on which was a ladle containing molten lead, on unenclosed land adjacent to the highway. The plaintiff, a young child, was playing with other children near the fire when a passer-by accidentally knocked over the fire pail, and the molten lead was spilled on the plaintiff, causing her injury. In an action by the plaintiff to recover damages, the County Court Judge found that the defendants were guilty of negligence in leaving the fire unattended and unguarded with the knowledge that it was surrounded by children and that it was being used for molten lead. In these circumstances two Judges of the King's Bench Division have held that there was evidence on which the County Court Judge could find that the defendants were negligent, and that the defendants were also liable on the ground that what they were doing was a nuisance in that it was dangerous unless precautions were taken to guard persons using the highway from the danger. It is to be observed that the decision was based partly upon the fact that to melt lead in a place situate near a highway was a nuisance for which the defendants were liable if it caused damage. It is clear, therefore, that whenever street repairs are undertaken, the electrical employés should be warned to take the utmost care to keep the melting lead out of harm's way. In effect they are bound to insure the public against any injury which may happen.

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THE RENAISSANCE OF THE LOW-TENSION FUSE.

By JOHN A CRABTREE.

When, if ever, the history of electrical switchgear comes to be written, it will be found that the last six years mark the "Renaissance of the Low-Tension Fuse." For some time prior to 1910, the general quality of low-tension switchgear had been steadily on the decline in this country. Mechanical strength and electrical efficiency had both been sacrificed for price, with the result that much of the switchgear sold at that time was flimsy, unreliable, and dangerous to operate. An examination and comparison of the average switchgear catalogue of 1909 and to-day, however, will show a remarkable difference and improvement in fuses and fuseboards. In the writer's opinion, this improvement is not merely due to the ordinary processes of evolution, but rather to the compelling forces of the Home Office Regulations governing the use of electricity in factories. Mr. Scott Ram's memorandum (Form 928, 1910) has also had no slight part to play in this development.

It is significant that though the Draft Regulations were published in 1907, and the approved Regulations at the

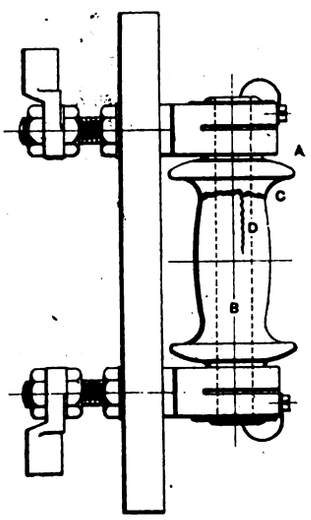

Fig. 1.—Old Type Tubular Hand-Grip Fuse, showing Typical Fracture.

end of 1908, nothing of any importance was done in the development of the "Home Office" type of fuse, until after the publication of the memorandum in February, 1910.

Prior to 1910, the tubular porcelain fuse of the hand-grip type, as fig. 1, was generally considered to be *the* thing in this country. In various forms, with differing ends and contacts of weird and wonderful design, it was almost universally adopted. It was a good fuse, infinitely preferable to the fuses it followed, but dangerous to handle, and with distinct limitations. The year 1910 marked its passing, or to be more exact, its development into the new fuse.

At first, manufacturers were slow to appreciate the position. A few, bolder than the rest, led the way and placed new designs on the market, and in 1910, at least six patents were taken out, on fuses specially designed to comply with the regulations and memorandum. These designs being based on the "safety first" principle, were naturally more expensive than the old-fashioned types, and therefore inclined to be slow sellers. Buyers jibbed at the price—did not recognise the necessity for "new fangled ideas"—the old style was quite good enough for them. Gradually, however, as the market became educated to the new demands and requirements, and non-"Home Office" material was being condemned, the new designs began to make headway. Other firms modified or re-designed their fuses, patent agents grew busy, and the "renaissance" became a reality.

The evolution of the new fusegear is still incomplete, but already assumes definite form in a distinctive class of "safety first" fusegear, which, in general appearance, may be said to be as essentially English as was the perpendicular architecture of the Middle Ages.

No one had recognised this change more than the German manufacturer. For years he had grown accustomed to pouring motors, switchgear, and accessories into this country in a steady stream. With one or two marked exceptions, the German fuse failed to comply with our Home Office Regulations, and there were distinct signs, prior to the war, that the Germans were taking strenuous steps to attack the British home trade in ironclad switchgear built to our Home Office Regulations. A great amount of time and paper is being wasted in discussion over the inevitable German competition after the war. The wisest plan, from the manufacturing point of view, is to get to business, and, by thorough organisation and careful design, to produce an article unequalled in efficiency and price. The rest may well be left to the politicians.

The home market has always preferred an easily rewirable fuse. While the cartridge fuse has its many supporters, it cannot by any means be said to be so popular as abroad. For the present, at any rate, the easily rewirable fuse, encased in some form of tube and supported by an insulating shield and handle, would appear to be the main feature of the removable "Home Office" unit of to-day; while the base unit includes some suitable protection for the metal contacts, bus-bars, &c., the whole combination making a shock-proof fuse. There are, however, many features requiring recognition and development, before we can hope to regard the question of our "Home Office" fuses with any satisfaction or credit to ourselves. Only too frequently the design of low-tension switchgear is left in the hands of junior draughtsmen, who produce interesting assemblies of detail parts, but with little regard to the functions to be performed.

Shielding of Live Parts.—The shielding of live parts is a matter provoking considerable discussion, particularly when the base contacts are in question. All are agreed upon the necessity of well shielding the hand from any danger from the handle contacts or fuse wire, and suitably shielded grips are universally provided. Opinions may differ as to the efficacy of some of the designs marketed, but the safer types of handle must ultimately prevail.

When the question of shielding the base fittings comes into consideration, we do not find the same harmony. When the switchgear is in some special position, and only accessible to duly authorised persons (*e.g.*, in "rooms, compartments set apart for the purpose"), it would appear that contact shielding may not be insisted upon, but the average board about a works, enclosed in a wood or iron case, should unquestionably be effectively guarded in every way against accidental shock.

To comply fully with the Regulations, one has to consider the fuse under all conditions. Thus, it is possible to combine the base contact shield with the handle, so that insulating shrouds carried from the handle effectively cover all live parts. If, however, the fuse handle is withdrawn, the protection to the base contacts is likewise removed, leaving the board entirely unprotected. The fact that the shields are on the handle tends to make the operator careless, and he is inclined to ignore the danger in the contacts and bus-bars. There is, further, the danger of making accidental contact with the exposed contacts when handling an adjacent fuse.

The bus-bars also require protection. Some firms fit these bars behind the fuse bases to protect them, others fit them at the front and shield separately, while still others carry them in suitable holes passing through the bases. Whatever arrangement is adopted, the danger of accidental contact should be considered, and all live metal effectively shielded as much as possible.

Other designs of fuses are rendered unsafe by reason of the fuse wire terminals on the handle being exposed, even though the base contacts may be fully protected. This not only offers a possibility of accidental shock, but by the very fact of the covered contacts and shield handle lulling the operator into a false sense of security, offers additional danger. The risk is, of course, greater in the case of the smaller sizes of fuses with merely a finger-grip. The unused fingers curl themselves into unexpected positions, and find the live spot, if it is to be found. The solution, therefore, appears to consist in so arranging the fuse wiring terminals that no live parts can be accidentally touched by any normal individual. The fool looking for trouble with a steel rule or wire, and poking his finger down openings to see what

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he can find, must always expect a suitable reward for his folly.

Hot Handles.—With long-break fuses there is frequently difficulty in handling the fuse handles, owing to the excessive heat of the grip. It is hardly realised that each fuse wire is a small electric heater on its own, and, in a confined space, may heat up the handle to a dangerous degree, softening clips and burning the hands. When a man burns the skin off the palm of his hand in pulling out a fuse, or has to use cotton waste to get a safe grip, it is time that fuse was re-designed. Yet a large percentage of the present-day fuse is of that brand. If the designer had to re-wire and handle his own fuses, he would pay more attention to their cool working. It is undoubtedly necessary, therefore, in design, that the question of hot fuses that cannot be safely handled, should have equal consideration with the effective shielding of live parts.

This matter is intimately bound up with the questions of break, and ventilation of the fuse wire, both of which are dealt with at a later stage. If any doubt exists on the matter, it is always wiser to have a new design modelled by hand, for the purpose of testing the heat by actual experiment, before any expense is entailed in the manufacture of tools, &c. The Potteries are always willing under ordinary conditions, to assist manufacturers in these matters.

Fuse Break.—Passing to general questions of design. It is to be hoped that some day the Engineering Standards Committee will be able to turn their attention to the standardisation of fuse-breaks. Under the varying specifications, corporation regulations, and manufacturers' designs of to-day, we have a multiplicity of breaks for the same conditions.

Fig. 2, gives a graph showing 500-volt fuse-breaks by several of the leading British manufacturers. It will be

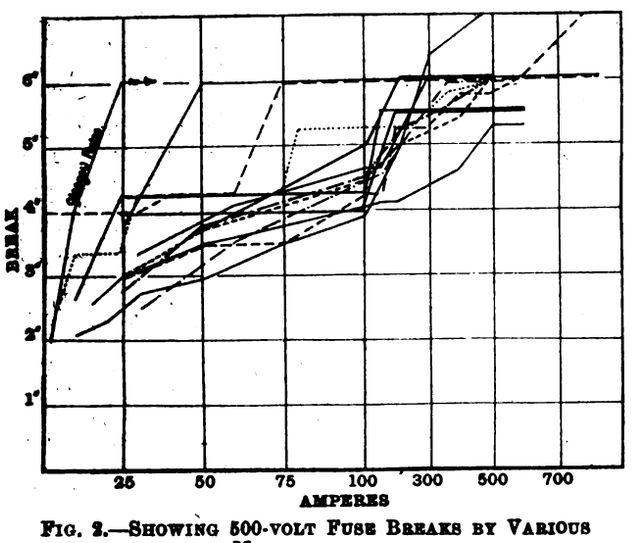

Fig. 2.—Showing 500-volt Fuse Breaks by Various Manufacturers.

seen that there is a considerable variation in the lower capacity fuses, and the various makes only draw into reasonable harmony towards a 6-in. break for 500 amperes. Soaring well above the majority is plotted the Glasgow Corporation fuse-breaks.

It seems hard to realise that all these varying sizes are seriously put forward by manufacturers to perform exactly the same function. Surely it should be possible to establish some suitable standard, leaving each manufacturer to work out his own details. The circuit opening efficiency could, and should, be covered by a definite clause as to the conditions under which each size of fuse should effectively blow.

One has seen a long-break fuse deposit its fragments about the room when blown on a short test, while specially designed shorter break fuses have repeatedly snapped out the arc without the least damage to themselves. Without wishing to minimise the question of break, it has admittedly grown into a fetish with many firms, and is often used as a safety-valve for badly-designed gear.

While on this question of tests, one might with advantage give extracts bearing upon the matter of testing fuses from the rules of the American National Board of Fire Underwriters:—

(67*c*). Cut-outs must operate successfully on short circuits under the most severe conditions with which they are liable to meet in practice, at 25 per cent. above their rated voltage, and for link fuse cut-outs with fuses rated at 50 per cent. above the current for which the cut-out is designed, and for enclosed fuse cut-outs with the largest fuses for which the cut-out is designed.

With link fuse cut-outs there is always the possibility of a larger fuse being put into the cut-out than it was designed for. . . . Again, the voltage in most plants can, under some conditions, rise considerably above the normal. The need of some margin as a factor of safety to prevent the cut-outs from being ruined in ordinary service is, therefore, evident.

The most severe service which can be required of a cut-out in practice, is to open a "dead short-circuit," with only one fuse blowing, and it is with these conditions that all tests should be made.

(68*k*). Enclosed fuses must not hold an arc, or throw out melted metal or sufficient flame to ignite easily inflammable material on, or near the cut-out when only one fuse is blown at a time on a short circuit on a system of the voltage for which the fuse is rated.

The normal capacity of the system must be in excess of the load on it just previous to the test, by at least five times the rated capacity of the fuse under test.

The resistance of the circuit up to the cut-out terminals must be such that the impressed voltage at the terminals will be decreased 1 per cent. when a current of 100 amperes is passed between them.

For convenience, a current of different value may be used, in which case the per cent. drop in voltage allowable would vary in direct proportion to the difference in current used.

The above requirement regarding the capacity of the testing circuit is to guard against making the test on a system of so small capacity that the conditions would be sufficiently favourable to allow really poor fuses to stand the test acceptably. On the other hand, it must be remembered that if the test is made on a system of very large capacity, and especially if there is but little resistance between the generators and fuse, the conditions may be more severe than are liable to be met with in practice outside of the large power stations, the result being that fuses entirely safe for general use may be rejected if such test is insisted upon.

One wonders how many of our British fuses would satisfactorily comply with these regulations and tests.

(*To be concluded.*)

THE NEGLECT OF COMMERCIAL MATTERS BY THE ENGINEER.

By JOHN MARKS.

The neglect of business matters by engineers in the past has had an effect on the engineering industry which is too often overlooked, especially when ways and means of setting the engineering industry more firmly on its feet are being discussed. Let us see what has been the effect on the industry as a whole, and on the electrical engineering industry in particular, of the want of business qualities in so many of our engineers.

Right from the start of the electrical industry the majority of engineers have been too much accustomed to look on the business side of the matter as beneath their notice, and this policy has had the following unfortunate effects.

The manner of financing many of the original electrical concerns was left in the hands of financial men who cared nothing for the industry, and less than nothing for either the great possibilities of the electrical industry or the benefit to the nation of its correct development. What they did care about was being able to float companies on to the general public at heavy promotion profits, afterwards taking the first opportunity to get rid of their own holdings in the various concerns.

The engineers who were financed by these people were as clever and able a set of men as any country ever possessed. In the majority of cases, however, they were purely engineers, and not business men in any way.

They conducted many and valuable experiments, but paid too little attention to getting goods delivered; often they developed personal fads, and ran these fads at the expense of the company long after other and rival concerns had produced more suitable and reliable, if somewhat less novel, designs. When profits were made, and in the early days they were made, in spite of the faulty financial management, they were too often divided up to the hilt, and little provision was made for the days when more firms would be in the field and competition would be much keener.

Assertion without facts to back it up is of little value. The writer, therefore, mentions one or two instances, with which he was quite familiar, of faulty management by clever, but non-businesslike, engineers.

One concern, some years ago, appointed a very clever and scientific engineer as its head. One of the first positions taken up by that engineer was to state that in connection with a new line then developing, he was going to make the

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product turned out from that works the perfect product of its kind. A very worthy object, and one which might quite well have been attained along with commercial success if only businesslike methods had been employed.

Orders were fairly plentiful at the time, and the product of that firm was then as good as that turned out by any other firm, and the projected improvements could have been carried out on each fresh batch of machines put in hand; at any rate, that is what a businesslike manager would have done. This policy was not sufficient for the engineer in question, who actually stopped machines going out which had been tested and more than satisfied the specification under which they were ordered. No matter, they were not to go out; some detail improvement had occurred to the manager overnight, perhaps, and those machines must wait in the shops, be partially dismantled, the detail improvement fitted, and the result tested. It may seem incredible, but it is a fact that in some cases machines were tested and partially dismantled twice and three times before they went out.

Naturally, customers became first impatient, and then disgusted, and got into the habit of not expecting delivery from the firm, the natural consequence being that they placed their orders elsewhere. Unhappily, the firm had a good standard line of essential goods in the electrical world, and were, in fact, in possession of a really good paying speciality; for a time the money earned by this speciality enabled the process described above to go on without altogether upsetting the dividends.

This could not last for ever, and by the time the perfect apparatus was on the market the firm found that people had lost faith in its ability to deliver anywhere near to time; also, that other firms were then making and cutting into the market in the original special line in which the firm had done so well.

The engineer in question was disgusted to find that people would not pay an enhanced price for his apparatus, though it was undoubtedly the most efficient on the market. This extra efficiency, however, only amounted to about ½ per cent. or ¾ per cent., and the money spent in gaining it made the apparatus unnecessarily expensive.

Had the batches of apparatus for which customers were waiting been delivered, and the improvements incorporated in the next batch made, then the same perfection could have been reached, the firm's good name and connection retained, and money brought in which would have helped to pay dividends and support experimenting as well. In fact, under such circumstances there would have been many firms ready to pay rather a higher price for the superior article. The policy which was followed upset the whole financial state of the concern and cut down dividends to vanishing point for some time.

In another case the writer saw the same idea carried out, but with regard to a different product. When the writer happened to mention to one official that money was being needlessly expended the same answer came out, namely, that the older department could earn more than the newer department could spend. Here, again, financial wreck, or something very near akin to it, resulted.

Again, in another instance, an engineer-manager not only spent a tremendous amount of capital in trying to carry out a pet theory in connection with the governing of engines, but also carried his experimenting on to the premises of the firm's clients. This process gave annoyance to the firm's customers, who pointed out that they required their engines to drive their factories. The result was not an assurance that if the various experiments were a source of annoyance to the clients, the experimenting would be discontinued, but consisted of the information, conveyed in a chilling tone, that the plants belonged to the makers until the guarantee had run out, and that they (the makers) would do as they pleased. Naturally, clients fell off, the firm got into difficulties, some of the bolder spirits suggested to the engineer-manager that he should drop these costly and futile experiments, and the engineer in question promptly put in his notice and left the firm.

Now cases such as the above, which can be vouched for by many people, are by no means isolated cases; similar incidents must be known by any engineer who has spent, say, the last 20 years in the British engineering industry, and particularly in the British electrical engineering industry.

The result has been that in the British electrical industry one finds company after company which has had its capital reduced, and company after company which pays either nothing or a totally inadequate return. If every concern confining itself to the manufacture of electrical goods was in the same position, it could then be argued that there was something radically wrong with the state of the whole industry in this country. The above, however, is not the case; plenty of firms give a good return to their proprietors, and have done so for many years, though many of them started up after the first boom period had passed. In every instance, however, such firms have been sensibly managed on the business side. Their managers have always remembered that the purpose of the company was to make dividends, whether it made them on high-class dynamos or cheap rat-traps.

Now the effect on the whole industry of the financial neglect outlined in the above examples has been to cripple every electrical concern in the country. Those firms which have always paid a steady return on their capital could have either paid more in dividends, or put away money for development, or reserve funds, in larger amounts had the badly managed type of firm been paying. Those firms who are not paying simply have to get work at any price in order to keep going. Thus, profits are cut and competition becomes exceptionally keen for all firms concerned. Naturally, capital will not flow towards an industry which is not in a healthy financial state, and here, again, the badly managed firm makes it difficult for the well managed concern to extend its works.

Another and more regrettable effect of such mistaken policy has been to cultivate in the mind of the business man the idea that no engineer ever had, or could have, any financial sense, and that it was necessary to keep a sharp eye on his little proclivity for spending large amounts of money in somewhat unprofitable ways, especially when this meant the delaying of delivery and disappointing of a customer. Consequently, all the best appointments are held by the purely business man in by far the majority of cases, and the business man, with a far less expensive or trying professional training, usually runs the engineers who are responsible for the design of plant turned out by the works, or for the maintenance of the plant necessary to operate an electric railway.

The engineer, especially the thoroughly well-trained man of about 30 or 40 years of age, complains bitterly of the fact that he is remunerated at a far less rate, worked more hours, and carries far more responsibility than his financial colleagues; yet how often do good engineers spoil themselves when a chance of showing a little commercial ability comes along.

The writer gives two instances from personal knowledge, showing different attitudes of engineers towards the business side of engineering.

A relative, who was manager at a large engineering works, prided himself on his business abilities. Quite a short time ago an engineer with ideas on the manufacture of motor delivery wagons and swift tractors was introduced to him, with a view to getting the inventor's ideas carried out and tested. Let us consider how the matter was taken up.

The statement of the relative in question was as follows:—"I could see from the beginning that his idea would hardly be likely to be a success, and that he was somewhat vague in his ideas of business; so I proposed that before we carried out any work at all we should have a definite agreement regarding all work done for him, and the payment for the same." How typically British! No tact; no idea of chatting over the matter with the inventor, who did not want for money; no suggestion here and there in order to sound the trend of his ideas on the subject, and to see whether he would be open to accept advice or not; none of this sort of work, and then a tactful allusion to the matter of payment for work done and the proposal for a regular agreement. No; a demand straight out for cash down almost, which in itself showed lamentable want of tact in that it displayed want of faith in the idea and its inventor.

The work was done, the tractor made, experimented with, and tried on various gradients, but it did not come up to the inventor's hopes. It was, after some months' trial, abandoned, and my relative then bade the inventor a friendly good-bye and patted himself on the back in that the firm had received profitable payment in full for all they had done; and there he was content to let the matter end. Asked if the tractor could have been improved, the answer was, "Oh, yes; I believe it could; there was one point in the design of which the inventor was rather fond, and which I knew would trip him up."

Now let us take the American or German engineering manager's view. The trials show that the inventor's idea is not altogether feasible, and then the suggestion is tactfully made that, if the inventor will permit, the firm will be pleased to put money into the idea, as they consider that with a little alteration the tractors would be quite satisfactory. Experiments would have followed, the design been thoroughly developed, and another paying line added to the firm's enterprises. Please observe that the mistaken policy was adopted by an engineer who thought that he was an up-to-date business man.

As a contrast to the type of engineer dealt with above, the writer was pleased to meet and entertain, a short while ago, the manager of a large constructional firm; their business is not electrical work, but the lessons to be learnt from this engineer's policy are of value to any engineer, electrical or otherwise.

Naturally, talk drifted to prospects of business when peace shall be declared. The opinion was then expressed by the writer that first-class business and technical organisation would be more than ever necessary to obtain any success worth having.

The engineer in question stated that his own opinion was that in the days to come business would be most effectively obtained by what he was pleased to term first-class and intensive advertising, followed up by representatives possessing strong personalities. Amongst the greatest of their assets he rated tactful handling of possible customers, and also called for a thorough understanding of the technical points of the work in question. He stated that he had difficulty in getting good engineers who were tactful representatives, or good representatives who were acquainted with their products from A to Z. The writer happened to draw his attention to the disparity usually existing between, say, the managing engineer's salary and position and that of the general manager of a business, pointing out that the latter was generally much

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better remunerated, and had had a much inferior education and training to that of the engineer.

The engineer in question admitted the disparity in emoluments, but insisted that it was no more than fair, his statement being that the man who managed the concern in such a manner that it earned a good dividend was not only providing the possibility of a good and also improving position to those on the staff, but, by tending to bring further capital into the industry, was benefiting the whole community. He stated that at an early point in his career he had resolved to get the controlling position of some business before he reached 35 years of age; that he went into the shops during his practical training with the idea of one day selling the goods; that when he got into the drawing office he meant having the position of leading draughtsman as soon as it was available. Having, after a few years' hard work, attained that position, he realised that, much as he liked the engineering side of the business, something more was required of a man who aimed at holding the reins. With that end in view, he took every opportunity of influencing business for his firm, and when sent out to try and talk over possible clients on subjects of a technical nature, used the utmost tact of which he was capable. The result was that he attained the position of deputy-manager, and finally of general manager.

"Now then," he observed, "I am a much better man than the technical man alone; I not only help to arrange the designs, but annually get thousands of pounds' worth of work for the firm and all connected with it. Take my leading draughtsman, a splendid fellow, a first-class man whom I should be sorry to lose. I can't promote him to be an outside representative or my deputy; if ever he goes out to see about a contract, or any proposed work, there is always a dickens of a row to follow, and a possible loss of a customer. When possible clients make statements which are wrong fundamentally, he contradicts them and tells them that they do not know what they require; the proposed client gets in a huff, snaps back, and my leading draughtsman then shows the client in plain unvarnished terms that he does not know anything about the matter at all, and is a very poor sort of person when considered alongside an engineer. When spoken to about making such a hash of things, and counselled to be tactful, he retorts that he cannot, and will not, be told what is correct by a non-technical man. On the other hand, when I get that type of customer I handle him gently, find out his pet idea, and then gradually work him round by letting him think that I agree with him, until he comes somewhere near to a correct view of the case. This may take me an hour or more, but sooner or later I convince him by quiet, reasonable, and friendly conversation that the only way in which to carry out the work is the way our firm does it." The above policy may seem obvious, but how often is it carried out by engineers in a managing position? Too often the tendency to become dictatorial, and even testy, with a customer is considered to be quite a correct attitude.

The directing of a great business is like unto the conducting of a great orchestra; the engineer in an engineering concern is certainly the most important instrument; but as the purpose of an orchestra is to interpret some great musical work in a perfectly harmonious fashion, so is the purpose of an engineering business to earn a return on its capital. In the one case, neither the leading violin nor the 'cello player is permitted to display his own talents in such a manner as might endanger the production of the masterpiece; nor can the engineer be permitted to indulge his own fads if it means interference with dividend production. Both men must obey the man who organises the whole process in such a manner that the desired effect is produced with harmony.

In both cases there must be a conductor who will balance the efforts of each separate player or department; and in both cases the talent required for this conductor is not proficiency of an extraordinary degree in any one line, but capacity to organise other people's work, in order that a desired result may be attained. If the engineer is to rule in an engineering concern, then he must be something besides an expert engineer; he must be able so to conduct the firm that the desired end, dividends, is attained, or make room for someone else, who may not be an engineer, but who is a successful organiser and director of other people's efforts.

Let us keep an eye on our competitors, especially those from enemy countries; but let us not forget the severe handicaps which our own mistakes of the past have imposed on us. By so doing we shall be in a stronger position than ever to meet both our competitors and our shareholders.

THE INSTITUTION OF ELECTRICAL ENGINEERS AND ALIEN ENEMY MEMBERS.

As briefly stated in our last issue, the special meeting of corporate members to consider a resolution altering the Articles of Association was duly held on Wednesday last week. Owing to the difficulties which arose in the course of the discussion, the resolution was not put to the vote, and it was decided to call a fresh meeting to consider the whole question untrammeled by the restrictions which, as explained below by "W.B.E.," necessarily tied the hands of the meeting. No time was lost by the Council, the meeting being called for Wednesday this week; the result will be found in our "Notes" columns to-day.

The following is a brief account of the proceedings at the first meeting:—

The President, Mr. C. P. Sparks, explaining the object of the meeting, said that for some time after the Council had stated in the *Journal* what powers it possessed to deal with alien enemy members, no action was taken on the part of the members to put Article 41 in operation. Eventually, however, a petition was received, signed by 17 members, and the Council, after consultation with a deputation, had called that meeting in accordance with the Articles of Association to deal with the resolution [printed in our issue of February 18th, p. 206] modifying Article 41, and providing that any member who during war should be a subject of an enemy country should cease to be a member of the Institution. Moving the resolution, the President called upon Mr. C. Alfred Baker, who, in seconding it, read a letter which he had addressed to the Electrical Review [December 31st, p. 843]; correspondence followed, and he found no difficulty in obtaining 17 signatures to a petition—he could have obtained 170 if necessary. At a conference with the President the form of resolution was agreed upon, on the lines of a similar resolution adopted by the Iron and Steel Institute, and the meeting followed. The petition did not touch the question of naturalised aliens at all; they could not deal with any of these unless they dealt with all—and some of them had sons fighting for us. The resolution, however, covered the case of aliens who had not denaturalised themselves in their own country, who should be excluded.

Mr. A. Gay referred to a letter which he had written to the President with regard to the procedure to be followed, and to amendments which he had forwarded, and the President replied that he was advised by the honorary solicitor that the amendments were not in order, whereupon Mr. Gay strongly protested, and urged that according to the recognised rules of debate a relevant amendment must be in order.

Mr. C. C. Atchison thought the meeting would be farcical if limited to the resolution, and questioned whether a meeting held in London could be representative of the whole country; he held that every member should have an opportunity of voting. He considered that it should not be necessary for the members to act in such a matter—it was the duty of the Council to ascertain the feeling of the members and to take action accordingly. The resolution, in his opinion, did not go far enough, as it would not prevent alien enemies from rejoining after the war.

Mr. Gay moved the adjournment of the meeting and the holding of a postal ballot on the resolution and amendment, but the President refused to accept the motion, upon which Mr. Gay protested that the whole of the proceedings were irregular.

Mr. F. C. Raphael suggested that the resolution should be passed unanimously, and that afterwards the proposed amendments should be considered.

The President pointed out that any proposed change in the Articles must first be submitted to the Board of Trade for approval.

Mr. W. B. Woodhouse said he would support the resolution on the understanding that aliens who had not troubled to denaturalise themselves would be expelled, and Mr. E. M. Duncan, whilst suggesting that each case of alien membership should be dealt with individually, thought they ought to wait for the Institutions of Civil and Mechanical Engineers to lead the way.

The President refused to be guided by any other body, and pointed out, with regard to the question of naturalisation, that British law prevailed over German law in this country, so that naturalised aliens would not be touched by the resolution; but it would still be possible, under Article 41, for 10 members to take action with regard to any individual case. As for re-election after the war, that would be in the hands of the members themselves.

Mr. A. A. Campbell Swinton feared that the interpretation of the law with regard to aliens naturalised, but not also denaturalised, altered the conditions very much, and several members who were in favour of the exclusion of alien enemy members, including Mr. G. W. Partridge and Mr. J. H. Rider, declared their intention of voting against the resolution if it would not have the effect of excluding this class.

Suggestions to modify the wording of the resolution, and to adiourn the meeting, having been rejected by the President, Mr. L. L. Robinson proposed that the resolution be referred back to the Council and brought forward again in a form that could be amended so that it would be a resolution of the Institution and not of the Council. It was pointed out that the resolution ought not to be negatived, as this would produce an erroneous impression outside the Institution, and eventually the President, remarking that the matter was of very great importance, announced that the resolution would not be put to the vote; a new meeting would be called at which the various proposals could be fully discussed, and the final decision would be submitted to the Board of Trade for approval.

The meeting at the Institution of Electrical Engineers on the 1st inst. was extremely interesting, as revealing amongst other things the misconceptions which exist amongst professional —often business—engineers regarding business methods.

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After the resolution with which we are all familiar was proposed and seconded, Mr. Gay charged in with the question as to whether the proceedings were to be conducted according to the recognised rules of debate. The obvious answer would have been: "This is not a debate, but a meeting of a public company convened for a specific purpose, viz., to pass, if thought fit, a resolution altering its Articles of Association. You are at liberty to discuss the resolution on its merits; if you are in favour of it pass it, if you are not in favour reject it, but there, so far as this meeting is concerned, the matter ends." Why this answer was not given clearly and directly I am at a loss to know; it would have saved much in talk, though, of course, we should have lost much in entertainment.

Mr. Gay wanted to propose amendments, and mentioned the Mayor of Islington as authority that his proposals were in order. This did not necessarily prove that the Chairman's ruling was wrong; it might only prove that the Mayor of Islington knew no more of company procedure than Mr. Gay! As a matter of fact, his confusion is easily understood. If the occasion had been a meeting of the Institution *as an institution*, the members would have been at liberty to put forward any amendments they pleased, but it was a meeting of the Institution *as a company*, consequently the proceedings had to be conducted in strict conformity with the Articles of Association. There was no use in badgering the President. He didn't make the laws governing public companies, and he didn't make the Institution Articles; in short, he had in this particular case no option.

In submitting the resolution, the Council had undertaken a thankless job, and the meeting showed little appreciation of their efforts. But, really, they had some justification for their action. Seventeen members, as I understand it, brought the question of expulsion of enemy aliens before the Council. Meetings and negotiations took place. A proposal as to how to deal with the question was drafted by the group of members. The Council could not agree with that altogether, but intimated that with some alteration they could give it their whole-hearted support, and that a definite proposal could consequently come before a meeting with all the weight of the Council behind it. All right so far, but, alas! for the next stage. Instead of bringing this proposal or some resolution embodying it before the Institution, to be talked thin "according to the recognised rules of debate," assuming that there would be no opposition, they determined to alter the Articles of Association right away, and called a company meeting for the purpose. Their assumption was false. The subject is highly contentious, and a general debate at another meeting is to take place, after which the mangled remains of the various resolutions and amendments proposed may serve to indicate the lines on which a resolution can be drawn amending the Articles. In not submitting a resolution to the Institution first the Council were guilty of an error of judgment; that is all. But what were the Council thinking about to have made such a mistake?

The resolution seemed as clear in its meaning as language could make it. I very carefully considered the wording when the notice of the meeting reached me, and decided to vote for it. It appeared quite free from ambiguity, and my view was evidently that of Messrs. Baker, Swinton, Rider, Atkinson, and many others present. It was clearly stated that enemy subjects should cease to be members of the Institution, and with this I was well content. But, unfortunately, the President told us that the interpretation of the resolution was a question of law, with which statement I entirely disagree. As the wording stood, it was not a question of law at all, but a question of fact, and the fact is that until an enemy Government has released its subject from his obligations to his country of origin, he continues to be an enemy subject, and this whether we take him to our hearts by naturalisation or not. The latter event makes no difference at all, because it is not recognised by the enemy Government. It is true that, in the absence of release from his continuing obligations, the return of an enemy subject to his own country might imply his being imprisoned or shot, which would possibly bend his sympathies in the direction of the country of his adoption; but, nevertheless, he is still an enemy subject, and consequently, by the wording of the resolution, he is got rid of. Do the Council mean this, or do they not? If they do, let them say so clearly and put forward a resolution worded so that there can be no hedging behind legal argument. If they do not, they unconsciously deceived the men who went to the meeting to vote for the resolution, and in this case also a new wording will be necessary. Evidently, so far as our present Council are concerned, clarity of thought does not march with technical attainment.—W. B. E.

Wages at Greenwich Generating Station.—The L.C.C. Highways Committee has received a petition from certain employés at the Greenwich generating station for an increase of wages, and also an application for increased pay for overtime. The Committee reports that the question of the wages of these employés was settled by arbitration in June, 1915, and it is of opinion that they are not entitled to have their wages reconsidered by the Conciliation Board until June, 1916. As regards the application for increased pay for overtime, the Committee recommends that it be referred to the Electrical Conciliation Board.

CORRESPONDENCE.

Letters received by us after 5 P.M. on TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

15,000-KW. Generator for Manchester Corporation.

In the "Contracts Closed" column in your last issue, a reference is made to the transfer of the order for the above machine from us to the British Westinghouse Co., and as the bald statement of this fact in times such as these might be misunderstood by your readers, we should be much obliged if you would allow us to point out that the change in the contract—which has been made by friendly arrangement between the parties—is simply due to submarine risks in sea transit, it being imperative in the national interests that this plant shall be ready for running by March, 1917.

Mr. Pearce has authorised us to state that this action is not in any way due to technical or political reasons, but has been determined solely having regard to the serious risks attendant upon the delivery of goods by water during the period of hostilities.

Brown, Boveri & Co., Ltd.
A. C. EBORALL, *Managing Director.*

London, S.W., *March 3rd*, 1916.

City Guilds' Subject: "Electric Wiremen's Work."

I have read with interest the letter under the above heading from Messrs. A. P. Lundberg & Sons. The most important feature missing from the letter is the fact that the classes do not attract the men engaged in this section of the electrical industry. The bulk of the students with whom I have come into contact are invariably engaged in occupations outside the scope of electric wiremen's work.

There are indications of considerable modification in the subject matter of the syllabus, which, it is hoped, will bring the tuition in the classes into line with the requirements of so-called "wiremen," and thereby encourage larger classes and more candidates in the examinations.

In addition, electrical contractors should interest their employés in technical training and the advantages appertaining thereto.

W. Ellerd-Styles.

London, W., *February 29th*, 1916.

What is an "Electrical Contractor?"

Your correspondent "Contractor," on page 251, complains of consulting engineers who, while doing their best for their clients, do not assist "electrical contractors," which, in this particular case, seems to mean "wiring contractors"; but what right have such contractors to supply engines, dynamos, and plant they do not understand?

Is "Contractor" himself an engineer or electrician? If so, then he is an exception, and he should advertise his qualifications so that consultants may avail themselves of his assistance. Any man may dub himself "electrical contractor," though knowing nothing of electrical work, and not making any of the apparatus he uses; even the wiremen he hires have been trained by others; and he feels aggrieved if he does not get a middleman's commission on everything!

I have had 35 years' experience in this particular line of work, so I know what I am talking about.

Facts.

Cause of Flicker.

Mr. Bulsara's trouble with light flickering seems to me to be due to a broken earth return somewhere or other. The fact of the trouble being present with any of the generators running proves to me that the fault is either close to the switchboard or beyond it in the lighting circuit wiring. The vibration of the engines running is disturbing this broken earth wire more or less, according to the proximity of the engine to the fault.

I rectified a similar fault a short while ago in a lighting circuit on a 3-wire D.C. system, 230-460 volts. The fault had been on for two years, and was only noticed when the main middle-wire fuse blew. From this time onwards an occasional nasty flicker was observed in a certain circuit; the switches acted all right, but the withdrawal of the fuse did not affect the circuit at all. I knew then that I was getting light through the earth return of the conduit, which was being vibrated at times by the engine working close by and sometimes breaking the circuit.

Eventually, I opened out the faulty circuit and found the return wire trapped in the angle of a split elbow, and making a lovely contact thereto. If Mr. Bulsara's trouble is something like this he will find some fault on the earth return or middle-wire cable.

It cannot be on the outers, which are both above earth potential by 230 volts or more in his case, and would certainly blow the fuses. I should advise Mr. Bulsara, if the fault is only on a certain section of lighting, to have the return cables tested for an earth leakage.

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If the fault is on every light in the place, then the main middle-wire cable is faulty at some point or other beyond the switchboard bus-bar connection, and should be tested out for earth leakage. If the fault were traced to valve trouble in each engine it would constitute a record fault, I think.

I should be glad to know the ultimate death of this fault, and hope Mr. Bulsara will acquaint the ELECTRICAL REVIEW when he finds it.

Hy. Fowler,
Electrician.

Liverpool, *March 2nd*, 1916.

Concerning Discounts.

In the interesting communication on the above subject your correspondent says: "Just why makers do this kind of thing it is not easy to understand." But the reason is not far to seek. Invoice clerks, and, indeed, most people who have the making up or checking of invoices, know nothing of "decimals," which they regard as a mysterious arithmetical process, which only schoolmasters and scholars, who have devoted their lives to the subject, can possibly understand. The invoice clerk works with a book of discount tables, and as these are made up for discounts of 1¼, 2½, 5, 10, 15 per cent. and so on, the reason for the imposing array of discounts is obvious.

It is rather odd, however, that cable makers and other jugglers with discounts have not heard of the marvellous discovery made by some brilliant genius in the tube trade (or is it the file trade which has the honour?). The tube makers use a standard list for all classes of tube, and different discounts are quoted for steam, water, and gas tube, &c. The discounts are single figures like 57½ or 62½, and so on. But the discount tables do not give discounts like these, so what is the invoice clerk to do, poor thing? Well, after a little instruction and a lot of hard thinking, it dawns on him that 62½ per cent. discount, for example, is simply 50 per cent. of the list price, plus 10 per cent. of the list price, plus 2½ per cent. of the list price, or 12s. 6d. per £1. The arithmetical genius simply takes 62½ per cent. off list = list × (100−62½/100) = list × .375 or list × ⅜. Thus does the wily tube maker win the esteem of the scholar and the plain clerk alike, "two at a blow."

The tube maker's method has a decided advantage in this respect, that all discounts are calculated on the *list price*, which is generally a round sum in pounds or shillings, or pence with no fractional parts. Compare the following:—

Cable Maker's Method.		Tube Maker's Method.	
List £146, less 25, 15, and 10 p.c.		List £146, less 42½ p.c. *Using discount tables.*	
Less 25 p.c.	£36 10 0	20 p.c. on £146 =	£29 4 0
	109 10 0	20 p.c. on £146 =	29 4 0
Less 15 p.c.	16 8 6	2½ p.c. on £146 =	3 13 0
	93 1 6	Total discount	£62 1 0
Less 10 p.c.	9 6 2	£146 less £62 1s. net.	= £83 19s.
Net	£83 15 4	Another way is to take off 8s. 6d. per £1.	

The slight difference in the results obtained is, of course, due to the fact that 25, 15, and 10 per cent. is equal to 42.625 per cent., or .125 more than 42½ per cent.

I think that this is a most opportune time to invite discount jugglers to mend their ways and "put away childish things," and I suggest that the ELECTRICAL REVIEW should take this matter up vigorously and now. If we are to compete successfully with our enemies after the war is over, we must "lay aside every weight."

"A Station Engineer" deserves a hearty vote of thanks for bringing this question up; we have suffered too long under the yoke of the discount designer.

John W. Black.

Glasgow, *March 6th*, 1916.

An Engineer's "Wages."

May I draw your, and other people's, attention to the first advertisement in the current number of your paper under the heading of "Situations Wanted"? It seems to me that the rate of remuneration for technical men is poor enough already, and advertisements such as this do not tend to improve matters.

If any firm can get the services of a well-trained engineer for "low wages," why should they pay high, or even moderate, salaries? Is it lack of *esprit de corps* that is responsible, to a great extent, for advertisements of this kind?

There is one advantage of trade unionism which might be applied to engineers here illustrated.

Disgusted.

Ealing, *March 6th*, 1916.

The I.E.E. and Alien Enemies.

From the feeling expressed at last night's Institution meeting, I am sure that no mere form of words will satisfy the general mass of members which does not render the exclusion of the German *after* the war total and (as far as is humanly possible) permanent.

This point I endeavoured to make in the following letter to the Council, the publication of which should now be no breach of confidence.

W. P. Anderson.

The Council of the
Institution of Electrical Engineers, London.

I.E.E. AND ALIEN ENEMIES.

GENTLEMEN,—I am in receipt of your post-card of the 15th inst. With regard to the matter contained in it, perhaps I may be permitted to express my own personal view, which I know to be shared by a large number of your members in the North. This view is that the resolution has been drafted on wrong lines, in that, although we are logically quite safe from the intrusion of Germans at our meetings throughout the duration of the war, we are not protected from their becoming members after peace is declared.

There is little doubt that German commercial men will make a superhuman effort immediately after the war to regain their footing in our social and industrial life, using the membership of our clubs and institutions as a lever to that end; and that they will be successful in this aim in the course of a few years is more than probable, our national characteristics being what they are.

May I suggest, therefore, that a new resolution be framed making it impossible for any member of this race to join the Institution after the war? I fully realise that no rule can be made to hold "in perpetuity," but he will be a bold man who in the next 50 years attempts to rescind such a resolution passed *now*. Surely, also, partial achievement is better than the making of no attempt.

I would make the resolution I propose apply to Germans whether naturalised or unnaturalised (if legally possible), the former, in my opinion, being much the more dangerous of the two.

As indicative of local feeling here, I would say:—

1. That the rules of the Engineers' Club, Manchester, have been so altered that no present alien enemy can, in future, enter the Club either as member or guest.

2. That the City Corporation has placed upon its standing orders a resolution prohibiting the purchase of German machinery out of the public funds.

There can be little doubt that these steps will be of a most *far-reaching character*.

I have purposely only confined myself to the German, and would make it clear that the proposal is put forward not because he is our enemy, but because he is, and must be made to remain for many years to come, a social outcast with whom one cannot treat as with an honourable foe.

While extremely unwilling to be a party to any policy which might be considered undignified, I would make a strong appeal to you, as members of the Council, to give the above matter your very earnest consideration.

Yours faithfully,
W. P. ANDERSON, *Member.*

Manchester, *February 21st*, 1916.

Decimal Coinage and the Metric System.

I have been following your articles on the metric system with great interest, and, although it may seem like flogging a dead horse, I should like to point out that the introduction of anything metric at home and in the Colonies would be enormously to the advantage of British trade and intercourse generally with Netherlands India.

When the war is over and Germans realise that they are no longer welcome guests in British countries, they will probably swarm to this country, so that everything possible should be done to enable British firms to compete with them.

In addition to the many examples you have given of the advantage of using the metric system, permit me to point out that when using the Vernier. Take an example with the very common form of sliding callipers engraved with inch and metre scales. On the former 7/16 in. is divided into 8 equal parts, so that each division is 7/128 in., on the latter 9 mm. is divided into 10 parts, so that each is 9/10 mm. I put the callipers on my ruler and, finding that the reading is something more than 28 mm., run my eye along the scale, and, finding alignment at the third Vernier division, write down 28.3 without the slightest mental effort or delay. When I look at the inch scale, however, I find 1 1/16 in. with alignment at the seventh Vernier division, so that I have to write down 1 1/16 in. plus 49/128. Need I say any more?

Only a few days ago a gentleman who represents a very important American firm, and travels all over Java, told me that he was convinced that British firms had lost their hold on the trade greatly through their representatives and travellers not being able to speak Dutch. Now I do not suppose that many young Britons will learn this language, but there are plenty of young men in Holland who would be only too glad to work for a time in British factories so as to perfect their knowledge of English and learn British methods of business. There should be no great difficulty in attracting such young men, and as many of them would afterwards naturally gravitate to Netherlands India, even if it were not worth while to send some of them out in the interests of the

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firms for whom they had worked, they would be of great use in pushing British goods of all sorts.

The following experience of my own may interest you: The chief engineer of a sugar factory saw the catalogue of a British firm dealing in small tools on my table, and asked me to order some for him. He made a list of what he wanted with the prices, which, to save me trouble, he kindly added up, making a total of something like £2:236:172. The smile with which I greeted this was perhaps in rather bad taste, but it was nothing to what he said about our monetary system.

I have written the above in the hope of advancing, if ever so little, the introduction of the metric system in British countries, and leave it to you to make such use of it as you may think fit.

C. H. Pownall.

Banjoewangi, Java, *January 6th*, 1916.

Mr. Trotter's Recommendations for Feeder Pillars.

Mr. Trotter's recommendations for feeder pillars appear to be very difficult to carry out in many cases. It would meet his requirements if the carcass of the pillar was made of wrought-steel or cast-steel.

It is a well-known fact that cast-iron will fly into pieces if struck a severe blow, but either wrought or cast-steel would be free from this defect. Indeed, it seems likely that the Eastbourne accident would not have had serious results if the pillar there had been of cast-steel.

The opinions of other engineers on this question will be interesting.

Feeder Pillar.

WAR ITEMS.

Australia and Enemy Holdings.—Statutory Rules, 1916, No. 13, made January 29th, under the Australia War Precautions Act, require:—

All naturalised persons of enemy origin, unless exempted by the Attorney-General, and all enemy subjects, to transfer to Public Trustee, before April 16th next, shares held by them in companies incorporated in Australia.

Public Trustee to be appointed by Government and to have authority to hold shares for twelve months after end of war, or to sell them at the request of transferor or by direction of the Attorney-General.

Proceeds of sale of shares to be paid by Public Trustee to transferor, unless Attorney-General otherwise directs, dividends or shares transferred to Public Trustee or held by enemy subjects to be paid to Public Trustee, and dividends on shares of naturalised persons to be paid so if Attorney-General requires.

Applications from naturalised persons to be exempted from regulations require to be made in writing to Attorney-General, accompanied by statutory declaration giving full particulars of name and address of place and date of birth, parentage, and occupation of applicant, and setting out list of names of companies in which he holds shares, number and value estimated of shares, and ground upon which application based.

The Attorney-General has absolute discretion to deal with applications as he thinks fit.

As to calls on shares transferred, the regulations provide that the Public Trustee may, at request of transferor, and, if directed, by Attorney-General, shall pay calls out of funds supplied by transferor, or out of proceeds of sale of some of his shares.

After the date of regulations any enemy subject, and any naturalised person of enemy origin to whom exemption has been refused, who sells or otherwise disposes of his shares to any person other than the Public Trustee, and any person who buys shares from any enemy subject or any such naturalised person, shall be guilty of offence against the Act, and the sale or transfer shall be void.

Naturalised person of enemy origin means person who having been subject of country with which United Kingdom is now at war is naturalised British subject by virtue of certificate of naturalisation issued in any part of British Dominions to himself, father or mother, or, in case of married woman, to her husband, and includes the wife of any such naturalised person.

The regulations apply to London Register, Australian Companies, equally with Australian Register.

Exemptions.—The Swinton and Pendlebury Tribunal has granted total exemption to one of the attendants at the Swinton sub-station of the Lancs. E.P. Co. The attested man, it was stated, ought to be badged with the rest of the company's workers, but was under the military age when the badges were supplied. Attendants at generating stations were in a reserved trade. Mr. Purritt, for the company, said he himself was doing the work of about six people, and he had had to get five men back from the Army to their employment. If the employé now appealed for were taken he did not know how the electricity supply of the district could be continued.

Temporary exemption has been granted John Gibson Grimes, whose exemption was applied for by the Windermere Electricity Supply Co.

At the Woolwich Military Tribunal last week an electrical firm applied for exemption for a specialist in automatic telephony. It was stated that this was not a reserved occupation, but in order to obtain his present position this man had had to undergo the training of certain reserved occupations. Formerly the firm had ten of these automatic telephone specialists, but seven had already gone, and the remaining three were absolutely indispensable. The firm had established three automatic telephone exchanges, and if anything went wrong these were the only men who could put it right. The certificate was granted conditional upon his continuing in the same occupation.

Portishead Tribunal on Saturday exempted an electrician employed by the Clevedon, Portishead and District Electric Light Co., who was stated to be the only skilled employé left, and whose services were necessary for the running of the plant.

Trading with the Enemy: An Australian Action.—We read in the "Melbourne Age," for January 20th, that a High Court writ has been issued on behalf of the Welsbach Light Company of Australia, Ltd., of Melbourne and Sydney, directed against the Commonwealth of Australia and the Federal Attorney-General. The writ claims:—

(*a*) A declaration that the Trading with the Enemy Acts are *ultra vires* of the Commonwealth constitution, or, in the alternative, that section 2, sub-section 2 (b) of the first Act is *ultra vires* of the Commonwealth constitution.

(*b*) A declaration that the proclamation of his Excellency the Governor-General, dated July 7th, 1915, pursuant to the Act, is unlawful.

(*c*) A declaration that the notice dated September 18th, 1915, declaring the plaintiff company to be, in the opinion of the Attorney-General of the Commonwealth, managed or controlled, directly or indirectly, by or under the influence of, or carried on wholly or mainly for the benefit or on behalf of persons of enemy nationality, or resident or carrying on business in an enemy country, is unlawful, and is also contrary to fact.

(*d*) An injunction restraining the further publication of the said notice.

The case was expected to come on for hearing before the full bench of the High Court in Melbourne last month.

German Press Campaign in Spain.—We have received the following communication from Mr. R. M. Nosworthy, president of the British Chamber of Commerce for Spain, Barcelona:—In view of the powerful and unscrupulous press campaign which is being carried on in this country by German and pro-German interests, the British Chamber of Commerce for Spain is strongly of the opinion that a combined effort should be made at once to counteract it by an efficient means at our disposal, viz., by bringing pressure to bear on Spanish newspapers by the organisation of British advertisers. Such organisation is intended to serve two objects: (1) The advancement of British commerce in Spain. (2) The well-merited support of those newspapers and periodicals which have declined to sacrifice their sense of truth and justice to the pressure of the German Press Bureau. Great Britain has already a large export trade with this country, but it might be considerably increased by judicious press advertising, which phase of commercial activity is still in its infancy in this country. This Chamber is of the opinion that a well-organised advertising campaign on behalf of British productions would certainly meet with immediate success, and this must apply especially to the ever-increasing number of proprietary and household articles of daily use. A special committee of this Chamber has been formed to deal with the subject on the following lines:—

1. Advertisements should be inserted only in those newspapers and periodicals free from German influence.
2. A list of the most influential newspapers and periodicals in Madrid, Barcelona, Seville, Bilbao, and other centres in Spain, with their tariff for advertisements, will be compiled and sent to advertisers on application.
3. The British Chamber of Commerce for Spain, having the placing of a large number of advertisements, may be able to obtain specially advantageous rates, rebates, and discounts, the benefit of which will be given to advertisers or their agents.
4. This Chamber will, if desired, undertake the translation of advertisements into Spanish, and their publication, free of charge.
5. Firms which prefer to leave their advertising to local agents should instruct them to patronise only those newspapers recommended by the British Chamber of Commerce.

Applications should be addressed to the Secretary, Advertisement Committee, British Chamber of Commerce for Spain, Plaza Cataluña 9, Barcelona.

Congestion at Havre.—The Commercial Intelligence Branch of the Board of Trade is informed by the Foreign Office as follows:—The French Government desire it to be known that the port of Havre is much congested, and it is consequently desirable that British exporters of goods for Switzerland should send, in their own interests, as little as possible by this route for the present; meantime efforts are being made to relieve the congestion.

Nottingham Corporation Contracts.—The Nottingham Corporation has unanimously decided to support the Manchester decision that no public contract shall be entered into with any body of German or Austrian nationality.

Controlled Works.—The number of controlled establishments is now 3,052.

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German Trade Preparations.—The French Minister of Commerce and Industry has just communicated to the French Chambers of Commerce the intimation that, according to information received from authentic sources and supplied to his department by the Minister of War, Germany and Austria-Hungary are engaged in laying down stocks in America of certain classes of merchandise of prime necessity under the conviction that after peace is declared there will be a great demand for them, and consequently an enhancement of prices. These stocks will be held until the end of the war owing to the present difficulty of shipment. Among the goods scheduled for these manipulations are:—Wool, lard, animal fat, copper, tin, raw rubber, tires, cottons, oil, vegetable grease, soap, and woven goods. The Minister adds that he deems it needful to signalise these preparations, so that French commerce and industry may take measures to guard against being forestalled in connection with the products mentioned. It is, of course, obvious that copper, tin, rubber, and oils and grease are products in which the electrical industry have an interest.

War Trade Department.—Mr. W. C. Bridgeman is acting as assistant director of the War Trade Department, and will continue to represent the department in the House of Commons.

LEGAL.

Morshead *v.* Quasi Arc Welding Co., Ltd.

A claim by Mr. L. R. Morshead, an engineer, against defendants, electrometallurgists, Caxton House, Westminster, came before Mr. Justice Darling and a special jury, in the King's Bench Division on March 2nd. The plaintiff claimed damages for alleged wrongful dismissal from his position as technical representative. Defendants, who are the owners of patents for a special method of electrically welding metals, pleaded justification on the ground that they were dissatisfied and, in reply to that, Mr. Morshead contended that such dissatisfaction was unreasonable.

The jury eventually returned a verdict for the defendants, and judgment was entered accordingly, with costs.

Counsel for the plaintiff asked for a stay of execution with a view to a possible appeal, but this was refused.

Electrical Engineer's Libel Suit.

In the King's Bench Division, on Tuesday, before Mr. Justice Ridley and a special jury, Capt. Herbert Wm. Lowe, of Cricklewood, sued Mr. C. J. Weld Blundell, of Lulworth Castle, Wareham, for an alleged libel. Defendant did not admit publishing the libel. The letter complained of was written on a privileged occasion, and was *bonâ fide* and without malice.

In opening the case, Mr Lewis Thomas, K.C., stated that plaintiff was now a captain in a Warwickshire Regiment, and had been for 18 months in the trenches. Plaintiff was an electrical engineer. In 1911 he was approached by a friend of defendant's to undertake the management of the Float Electric Co., Ltd., in which Mr. Blundell was the largest shareholder. The company was engaged in the manufacture of a patent safety electric lamp. According to the agreement defendant was to find sufficient capital to enable the business to be carried on. There was a difficulty owing to sufficient capital not being provided by the defendant. Plaintiff eventually resigned his appointment, and his resignation was accepted. He received his commission in November, 1914. In July, 1915, on returning home, plaintiff found that defendant had been making certain reflections on his character. After a new manager had been appointed to take over plaintiff's work, defendant wrote a letter to Mr. Stephens, his accountant. This communication referred to the new manager, and stated:—

> But my experience with workmen is that they all follow exactly the tricks and roguories of their predecessors, and his predecessor, Lowe, an ingenious thief, with the help of the rest of the gang—managed by just the same manœuvres and pretexts to get £1,000 or £3,000, and—sheltered him completely and pretended that the money had been fairly used in trading transactions.

Plaintiff gave evidence in support of Counsel's statement.

Mr. Charles Comins, chartered accountant, 50, Cannon Street, E.C., was called to show that the balance-sheets and accounts of the company were accurate.

Mr. Mitchell Innes, K.C., for the defence, stated that there was no evidence of publication. The letter was addressed to Mr. Stephens, who had acted as defendant's accountant. He also contended that the letter was written on a privileged occasion. It was addressed to an accountant whom defendant had consulted for the purpose of guidance and information.

The Jury, having briefly deliberated, returned a verdict for plaintiff, assessing the damages at £1,000.

Judgment was entered accordingly, with costs. A stay of execution was granted with a view to an appeal.

Sweden.—It is announced from Stockholm that the Allmanna Svenska Elektriska Aktiebolag has acquired the majority of the shares of the Nya Forenade Elektriska Aktiebolag, of Ludvika

BUSINESS NOTES.

Consular Notes.—SIAM.—The American Vice-Consul at Bangkok reports a demand for electric motors, tramcar equipment, telephone and telegraph supplies, X-ray apparatus, electric fans, bells, batteries, and a variety of similar goods. Bangkok is at present the only city in Siam supplied with electric power for industrial purposes. It has two electric light and power plants—the Siam Electricity Co., Ltd., a private company, and the municipal light and power station, owned and operated by the Siamese Government. Particulars of these undertakings have appeared in our pages.

CHILE.—According to a report from the American Commercial Attaché at Santiago, two new electrical companies have been floated in Chile. The Compania E'éctrica Canpolican, Rengo, Chile, has been organised, with a capital of 800,000 paper pesos (about £27,000), to take over certain electrical machinery already installed, and to purchase the concession for lighting the towns of Rengo, San Fernandom Rancagua, Peumo, San Vicente, and eight others. La Campania de Luz Eléctrica de Constitucion has been floated with a capital of 60,000 Chilean paper pesos (about £2,000) for lighting and providing power to the town of Constitucion, located in the Province of Maule, on the coast. Constitucion has a population of about 6,500, and is a popular seaside resort.

COLOMBIA.—The Colombian Congress, according to information supplied by the American Consul at Barranquilla, has appropriated $5,000 for the purpose of establishing an electric light station at Puerto Colombia to supply that village and the railway and steamship pier with electric light. In consideration of this sum the authorities of Puerto Colombia will be required to supply lights free for 10 years to the coastguard, post office, and telegraph offices, and one searchlight of 2,000 C.P., or two of 1,000 C.P. for use by the coastguard in lighting the bay for police purposes. The surveys and plans are under way. American machinery and equipment are to be installed.

ECUADOR.—The American Consul-General at Guayaquil states that, notwithstanding the fact that several contracts for the construction of the Esmeraldas-Quito Railway have been entered into between the Government and different parties, none of which have ever been fulfilled, another project was recently laid before Congress, and accepted, providing for an electric railway between the two cities. To give an impetus to the work, another law was enacted instructing the Executive to proceed without delay with the construction of the line, provided experts approved of the proposition. The line is to be built under the direction of a commission, composed of the Minister for Public Works and four persons nominated by the municipal Councils of Quito, Ibarra Tulcom, and Esmeraldas. The funds required are to be obtained from certain taxes designed as a guaranty for a foreign loan which has been authorised.

GERMANY.—In a report from Breslau, the American Consul in that city refers to the establishment of a new Electro-Chemical Co. (Electro-Chemische Fabrik Fürst von Pless) at Kattowitz. The purpose of this undertaking is the building of a chloride factory in the neighbourhood of Emmanuelsegen, near Boerschachte, and the production and sale of chloride of potassium, as well as of other electro-chemical products.

NORWAY.—A serious situation as regards the electricity supply of Stavanger was indicated in a recent report from the American Consul in that city. A lack of autumn rain threatened to produce such a shortage of electricity that the city might be without light and its factories without power. The lake supplying the water-power for the city's electric works had sunk more than 18 ft. below normal. Radical measures were being taken to conserve the remainder of the potential electric power. About 40 per cent. of this power (3,550 KW.) is used for light and heat, and about 60 per cent. (5,000 KW.) for the fish, textile, wood-working, &c., factories. The extreme northerly situation necessitates artifical light for a good part of the day. The electric works are in the mountains, about 18 miles from Stavanger, near Lake Oltedal, which furnishes the water-power. A project has been under way for obtaining the main power from a river about 60 miles from the city, connecting the wires with Lake Oltedal, so that both sources may be used. The unprecedented shortage was expected to hasten the work on this project, but two years at least will be required for its completion.

SPAIN.—The American Consul at Seville reports that permission has now been given for the extension of the telephone lines in that city to 22 towns in its vicinity. Some of the towns are petitioning for immediate connections, while some are waiting until proper financial arrangements can be made. It is expected that the first line will be installed between Seville and Guillena, as this is one of the neighbouring towns that has a considerably daily commerce with Seville.

Fire.—Messrs. Nalder Bros. & Thompson, Ltd., state that the fire which broke out at their works at Kingsland Green, on Sunday morning last, was fortunately discovered in time, and the damage done, though somewhat inconvenient, has not shut down the works. We are sure that their friends will excuse such slight delays as have been caused by this misfortune.

Board of Trade Inquiry.—The Board of Trade Commercial Intelligence Branch has been asked by firms at home for names of manufacturers of porous pots for electric batteries, No. 2 (5,000 required), and pumps for high vacua, power-driven.

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Trade with New Zealand.—Mr. W. G. Wickham, late H.M. Trade Commissioner for New Zealand, now H.M. Trade Commissioner for South Africa, has furnished the following particulars relative to imports of machinery into New Zealand in 1914 :—Of the total value of the imports of machinery into New Zealand in 1914, about one-half paid duty under the preferential tariff. The electrical machinery and cables imported are almost entirely for lighting, telegraph, and telephone purposes. Of the imports of internal combustion engines, more than half are for motor cycles and motor boats. A further deduction for agricultural and dairy machines, and domestic and office appliances, leaves an exceedingly small residue available for industrial purposes. The following table shows the total value of imports of machinery into New Zealand in 1914 under the new classification, imports from the United Kingdom being especially distinguished :—

Under the preferential tariff.	From United Kingdom.	From all countries.
Steam engines and boilers	£48,037	£54,234
Internal combustion engines	132,467	156,701
Electrical machinery and accessories ...	147,954	236,163
Mining machinery	21 388	28,475
Sundry	113,925	160,691
Total	£463,771	£636,264

From the items quoted "Under the general tariff," we select two items :—Electrical cables and insulating materials, £123,916, United Kingdom; £156 005, other countries. Engineers' and machine tools, £34,545, United Kingdom: £57,844, other countries.

In this section the totals are :—£268,189, United Kingdom; £598 015, other countries, making the grand totals, £731,960, United Kingdom; £1.234 279, other countries.

The statistical headings relating to electrical goods have in the year under review been amplified, and now yield information of some interest and value. In every line the United States was the chief competitor, with Germany following at a long distance. It is satisfactory to know that two-thirds of the generators, motors and transformers imported came from the United Kingdom, and more than half of the lamps and fittings. In the groups of machinery where competition is open, and no preferential duties apply, the United Kingdom made a poor show in 1914. Leaving out of account insulated electrical cables, only a bare one-third of the remainder was of British make. Telephones in the past provided an instance of goods being consistently supplied to the New Zealand market from foreign works when they might easily have been supplied from works in the United Kingdom. Of machine tools the United Kingdom supplied nearly two-thirds; the remainder was shared by the United States and Germany, the latter country being credited with 5 per cent. Of the considerable importation of insulated electrical cable and wire Germany supplied about 12 per cent. of the general trade. Importation in 1914 by the New Zealand Government included shipments of German origin valued at £7,500.

G.E.C. Electrical Plant for China.—Much has been written of late respecting the undoubted value of foreign markets to British engineering manufacturers. As an example of what is being done, we may refer to a few electrical contracts which have been secured in China recently by the General Electric Co., of China, Ltd., whose head office is in Shanghai, with a branch office in Hong Kong. This company looks after the interests in Southern China of the General Electric Co., Ltd., of Witton, &c. An important contract for the electrical lighting of the ancient city of Ningpo has recently been secured. A specially interesting point in connection with this contract is that the negotiations were very protracted, even by the Chinese standard, as they took nearly three years from start to finish. The existing plant is of German manufacture, and was partly secondhand when installed. The new plant will consist of a 120-kw. "Witton" steam-driven three-phase, high-pressure alternator, complete with main high-pressure switchboard, feeder panels, transformers, &c. The generating station is situated in the Chinese quarter of the city, and to transmit the electrical energy to the European quarter, under the new scheme a "submarine" cable is laid on the bed of the river. Previously, the Chinese had a very primitive high-pressure cable laid across a pontoon bridge, which was opened from time to time for sailing craft to get through. No proper system of breaking connection was provided—a rough-and-ready method of connection and disconnection only being used. Another recent contract is for the complete electrical plant for lighting the city of Yangchow. Electric light has not hitherto been used in Yanchow, but the first demand is for plant of 160-kw. capacity. As in the case of Ningpo a "Witton" high-pressure alternator direct coupled to a Belliss and Morcom steam engine fed with steam from Babcock & Wilcox water-tube boilers, is used. In the south of China a contract was obtained recently for four complete lighting sets for the city of Kweilin. In addition to the above, plant and switchgear have recently been supplied to the Fatshun Electric Co., the Nanking Electric Co., Funshun City, &c. Several further contracts are now being negotiated. Besides the foregoing, the General Electric Co., of China, Ltd., has just supplied a 125-kw. three-phase "Witton" alternator, 10 10-h.p., one 25-h.p., and several smaller "Witton" motors for a Chinese cotton and rice mill at Yungchow. We understand further that the sales of Osram drawn-wire lamps, as well as electrical supplies generally, are exceedingly brisk in China and the company looks forward to a long period of great prosperity.

Annual Dinner.—The second annual staff dinner in connection with the Efandem Co., Ltd., Fallings Park Works, Wolverhampton, took place on Friday night, Mr. Jesse Varley (director) presiding. Proposing the toast of "The Company," Mr. C. H. Stephenson said that during the year the works at Wolverhampton had been made the chief office of the company. Mr. Varley, in replying, said that in 1911 they started with a capital of £15,000; to-day they had approximately £100,000 employed in the business, and whereas their sales in 1911 were roughly £11,000, this year they had reached £15,000 per month, and like all new companies, they had had their difficulties and troubles, but owing to the loyalty and devotion of the staff they had overcome them all. This year they had done well. It would be within the knowledge of most of them that a new company—the Scott Electrical Co.—had been formed, and it was proposed to lay down works adjoining those of the Efandem Co. The Scott Co. had been registered with a capital of £100,000, and it was proposed to take over the electrical side of the Efandem Co.'s business, in order that the Efandem Co. might be enabled to increase their output in the portable electricity line. For the comfort of the staffs, it had been suggested that they should purchase a further plot of land in Park Lane for the erection of mess rooms and an institute for the benefit of the Efandem, Scott and British Ferro Plate Companies. This would mature in time. In the meantime they had to look to their business. It had been his privilege to attend a gathering of the leading manufacturers of portable electricity in the country. The Efandem Co. were the largest manufacturers of portable electricity in the world. At the present time they had little or no competition so far as outside companies were concerned, but they had to face it in the future, and they were endeavouring to influence the Board of Trade to grant them a protective tariff. Last week they had an interview with certain officials of the Board of Trade, and they were informed that if the Efandem Co. would prepare a scheme, it would be received favourably—sympathetically. They were preparing a scheme for submission to the Board with that object in view.

Mr. P. Smith proposed "Absent Colleagues with the Colours," and said there were 65 men from their workshops serving in the Army.

A pleasing entertainment, which was provided, included songs and monologues, concerted items by the Efandem Glee Party, and a display by T.E.C. Society of Artistes.

Liquidations.—The Adnil Electric Co.—The following are among the unsecured creditors in this case :—

Acme Electric Co.	£55	Horn, L.	£84
Aland & Co.	44	Higgs Bros.	16
Anglo Engineering Co. ..	45	Hunt & Co., R.	18
Armstrong, W.	36	Leach, S. G.	18
Atlas Carbon and Battery Co.	12	Le Carbone	17
Bergmann Electricitäts Werke, Berlin	27,704	Michael Abrahams, Sons, & Co.	39
Bush & Co., W. J.	127	Neuberger, J., Munchen ..	19
British and Northern S.S. Co.	13	Palmer & Co., A.	81
Booth, H. C.	12	Prechatyck, F., Berlin ..	26
Century Electric Co., St. Louis, U.S.A.	416	Rosenberg, R., Berlin ..	112
Crypto Electrical Co.	103	Reid, Ferens & Co.	44
Crammond, H. E	55	Reliance Electric Wire Co ..	86
City of London Elec. Ltg. Co.	25	Swedish General Electric Co.	1,182
Deutsche Telephone Werke, G.m.b.H., Berlin ..	1,965	Smith & Earle	215
Eschenbach, —., Berlin ..	47	Sterling Electric Co.	87
Enfield Elec. Cable Mfg. Co.	18	Straker & Co., E.	14
Fuller Electrical Co.	49	U.S. Electric Tool Co., Cin.	88
Goslin & Sons, S. B.	60	Universal S. and F. Co. ..	19
		White-Jacoby & Co.	24
		Walker Bros.	11

Reader's Patents and Engineering Co., Ltd.—Creditors must send particulars of their debts, &c., to Mr. E. W. C. Whittaker, 3, Portland Street, Southampton, the liquidator, by April 12th.

Holzappel Marine Gas Power Syndicate, Ltd.—A meeting is called for April 4th, at 57, Fenchurch Street, E.C., to hear an account of the winding up from the liquidator, Mr. N. W. Ward.

Good, Marriott & Co., electrical and mechanical engineers, 4, Chesterfield Street, Nottingham.—Messrs. E. V. Marriott and F. E. Good have dissolved partnership. Mr. Marriott will continue the business under the same style, and will attend to debts, &c.

Economisers, Ltd.—This company is winding up voluntarily with Mr. W. F. Johnson, 18, Theobald's Road, Bedford Row, London, as liquidator. A meeting of creditors is called for March 21st.

In the matter of J. Davis & Co. (Southampton), Ltd., electrical engineers, Hands *v.* The Company, a receiver and manager was appointed by Mr. Justice Neville, in the Chancery Division last Friday. This was an application in a debenture-holder's action made because Mr. Thos. Davis, the sole director, had died suddenly.

Trade Announcements. — The Electrical Supplies Co., London, hold large stocks of wood blocks for electrical purposes.

With reference to a notice published in our last issue, Mr. E. I. Hill has removed from 26, Stanton Road, to 2, The Broadway, Wimbledon. Telephone: No. 1239 Wimbledon.

Messrs. G. Noakes & Co., electrical engineers, of 32, London Street, Greenwich, S.E., announce that owing to enlistments they are relinquishing the business.

In addition to the vehicles illustrated in our last issue, we learn that Electromobiles (Leeds), Ltd., have acquired the sole British agency for the "Urban" electrical vehicles manufactured by the Kentucky Wagon Manufacturing Co., of Louisville, Kentucky, U.S.A.

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Bankruptcy Proceedings.—W. D. Birkett, factor of electrical goods. Whitley Bay.—Receiving order made at Newcastle-on-Tyne, February 28th, on a creditor's petition. First meeting, March 16th; public examination, March 23rd—both at Newcastle-on-Tyne.

J. Taylor Peddie, mechanical engineer, Aldwych Site, Strand.—March 18th is the last day for the receipt of proofs for dividend by Mr. F. S. Salaman, 1 and 2, Bucklersbury, London, E.C.

Book Notices.—*Questions and Solutions in Telegraphy and Telephony.* Final Examinations. By H. P. Few. London: S. Rentell & Co. Price 1s. 6d. net.—This book covers the questions set by the City and Guilds Institute in the final examinations of Telegraphy and Telephony for the period 1906-15, and gives very full solutions to the last papers. The syllabuses of the Institute in these subjects, and the answers to the numerical problems set in previous years, are appended. The answers given appear to be all that could be desired, and a great deal more than could be hoped for, by any examiner.

"*Journal* of the Institution of Electrical Engineers." Vol. 54. No. 257. March 1st, 1916. The issue contains the Seventh Kelvin Lecture on "Lord Kelvin and Terrestrial Magnetism." By Dr. C. Chree, F.R.S.

"Employers and Workmen under the Munitions of War Acts." By T. A. Fyfe. London: W. Hodge & Co. Price 2s. 6d. net.

"Science Abstracts," A and B. Vol. 19. No. 218. February 28th, 1916. London: E. & F. N. Spon. Price 1s. 6d. each net.

The Electrical Press, Ltd., will shortly publish "The Motor Transport Year Book and Directory, 1916," at 10s. 6d. net.

The Engineer's Year-Book of Formulæ, Rules, Tables, Data, &c., for 1916. Compiled and edited by H. R. Kempe, M.Inst.C.E. London: Crosby Lockwood & Son. Price 15s. net.—This valuable reference-book now makes its appearance for the twenty-third time, and is, if anything, more welcome than ever. It has grown appreciably in bulk; the text-matter now occupies 1,866 pages, the directory matter has been re-arranged, and French, Spanish, and Russian translations of the terms used in the directory have been appended. The revision of the Year-Book has been carried out as fully as usual, and amongst the new features are contributions on railway signals, aerial ropeways, electric drills, magnetic chucks, hydroelectric plant, mechanical draught, electrical plant, &c. "Electrical Engineering" has been overhauled by Prof. C. A. Carus-Wilson, and "Steam Turbines" by Mr. H. L. Guy. If one were to contemplate the compilation, *ab initio*, of a reference-book which should cover practically all branches of engineering, and should be so useful as to be almost indispensable to every engineer, one would be appalled by the magnitude and complexity of the task. Let us be thankful, then, that the feat has already been accomplished, and that in "Kempe's Year-Book" we have an invaluable desk companion, an encyclopædia in miniature, and all in one handy volume.

Eight Months' Italian Trade.—The official figures of Italy's foreign trade for the first eight months of 1915 have just been published, and they show an aggregate total of 3,667,394,168 lire, and a shrinkage on the figures for the same period of 1914 of 168,111,814 lire. The shrinkage was chiefly on the imports, which on a total of 2,296,200,000 lire, showed a falling off of 194,700,000 lire; while the exports, to the value of 1,565,900,000 lire, marked an advance of 26,600,000 lire. The exports to, and imports from, various countries are shown in the following table:—

	Exports, 1915.	Difference on 1914.
Austria-Hungary ...	104,926,000	− 32,139,000
France	270,055,000	+ 128,532,000
Germany	184,195,000	− 38,549,000
Great Britain ...	223,884,000	+ 28,704,000
Switzerland ...	178,513,000	+ 20,268,000
Argentina	70,206,000	− 14,618,000
United States ...	173,285,000	− 1,664,000

	Imports, 1915.	Difference on 1914.
Austria-Hungary ...	33,636,000	− 145,072,000
France	90,407,000	− 83,382,000
Germany	149,602,000	− 186,051,000
Great Britain ...	285,205,000	− 83,382,000
Switzerland ...	41,671,000	− 8,894,000
Argentina	234,165,000	+ 207,041,000
United States ...	771,617,000	+ 459,961,000

These figures show that, while on the one hand there has been a falling off in the aggregate interchange of goods with Germany and Austria-Hungary, there has been an increase of Italian exports to France, Great Britain and Switzerland, and of imports from Argentina and the United States.—*L'Elettrotecnica.*

Catalogues and Lists.—The Edison & Swan United Electric Light Co., Ltd., of Ponder's End, have issued a blue ground show-card of Royal Ediswan drawn-wire lamps. An outstretched hand brings the lamp more closely under the attention than the card alone could do.

Messrs. H. Tinsley & Co., Eldon Park Works, South Norwood, S.E.—12-page illustrated pamphlet giving full particulars and prices of Dr. C. V. Drysdale's distortionless sine-wave phase-shifting transformers.

Messrs. Jenson & Nicholson, Ltd., Goswell Works, Stratford, London, E.—Circular giving particulars of their British Standard insulating compositions. Mr. Arthur Hutchings, who has joined the firm, will attend to all matters in relation to the electrical insulating varnish department.

Italy.—The Societa Partenopea per Industrie Metallurgiche ed Elettriche has been formed at Naples with the object, while the war lasts, of manufacturing arms, munitions and war material, but later of working in iron, aluminium, &c., and selling the products of the same. The capital of the company is 1,000,000 lire in 10,000 shares of 100 lire each.

For Sale.—Darlington Corporation electricity department has for disposal two 100-kw. D.C. 460/520-volt dynamos direct coupled to enclosed steam engines; Messrs. Wheatley Kirk, Price & Co. will include in the sale by auction of the Barton Flour Mills, Gloucester, on March 29th, a 150-kw. electric light installation, complete with engine, boilers, superheaters, economisers, &c. Particulars are given in our advertisement pages to-day.

Board of Trade Inquiries.—H.M. Trade Commissioner in Canada reports that a firm in Toronto wishes to obtain agencies of United Kingdom manufacturers of electrical heating, pumping, and power house specialities. H.M. Consul at Rome reports that a local importer wishes to get into touch with United Kingdom manufacturers of small electrical appliances. Names and addresses can be obtained from the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C.

Football.—An interesting football match was contested on Saturday, March 4th, between the Ediswan Lamp Works, glass department, and Siemens Bros. Dynamo Works, Ltd., for the Siemens Silver Challenge Cup. The ground chosen was at the "Boundary," Ponder's End, kindly lent by Mr. Pass. After a very well contested game the honours went to the Ediswan team, who scored 3 goals to Siemens's 1. All the proceeds are to be utilised to provide comforts for the local lads fighting at the Front for their King and country.

LIGHTING AND POWER NOTES.

Accrington.—Plant Extension.—The Electricity Committee decided to obtain tenders and proceed with the work of installing a coal elevator and conveyor, which it is estimated will cost £700.

Barnstaple.—The T.C. has consented to the electrical engineer superintending the installation of the electric light at the Science and Art Schools.

Barrow.—Plant Extensions.—The Electricity Committee reported that although the formal sanction of the L.G.B. had not been received to the borrowing of the moneys for the extensions, the Board had agreed to the order for the rotary converter being placed.

Birmingham.—Price of Electricity.—The Electricity Committee states that the reduction of the rates for the supply of electricity in 1912 has been fully justified, as the growth of the output more than compensated for any loss in revenue, and the surplus each year had steadily increased: up to the end of the September quarter last year, it appeared that the revenue due to increased output would compensate for the advances in the cost of fuel and materials. Towards the end of November, however, the cost of materials, and especially fuel, rose rapidly, and as a result the returns for the nine months indicated that whilst the present year would show a surplus, unless an alteration were made in the charges the increased costs during the next financial year would not be met by the receipts. The Committee, therefore, recommends an increase of 15 per cent. on all charges for lighting and 20 per cent. on the charge for power, to take effect from the March reading of the meters. The H.T. supply is given under special agreements, which now contain a coal clause, advancing the price automatically. As opportunity arises, the agreements without the coal clause are being terminated, and new ones substituted. The Committee proposes to apply to the traction supply the terms of the coal clause in the H.T. agreements.

Blackburn.—Turbine Pumps.—The Waterworks Committee has requested an inquiry as to the early carrying out of the recommendation with respect to the erection of turbine pumps on the Bowland main.

Bo'ness.—The T.C. has received the report of the consulting engineer, Mr. J. M. Munro, of Edinburgh, on the conditions and prospects of the electricity undertaking, and the need for an immediate extension of plant. He approves of the scheme of the National Electric Construction Co. to install a new boiler of 10,000 lb. evaporative capacity, with mechanical stokers, superheater, &c. and a 500-kw. high-speed turbine unit with condensing plant, at a cost of £13,900, and on his recommendation the Council agreed to apply for sanction to the borrowing of £14,500. Mr. Munro pointed out that at present the inclusive capital outlay on the whole undertaking per kw. of running plant capacity is £73 10s.; after the extensions are completed the capital outlay per kw. of plant will be approximately £51. The number of kw. connected a year ago was 739, now they are 1,092. The maximum demand on February 9th, 1915, was 285 kw.; in the corresponding week of 1916, it was 400 kw; on December 20th, 1915, the demand reached 465 kw. Recently a further 215 kw. of possible load was connected, and Mr. Munro adds that the load cannot obviously be carried with the present 500-kw. plant with no spares.

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Bredbury and Romiley.—The U.D.C. has consented to the granting of an order to the Stockport Corporation to supply electricity in its area. The draft order provides that whenever the Bredbury and Romiley Council can satisfy the Board of Trade that it is in a position to supply electricity in its own district, the present order can be revoked.

Brighton.—Revised Charges.—The T.C. has given notice of a revision of charges for electricity as from the March quarter meter readings, as follows:—First 1,000 units, 6½d. per unit; ½d. per unit reduction for each extra 1,000 units to 3,000, and 4d. per unit for all above 3,000 units. Flat rate outside the borough to be 6½d. per unit; by prepayment meters in the borough 5½d. per unit and outside, 6½d. per unit. Power 1½d. per unit, first 2,000 units, beyond 1½d. per unit.

Burnley.—Price Increase.—The Electricity Committee has increased the charges for electricity for ordinary lighting from 3½d. to 3½d. per unit; for heating and domestic purposes from 1½d. to 1½d.; and for traction for 1·20d. to 1·25d. The old rates for power remain, except that the charge will be plus 10 per cent. instead 5 per cent.

New Plant.—With reference to the inauguration of new three-phase H.T. plant, which has been installed by the Corporation electricity department, this had become necessary owing to the growth of the demand in one section of the town. A sub-station was erected at Holmby Street, and two 300-kw. rotary converters with transformers, switchgear, &c., installed. This plant is fed at 6,600 volts, three-phase, from a 2 000-kw. Westinghouse turbine set at the generating station. The set runs at 3,000 R.P.M. on steam at 160 lb. pressure, and is equipped with a surface condenser and turbine-driven pumps. Two 600-kw. rotary converters are installed to link up the A.C. and D.C. plant.

Burton-on-Trent.—Loan Refused.—The L.G.B. has refused sanction to the borrowing of £3,500 for works in connection with the electricity undertaking. The Board further stated that it appeared that the cost of additional transformers and switchgear might be met out of revenue.

Colchester.—The Electricity Supply Committee reports that the total output of electricity for the month of January was 199,400 units, as compared with 186,084 for January, 1915. The number of consumers was 2,773, as compared with 2,686.

Continental.—Italy.—At a meeting of the Consiglio Municipale, of Rome, in October last year, a loan to the amount of 6,814,000 lire was sanctioned for public electric lighting improvements. Of this sum, 1,137,580 lire has already been spent in new installations and in the conversion of the previously existing oil and gas lighting to electricity, and a further 237,565 lire has been disbursed in the erection of two 1,500-c.p. lamps; 101 600-c.p. half-watt lamps; and 750 200-watt, 100-watt and 60-watt glow lamps in some of the principal streets of the city and suburbs. It is the intention of the electric light department to proceed with the further extension of the public electric lighting service, and a further sum of 410,000 lire is to be spent on the installation of 53 600-c.p. lamps and 2,047 glow lamps.

Dartford.—Price Increase.—The U.D.C. has decided to hold a special meeting to consider the Electricity Committee's report and recommendations. A deficit of £3,000 is estimated on the year's working of the undertaking, and the Committee, in view of the increase in cost of coal, recommends that the charges for lighting and power be increased by 20 per cent. from April 1st. The L.G.B. is to be asked to sanction the borrowing of £1,076 excess expenditure over the amount sanctioned for the extension of the electric light station and plant, and to cancel the unexpended sum of £75 in connection with the overhead cable.—*Dartford Chronicle.*

Derby.—The Electricity Committee reports that with the contracts for coal now being concluded, it is hoped to ensure the supply for the ensuing 12 months. While the lighting requirements have fallen off, the demand for power has increased during the nine months ended December 31st with a profit increase of £4,000; in the 10 per cent. advance charges realised £2,600 during the nine months.

Felixstowe.—Mr. R. P. Wilson, the Council's electrical engineer, reports that it is necessary to install a booster, &c., to increase the pressure in part of the district. The Council has decided, subject to obtaining the consent of the L.G.B. to a loan, to provide the money, estimated at £140, for the work.

Guatemala.—According to the *Journal of Electricity*, one result of the war is that Ocos will lose its electric light. About nine years ago, the Kosmos liner *Sesostris* was beached on the coast, and the chief engineer, left in charge, supplied the town with electricity from the ship's installation. Now the price of shipping has reached a point where it appears to be profitable to dig a canal and float the ship back to sea.

Hastings.—Owing to the restricted lighting, the Corporation Electric Lighting Committee estimates a deficiency of £6,225.

India.—Electric Heating.—The Simla municipality is encouraging the use of electric heaters by offering special rates, bringing the cost down to, approximately, that of coal fires, consequently heating by electricity has become very popular in the town this winter. The high cost and difficulty experienced in obtaining satisfactory radiators, &c., from England led to the municipal electrical engineer experimenting in this direction, with the result that radiators, water-boilers and several other types of heating apparatus have been constructed to suit individual requirements. The local made heaters are favoured to such an extent that the municipality cannot nearly keep the supply up to the demand. Several types have been standardised, and they are produced at a cost of half to one-third that of imported heaters. The elements used are manufactured in the country and the design has been patented by the inventor. The public has the option of either purchasing the heaters or of hiring them. A special tariff, which includes both the hire of the heater and current, has also been introduced. These appliances are stated to be the invention of Mr. F. L. Milne, of the Simla electricity department.—*Indian Engineering.*

With reference to our note on page 202 on the subject of Calcutta charges, which was based on the statement of an Indian contemporary, we understand that the statement that the Calcutta Electric Supply Corporation charges 8d. and 4d. respectively per unit for lighting and power is incorrect, as the company allows a discount of 25 per cent. off these prices to all consumers. Consequently, it would be more correct to state that the prices charged are 6d. and 3d. respectively per unit for lighting and power. Further, the company allows a gradual scale of additional rebates to large consumers, reducing the prices down, in some cases, as low as 3½d. per unit and 2d. per unit for lighting and power respectively. The supply to the Government is at the rates charged to ordinary consumers. The only advantage to the Government is that it is allowed to aggregate its consumption at the different Government establishments for the purpose of getting the maximum rebates. Large consumers for power purposes at factories are supplied with alternating current at a pressure of 6,600 volts, at very low prices.

Japan.—According to a report from Tokio, occasional interruptions in the operation of the high-tension transmission lines in Japan have been found to be due to the fact that reptiles climb the masts and enjoy a sun bath on the cross arms, and, in the course of their walks abroad, create short circuits.

Kendal.—The estimated net deficit on the electricity undertaking, for the 12 months ending March 31st next, amounts to £370.

Leeds.—The local Chamber of Trades is leading a vigorous protest against the suggested increase of prices for electricity supply by the Corporation. One ground of protest is that large advances of salary have recently been granted to officials.

London.—Mr. H. W. Bowden, referring to the use of coke breeze under the boilers at the South Metropolitan Electric Light and Power Co.'s station, mentioned at the company's meeting recently that the results obtained over a period of nearly 12 months showed a considerable saving, notwithstanding excessive repairs due to design and stressed conditions. Although, owing to the demands on the plant, the experiment had been abandoned, he saw no reason to prevent the exclusive burning of coke breeze (unassisted by coal) in a boiler house properly designed and ventilated. This was important when using forced draught with a sulphurous fuel. He further mentioned that the new H.T. transmission lines and 3,000-kw. sub-station at Crayford, about 10 miles from the power house, had been brought into use. During the year about 11½ million units were sent over the feeders; the maximum load was 6,250 kw., and the coal cost was ·37d. per unit. New turbo-generator and boiler plant was expected to be in commission during the month.

Battersea.—The Electricity Committee recommends that owing to the restricted lighting an allowance of £1,000 be made in the next financial year from the total amount which would have been charged for public street lighting at the current rates.

L.C.C.—The Finance Committee recommends the County Council to sanction the borrowing of £3,000 by the Hackney B.C. for mains and switchgear, and of £2,000 by the Poplar B.C. for its share in linking-up costs.

Marylebone.—The revenue statement of the B.C.'s electricity undertaking, for the December quarter, shows a total income of £69,991, an increase of £5,832 over December, 1914. The expenditure amounted to £21,636, an increase of £2,197, *i.e.*, 1·042d. per unit as against 1·012d. in 1914. The net result is a balance of £44,168 available for capital charges, an increase of nearly 11 per cent., as compared with December, 1914. The output sold for the respective December quarters of 1915 and 1914 was 4,982,454 and 4,614,801 units. The Electricity Committee has refused a request for increased wages by members of the Amalgamated Union of Enginemen, &c.

The Metropolitan Electric Supply Co., Ltd., is increasing the charges for electricity for lighting, heating and cooking by a further 10 per cent., from the end of the present quarter.

Hackney.—The engineer recommends the installation of an auxiliary battery for excitation purposes at the generating station, at an estimated cost of £465. Hitherto the alternators have been excited from the main battery, but recently owing to a short circuit on the D.C. bus-bars and the consequent drop of pressure on the battery terminals, the excitation of an alternator was reduced so that the converters were able to send a reverse rush of power into the alternator and operate the reverse current relays, leading to a temporary shut down.

St. Pancras.—The Electricity Committee has reported on two or three fires which occurred in a reserve coal store in December and January. The chief engineer held that the pouring of water on the coal by the fire brigade had cause spontaneous combustion, although the fire brigade authorities did not agree to this view. It is estimated that the loss to the undertaking in cartage, labour, and calorific value is about £1,300.

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Manchester.—The Electricity Committee, owing to the great demands on its plant, has been compelled to refuse a supply to a proposed new works, whose requirements would have been "equal to the whole of the lighting in Manchester" (says the *Manchester Evening News*). Ald. Walker, in referring to the loss of these works to the city, pointed out the absurdity of the opposition of the Ratepayers' Association and others to the proposals of the Electricity Committee, through which he does not doubt that the city has suffered considerably.

Nuneaton.—Insurance, &c.—The T.C. has decided to obtain quotations for insuring the electricity works against damage by aircraft, for a total indemnity of £12,000. In respect of restricted lighting for nine months ending December, 1915, the Electricity Committee has allowed a rebate of £150.

Ripon.—E.L. Proposals.—The City Council has adopted the Electricity Committee's recommendation that inquiries be made of the Harrogate Corporation as to what price it would supply electricity in bulk, at the city boundary, and also on what terms the Thirsk authorities would give a supply.

Shaldon.—E.L. Scheme.—At a meeting on March 2nd an E.L. scheme for the district, to be carried out on co-operative lines, was submitted by Dr. Purves, of Exeter, and a motion in favour of the project was adopted. The company interested proposes to supply current at 3d. per week per 25-c.p. lamp, or 2½d. per unit, if consumers do their own wiring.

Sheffield.—Loan Sanctions.—The formal sanctions of the L.G.B. have been received to the borrowing of the following amounts for additional plant at Neepsend:—£3,100 for reservoir pipe work and circulating water discharge pipes, valves, and bends; £1,250 for cables for connections and auxiliary boards; £49,742 for new plant and foundations, switchgear, and accessories; £45,050 for three new boilers, sludge pump and pipe work, screens, motor pump and housing, boiler foundations, sub-station equipment and transformers; £12,500 for cooling towers and foundations, coal shoots.

Southampton.—Ash Plant.—The T.C. has adopted a scheme of the electrical engineer for removing the ashes, clinker, &c., at the works, by other means than the existing coal conveyor. The total cost of the work is put at £500, which will be defrayed out of revenue. This includes £300 for a lift, for which it is proposed to obtain tenders; the remainder of the work will be carried out by direct labour.

Southwold.—Price Increase.—It is announced that the Electricity Co. has increased the price of current (7d. per unit), by 20 per cent.

Wigan.—Mr. S. L. Pearce, the city electrical engineer of Manchester, has been appointed to report exhaustively upon the Corporation's electricity undertaking.

TRAMWAY and RAILWAY NOTES.

Aberdeen.—The Corporation Tramways Committee has instructed the manager to try for six months a new type of ventilated motor for the cars.

Australia.—The Melbourne, Brunswick and Coburg Tramways Trust is entering into negotiations with the recently-formed Fitzroy, Northcote and Preston Tramways Trust for the construction and the running of the latter system. It is understood that there is a good opening for the economical running of the two systems under one management.—*Melbourne Age.*

Sydney City Railway.—The N.S.W. Minister of Works forecasts the successful working of the City Railway from the commencement of operation, which is assumed to be in 1920. The first year's working is estimated to give a net surplus of £125,000, and for 1926, the net surplus is estimated at £369,000. The total cost of the work, which is to be commenced this month, is estimated at £7,000,000. Two types of car are under consideration, with accommodation for 100 passengers seated and 166 standing, and 98 seated and 100 standing respectively.—*Sydney Telegraph.*

Blackpool.—Commencing on April 1st, soldiers are to be allowed to use the Corporation tramcars on payment of half-fares, this applying to all routes except the circular routes.

Bristol.—Tramways Purchase.—At the annual meeting of the Bristol Tramways and Carriage Co., on March 2nd, Sir George White referred at some length to the negotiations which have taken place with the Corporation in connection with the proposal of the latter to acquire the tramway undertaking. In this connection, the correspondence between the Corporation and company, from October, 1914, to January, 1916, was published in the *Western Daily Press* of March 3rd, which, in an editorial, points out that the economic situation has completely changed during the war, and that the new situation has been used by the directors in the interests of the shareholders. Two years ago the situation favoured the exercise by the Corporation of its option; it could have raised money at 3½ per cent.; it could not now raise any money in the open market, and the Tramway Co.'s offer to find the money at ½ per cent. above current Government rate, would mean that the city would have to pay 5½ per cent., which, with the provision for sinking fund, gives the proposal quite a new complexion. Our contemporary sums up the matter by indicating what appear to be three courses open:—(*a*) The acceptance of the offer of the Tramways Co. to sell to the city the tramways system and the motor-omnibuses on the financial terms which the present situation would require; (*b*) the acceptance of certain concessions (not as valuable as the Option Committee hoped to secure) on the condition of waiving the option of purchase for 14 or 21 years; and (*c*) to let the whole matter stand over until 1922. It further hints that the choice, under the circumstances, may lie between (*b*) and (*c*).

Continental.—Italy.—La Societa Tramvie Campidano-Poetto is the name of a new company which has been formed in Cagliari, with a capital of £52,000, to acquire and electrify the Campidano and Poetto steam tramways.

Spain.—A concession has been granted to the Sociedad Tranvia del Este de Madrid for the construction and working of an electric tramway in Madrid (Monte del Pardo district).—*Board of Trade Journal.*

Switzerland.—The *Electric Railway Journal*, quoting a Continental source of information, states that bow collectors are to be substituted for trolley collectors on all the Zurich tramway cars. A great reduction in delay, due to trolley wheels jumping off the wire, and repairs, has been found on a route experimentally equipped with bow collectors.

Darwen.—School Return Tickets.—The Tramways Committee has decided to issue return tickets for school children for one penny, available for the journeys to and from school.

Edinburgh.—Several important notices of motion referring to tramway affairs have been tabled by the T.C., including a proposal to consider the expediency of appointing a tramway manager and establishing a tramway department, the advisability of appointing a tramway engineer to attend to the interests of the Corporation during the remainder of the lease, and a proposal to consider "as to the advisability, in the public interest, of adopting legal proceedings to terminate the lease between the Corporation and the company, in respect of its failure to implement its undertaking to provide an adequate service of cars in the city."

Lancaster.—The T.C. has decided to purchase and run three motor-'buses, for the accommodation of the workers at the new works now being erected in the town.

London.—At a recent inquest on the driver of an electric train, whose body was found in the tunnel at the Crystal Palace, it was mentioned that a wedge was found in the compartment of the train which he had in some way got out of, which might have served to render the so-called "deadman's handle" inoperative. The attention of the guard was drawn to the fact that something was wrong, by the train running at high speed through a stopping station, and he subsequently applied the brakes and stopped the train.

Northampton.—A statement as to the working of the tramways undertaking for the year to March 31st next shows an estimated balance of £4,594, which it is proposed to appropriate as follows:—To reserve fund, £2,600; to relief of rates, £1,500; balance to be carried forward (or the actual amount), £494. Application is to be made to the B. of T. to extend the period for exercise of the powers relating to trolley vehicles and tramway extensions not already carried out, as contained in the Corporation Act of 1911, for a further period of 12 months.

U.S.A.—The *Electric Railway Journal* states that the Interborough Rapid Transit Co., of New York, has ordered from the Westinghouse Co. a 70,000kw. turbo unit for its Seventy-Fourth Street power station. The unit will be in three sections, one high-pressure and two low-pressure, and on light load it will be capable of operation at high economy with the high pressure and one low-pressure cylinder. The three electric generators of the unit will be of equal size, and at about 60,000 kw. will divide the load equally. The steam pressure to be used will be about 225 lb., and the superheat approximately 150° F.

The *Journal of Electricity* states that the electric towing "mules" at the Panama Canal have been modified, to allow of the two main induction motors being operated in cascade at half the speed for which the machines were designed; the speed of the "mules" is thus reduced from two to one mile an hour.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—May 1st. Two 300-kw. turbo-alternators, condensers, switchboard, &c., for the pumping station at Ryde, for the Metropolitan Board of Water Supply and Sewerage at Sydney.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-kw. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.*

Melbourne.—April 26th. Electrical equipment and accessories for sub-station for the Sandringham-Black Rock tramway.*

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Aberdare.—March 11th. U.D.C. Electrical stores for 12 months. See "Official Notices" February 18th.

Belfast.—March 15th. Tramways and Electricity Committee. Stores, including a number of electrical items. See "Official Notices" February 25th.

Dundalk.—March 21st. U.D.C. Engine-room stores, cables, lamps, &c., for the Electricity Department. See "Official Notices" February 25th.

Dundee.—March 29th. Corporation. Electrical stores, meters, &c. Electricity Department, Dudhope Crescent Road.

Heston and Isleworth.—March 11th. U.D.C. Electrical supplies, including cables, meters, &c. See "Official Notices" February 25th.

Heywood.—March 15th. Electricity Committee. Stores, including some electrical items, for 12 months. See "Official Notices" February 25th.

London.—WESTMINSTER.—B. of G. Six months' supply of electric lamps, fittings, &c. Mr W. J. Lickley, Clerk, Guardians' offices, Princes Row, Buckingham Palace Road, S.W.

Manchester.—March 22nd. Electricity Committee. 6,600-volt three-phase switchgear, for Stuart Street station. See "Official Notices" to-day.

Merthyr Tydfil.—March 13th. Electrical accessories for six months for the B. of G. Mr. F. T. James, Clerk, 434, High Street.

New Zealand.—DUNEDIN.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.*

WANGANUI.—May 9th. Borough Council. Gas producer plant, gas engine, generator and switchgear.*

Pontypridd.—March 13th. U.D.C. Twelve months' supply of electrical stores for the Electric Light and Tramways Department. See "Official Notices" February 18th.

South Africa.—March 20th. S.A. Railways and Harbour Administration. 5,106 train-lighting cells.*

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London

CLOSED.

Barrow.—Corporation. Rotary converter and switchgear. British Thomson-Houston Co., Ltd., £2,760. The contract for 80 tons of coal per week—Pope & Pearson's washed smalls—at 19s. per ton delivered, has been extended for six months.

Croydon.—Corporation tramways. Wotan, tantalum, and carbon filament lamps for the year. Siemens Bros. Dynamo Works, Ltd.

Horsham.—U.D.C. Tender of the Electrical Apparatus Co., Ltd., for D.C. house-service meters for 12 months, accepted.

Leyton.—The Tramways Manager has purchased 10 tons 13 cwt. of steel tramway rails for £128. Messrs. B.I. & Helsby Cables, Ltd., have received a contract for trolley wire.

London.—BATTERSEA.—The Electricity Committee recommends acceptance of the following tenders:—

Oils, with the exception of turbine oils.—Price's Co., Ltd.
Packings.—Beldam & Co.
Consumers' fuse boxes.—British Insulated & Helsby Cables, Ltd.
Electrolytic meters.—Reason Manufacturing Co., Ltd.; Bastian Meter Co., Ltd.
Mercury meters.—Chamberlain & Hookham, Ltd.; Ferranti, Ltd.
Box compound.—Dussek Bitumen Co.
Troughing, conduits, bellmouths, &c., and way-bridges.—Callender's Cable and Construction Co., Ltd.
Coal.—Shipley Bright small nuts, Myers, Rose & Co., Ltd.; Pooley Hall small nuts, Foster & Co.

The Committee also recommends that no contracts be entered into at present for house-service boxes, &c., and watt-hour electricity meters.

BERMONDSEY.—The Electricity Committee recommends the renewal of the following contracts for annual supplies:—

Carbon brushes.—Morgan Crucible Co.
Cable.—C. Macintosh & Co., with the addition of 2½ per cent.
Insulating box compound.—Dussek Bitumen Co., subject to an increase of 8s. per cwt.
Conduits.—T. Wragg & Sons, with certain exceptions.
Joint boxes—Sykes & Sugden, plus 10 per cent.
Quotations for rubber and certain other cable and cut-outs will be obtained as required.
The Committee has purchased 90 tons of Welsh and picked steam coal out of contract from C. Franklin, at 37s. per ton for the Welsh and 31s. 9d per ton for the steam coal, and has accepted the quotation of Babcock & Wilcox, Ltd., for fire doors, fire bars, &c.

L.C.C.—The Highways Committee has received the undermentioned tenders for the supply of 500 driving-wheel tires and 250 pony-wheel tires:—

	Driving-wheel tires.	Pony-wheel tires.
H. Bessemer & Co., Ltd. (accepted)	£38 10s. a ton, less 2½ per cent. dis.	£35 10s. a ton, less 2½ per cent. dis.
Cammell, Laird & Co., Ltd.	£33 10s. a ton.	£25 10s. a ton.

The cost of the tires is estimated at £2,200.

HACKNEY.—The Electricity Committee has received the following tenders for an auxiliary battery, &c.:—

	Price.	10 years' maintenance at per annum.
BATTERY.		
Hart Accumulator Co., Ltd. (accepted)	£251	£17 16 0
Tudor Accumulator Co., Ltd.	258	18 10 0
Chloride Electrical Storage Co.	257	18 10 0
D.P. Battery Co.	259	18 8 0
CHARGING BOOSTER.		
Electromotors, Ltd. (accepted)	54	0 0
Crypto Electrical Co., Ltd.	55	0 0
Siemens Bros. Dynamo Works, Ltd.	58	0 0
J. H. Holmes & Co.	63	0 0
SPECIAL SWITCHGEAR.		
Naider Bros. & Thompson, Ltd. (accepted)	93	0 0

ST. MARYLEBONE.—The Electricity Supply Committee recommends the acceptance of the following tenders:—

New economiser, £1,242.—E. Green & Son, Ltd.
Repairs to artesian-well pump.—A. C. Potter & Co.
Re-linking chain grate stoker, £115.—Babcock & Wilcox, Ltd.
Coal.—Charrington, Sells, Dale & Co., 1,600 tons of Langwith and Glapwell nutty slack, at 2 s. per ton, during the four months March to June inclusive. A. Blackmore & Co., 11,000 tons of Low Laithes Yorkshire washed nuts, at 24s. 9d. per ton, at the rate of 1,000 tons per month from August, 1916.
The Committee does not think it desirable to enter into contracts for general supplies for 12 months to March, 1917, and has limited the inquiries to supplies which will be required for six months only.
As regards small house cable, flexible cords, rubber goods and insulating material, the Committee considers that it would be advantageous to buy in the open market as and when required.
Underground cables.—B.I. and Helsby Cables, Ltd.

The Committee has taken advantage of the high prices ruling in the metal market to dispose of a quantity of scrap cable and also of some surplus stocks at profitable rates. Prices cleared: copper £106 per ton, lead £28 per ton, and sundry small cable (unstripped) £36 per ton.

METROPOLITAN WATER BOARD.—St. Helens Cable and Rubber Co., Ltd., V.I.R. cable and flex, £40; Simplex Conduits, Ltd., electric light fittings, £28.

WANDSWORTH.—The Guardians will not this year invite tenders for the supply of electrical fittings, &c., for set periods, but quotations will be obtained as required.

Southampton.—The Tramways Committee. Messrs. Edgar Allen & Co., points and crossings, £196.

Sunderland.—Electricity and Lighting Committees. Accepted tenders:—

Metallic packing.—Penman Metallic Packing & Engineering Co.
E.H.T. switchgear.—Ferranti, Ltd.
Governor valves.—Willans & Robinson, Ltd.
Creosoted wood troughing, &c.—Armstrong, Addison & Co.

Winchester.—Corporation electricity works. Alexander Duckham & Co., Ltd., engine and cylinder oils for a year.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, March 10th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Experiments illustrating "The Flow of Heat in Conducting Sheets," by Mr. S. Skinner; "The Absorption of Gas by a Quartz Vacuum Tube," by Messrs. R. S. Willows and H. T. George.

Manchester Association of Engineers.—Saturday, March 11th. At the Grand Hotel, Aytoun Street. Paper on "India-rubber and Balata Belting as Conveyer and Power-transmission Belts," by Mr. J. Tinto.

Royal Institution of Great Britain.—Saturdays, March 11th and 18th. At 3 p.m. At Albemarle Street. Lectures (I and II) on "Radiations from Atoms and Electrons," by Prof. Sir J. J. Thomson.
Thursday, March 16th. At 3 p.m. Lecture on "Organic Chemistry in War: Organic Products used as Propulsive and Explosive Agents," by Prof. H. E. Armstrong, F.R.S.

Belfast Association of Engineers.—Wednesday, March 15th. Paper on "Civil and Military Engineering under the Roman Empire," by Mr. A. McI. Cleland.

Faraday Society.—Wednesday, March 15th. At 8 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Informal discussion on "Methods and Appliances for the Attainment of High Temperatures in the Laboratory," opened by Dr. J. A. Harker, F.R.S.

Nottingham Society of Engineers.—Wednesday, March 15th. At 7.30 p.m. At the Welbeck Hotel, Milton Street. Paper on "Brass Foundry Practice," by Mr. H. L. Reason.

Institution of Electrical Engineers.—Thursday, March 16th. At 8 p.m. At Victoria Embankment, W.C. Paper on "The use of Continuous Current for Terminal and Trunk Line Electrification," by Mr. N. W. Storer.

(**Students' Section**).—Wednesday, March 15th. At 7.45 p.m. At the I.E.E., Victoria Embankment. Adjourned discussion on "Suggested Applications of Science in Warfare."

(**Birmingham Local Section**).—Wednesday, March 15th. At 7 p.m. At the University, Edmund Street. Mr J. S. Peck will read Mr. N. W. Storer's paper on "The use of Continuous Current for Terminal and Trunk Line Electrification."

(**Scottish Local Section**).—Tuesday, March 14th. At 8 p.m. At 207, Bath Street, Glasgow. Kelvin Lecture on "Terrestrial Magnetism," by Dr. C. Chree.

Chemical Society.—Thursday, March 16th. At 8 p.m. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

Institution of Mechanical Engineers.—Friday, March 17th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Paper on "The Composition of the Exhaust from Liquid-fuel Engines," by Second-Lieut. R. W. Fenning, R.E. (T).

Greenock Electrical Society.—Friday, March 17th. At 7.45 p.m. At the Temperance Institute, 19, West Stewart Street. Papers on "Some D.C. Diagrams of Connections," by Mr. D. Angus, and "Heating and Ventilation," by Mr. W. A. Toppin.

Electro-Harmonic Society.—Friday, March 17th. At 8 p.m. At Holborn Restaurant. Smoking concert.

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NOTES.

L.C.C. Committees.—The L.C.C. is recommended to confirm the appointment of the members of the following Committees for 1915-16 :—

Highways Committee.—Sir John Benn, D. Davies, G. M. Gillett, A. O. Goodrich, W. Haydon, D. Hazel, T. F. Hobson, G. H. Hume, W. Hunt, H. Marks, Capt. T. Prestige, A. H. Scott, P. C. Simmons, W. J. Squires, H. Ward and A. W. Yeo.

Stores and Contracts Committee.—W. H. Ecroyd, W. Haydon, W. C. Johnson, Miss A. S. Lawrence, O. Lewis, H. Marks, H. Parsons, I. Salmon; the Education, Fire Brigade, Highways, Drainage, and Parks Committees have each to elect a representative.

Foreign Trade.—The February Figures.—The following are the electrical and machinery figures given in the official returns for February :—

	Month of February.	*Inc. or dec.*
Imports.		
Electrical goods and apparatus, excluding machinery and uninsulated wire	£96,494	+ £27.416
Machinery	613,691	+ 40,158
Exports.		
Electrical goods and apparatus, excluding machinery and uninsulated wire	298,638	+ 124,768
Machinery	1,524,653	+ 238,785

The Electric Vehicle Committee.—At a meeting of the Electric Vehicle Committee on February 18th, the increasing circulation of the official publication was commented on. The Committee had before it a letter from the secretary of the Electric Vehicle Association of America, offering every assistance in helping forward the movement.

The Committee has accepted an invitation by the Society of Motor Manufacturers and Traders to nominate a representative to sit upon the Tire Research Committee, which has recently been appointed to investigate all technical matters concerning rubber tires.

The Committee considered a communication from the Accumulator Manufacturers' Section of the B.E.A.M.A., stating that it was prepared to agree to the standard sizes and rating as set forth below. These will be known as E.V.C. standards, but it is hoped that, in due course, the British Engineering Standards Committee may give them the mark of approval by adopting them as British standards.

"*E.V.C.*" *Standard Rating.*—This shall be the capacity in ampere-hours obtained by a continuous discharge at a uniform rate for a period of five hours until the voltage of the cell falls to 1·7. Example: If a battery is specified to have an "E.V.C." standard rating of 180 ampere-hours, it means that the battery will give this capacity when discharged at a continuous rate of 36 amperes for a period of five hours, at the end of which time the voltage per cell shall not have fallen below 1·7 volts.

"*E.V.C.*" *Standard Plates.*—Height, 8⅛ in.; width, 5¾ in.; lug centres, 4¼ in.

"*E.V.C.*" *Standard Overall Sizes.*—For all sizes the width of the cell shall be 6$\frac{5}{16}$ in. and the overall height, including connector, 14¼ in. The length of the smallest size, *i.e.*, that with seven plates, shall be 2$\frac{1}{16}$ in., with the addition of ⅜ in. for each pair of plates above seven plates.

An exception is made in the case of the Chloride Accumulator Co.'s "Ironclad-Exide" type of cell, in connection with which the length of the seven-plate size is 2¾ in., with the addition of ¼ in. for each pair of plates above seven plates.

"*E.V.C.*" *Standard Inspection Plug.*—Shall be that which will fit a hole in the cover of the cell 1 in. in diameter.

"*E.V.C.*" *Standard Charging Voltage.*—Shall be that which is suitable for charging 44 lead-acid cells, *i.e.*, 85 to 120 volts.

The Committee has had brought to its notice difficulties which are being experienced in a few of the districts bordering upon the London area by electric delivery vehicles, operating from London on long delivery routes, in getting boosting charges. The difficulties consist in either delay in getting connected up for charging owing to there being no permanent connection for the purpose, or, on the other hand, the exhorbitant price charged for the service. The Committee appeals to all central station engineers to adopt, where they have not already done so, the Committee's standard tariff of 1d. per unit for "off peak" charging, with a minimum of 2s. per charge (24 units at 1d.) to include all connecting-up and disconnecting. At first, all that is necessary is a permanent (for the time being) connection from the switchboard bus-bars through a D.P. switch and fuses, or a maximum overload circuit-breaker, through an adjustable water resistance to a British standard charging-plug. If, perchance, there is a booster set, or an exciter in the station, giving about 120 volts, that can be used for this purpose when required, so much the better. The proper and permanent charging plant can be put in when the first car is put into permanent use in the district.

Glass Telegraph Poles.—According to the *Journal Télégraphique*, reinforced glass telegraph poles are being made in Germany for use in the Tropics and elsewhere, as being immune from the attacks of white ants, &c., and proof against climatic influences, and more lasting than wood. The poles are cast in moulds, in which is a fine network of steel, the combination yielding a product of great strength.

Red Cross Concert.—In the streets of London the afternoon of Saturday last was cold and raw, but in the King's Hall of Holborn Restaurant was warmth and light and friendliness, for the Junior Institution of Engineers were gathered for a Bohemian concert "in aid of the funds of the Red Cross Hospital of the City of London Branch of the British Red Cross Society." Sir Boverton Redwood, Bart. (Past President), was in the chair, supported by the Lord Mayor. The artistes were as follows :—Soprano, Miss Ethel Williams; contralto, Miss Mary Williams; baritone, Mr. Archie Anderson; elocutionist, Miss Frances Edmonds; royal campanologist, Mr. Wilfrid Alderton; cornet soloist, Mr. Chas. Leggett; living marionettes, Mr. Arthur J. Hill; character sketches, Mr. Ernest Cherry; humorous songs, Mr. Walter Montagu. Accompanists, Mr. R. Cooper and Mr. Fred. Froud. Hon. musical director, Mr. Geo. T. Bullock. The thanks of the Institution were proffered to Sir Boverton Redwood by Mr. Tookey. The Lord Mayor arrived early, and made, just before the interval, a brief speech. He introduced Mr. Richard Davies, Chairman of the City of London Branch of the Red Cross Society, who had a silent and very attentive and sympathetic audience to listen to his interesting account of the hospital, and his tactful appeal for aid. Although not in the programme, mention must not be omitted of a bevy of nurses in blue and white with the Red Cross badge, who dispensed programmes in return for donations to the hospital funds. The audience numbered 646.

Institution and Lecture Notes.—The Faraday Society.—The Society will hold an informal discussion on "Methods and Appliances for the Attainment of High Temperatures in the Laboratory," on Wednesday, March 15th, at 8 p.m., at the Institution of Electrical Engineers, Victoria Embankment, W.C. Dr. J. A. Harker, F.R.S., of the National Physical Laboratory, will open the discussion, over which Sir Robert Hadfield, F.R.S., the President of the Society, will preside. Workers interested in the subject, and particularly those prepared to speak on the results of their personal experiences, are invited to be present and take part in the discussion. Further particulars may be obtained from Mr. F. S. Spiers, secretary to the Society, 82, Victoria Street, London, S.W.

Institute of Metals.—The sixth annual May lecture will be delivered, on May 4th, by Prof. W. H. Bragg, the subject being "X-rays and Crystal Structure, with Special Reference to Certain Metals."

The Institution of Electrical Engineers.—On Wednesday an "informal general meeting" of Corporate Members was held to consider the question of the expulsion of alien enemy members from the Institution. There was a large attendance. After reading a number of letters from provincial members supporting the proposal, and others on the contrary, the President stated that before calling a special general meeting to vote on the question of altering the Articles of Association, the views of the members as a whole would be ascertained by a post-card plebiscite—not a postal ballot, which was not practicable. The meeting then proceeded to discuss the various aspects of the subject at considerable length, the sitting lasting for 2¼ hours. The main difficulty centred in the question whether a differentiation should be made between naturalised members of alien enemy origin and unnaturalised alien enemies, owing to the uncertainty as to the *bona fides* of naturalised Germans, who, if naturalised since January 1st, 1914, may, under a new German law, retain their German nationality. Eventually the President put a series of questions to the vote :—Should the voting be by ballot? Should subjects of enemy countries be expelled? Should naturalised aliens who had retained their original nationality be expelled?—all of which were carried by show of hands with hardly any dissentients. The question whether naturalised British subjects who had been subjects of a State now at war with this country, but were able to prove to the satisfaction of the Council that they had lost their orginal nationality, should be expelled, was answered by an overwhelming majority in the negative, and the question whether subjects of enemy countries should be barred from election in the future was carried by two to one. A Committee of Members, consisting of Messrs. Atkinson, Swinton, Gill and Rider, was then appointed to meet the Vice-Presidents (Messrs. Highfield, Russell, Smith and Wordingham) and decide upon the form of a resolution to embody the principles which had thus been laid down.

At the meeting of the Yorkshire Local Section on Wednesday last a paper was read by Mr. Henry Joseph on "The Hire and Maintenance of Continuous-current Motors."

The Committee of the Western Local Section has put forward the following nominations for the vacancies which will occur at the end of the present session :—Chairman, Dr. David Robertson, Bristol; vice-chairman, Mr. R. Howard Fletcher, Cardiff. Seven nominations to fill five places on the Committee :—Messrs. F. S. Carter, Port Talbot; W. D'A. Madden, Bath; T. Mills, Melksham; C. G. M. New, Cardiff; C. F. Proctor, Cardiff; H. I. Rogers, Bath; A. L. Stephens, Stroud.

Diesel Engine Users' Association.—At the February meeting a discussion took place on the use of tar oils as fuel for Diesel engines; Mr. W. Batho, of Messrs. Sulzer Bros., and Mr. L. W. Johnson, of Messrs. Banks, Warner & Co., Ltd., who had been specially invited to attend, contributed detailed statements on the subject, and in the discussion which followed stress was laid on the importance of rendering users of Diesel engines in this country independent of the use of imported petroleum fuel oils, and of utilising the mineral resources of the country. The next meeting will be held on the 22nd inst.

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A Diary of Electric Railway Operation.—A recent issue of the *Railway Review* contains an abstract of a memorandum in diary form of the inauguration of electric service between Three Forks and Deer Lodge, Mont., by the Chicago, Milwaukee and St. Paul Railway.

Reference occurs under date, December 2nd, 1915, to the running of a 1,016-ton train from Butte to Three Forks; it was calculated from the electric locomotive meter readings that the cost of handling this train from Butte to Donald, for power, was $9; on the same basis the amount of power returned to the line from regenerative braking between Donald and Piedmont amounted to $5, leaving the net cost of handling the train from Butte to Piedmont at $4.

Under date December 7th, it is mentioned that a constructional pipe in Tunnel 11, being too near a 3,000-volt feeder, a short circuit resulted burning off one feeder, steel messenger, and two trolley wires about 800 ft. from the tunnel entrance. While attempts were being made to find the trouble, a freight train passed through the tunnel, caught the loose ends of the overhead structure and practically tore the whole thing down. Twenty men repaired this during the next 24 hours.

On December 8th, a comparison was made between two electric locomotives hauling 3,000 tons and three steam locomotives hauling 2,200 tons; the former maintained an average speed of 16 M.P.H. on a 1·66 per cent. grade, while with the latter on the same road the speed was estimated to be between 9 and 10 miles an hour. The maximum A.C. demand noted during the test was 6,200 KW., and the maximum D.C. demand, 5,400 KW. showing an efficiency of combined motor generator sets of 87 per cent.

The memoranda cover the 10 days prior to opening the line for regular service, and the only other troubles worth recording were changing sliding members of pantograph owing to wear by trolley wire, due to its being roughened with soot and smoke; also damage to overhead structure and pantograph owing to the latter passing a trolley wire terminal. Regular operation commenced on the tenth day.

Tahiti.—According to the *Journal Télégraphique*, the French Government is installing a temporary wireless station at Tahiti, in the Society Islands, which will shortly be opened for traffic. The installation will be provided with plant of 10 KW, and will be able to communicate with New Zealand, Fiji, and Samoa. As soon as the temporary station is ready, work will be commenced on a permanent station of 300 KW., which will probably be able to communicate with Cochin China, South America, Honolulu, San Francisco, and Sydney.

Volunteer Notes.—ENGINEERING INSTITUTIONS' V.E.C.—Orders for week commencing March 13th, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commanding.

Saturday, March 11th.—Parade, Putney Bridge Station, 3 p.m. Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, March 13th.—Sections 1 and 2, Technical; Sections 3 and 4, Lashings and Trestle Bridging, Signalling Class and Recruits.

Tuesday, March 14th.—School of Arms, 6 to 7 p.m.

Thursday, March 16th.—Shooting for Sections 3 and 4.

Friday, March 17th.—Sections 3 and 4, Technical; Sections 1 and 2, Lashings and Trestle Bridging; Signalling Class and Recruits.

Saturday, March 18th.—Adjutant's Instruction Class at 2.30 p.m.

E. G. FLEMING,
Company Commander and Acting Adjutant.

3RD BATT. (OLD BOYS) CENTRAL LONDON VOLUNTEER REGIMENT.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, March 9th, 1916:—

Week-end Parades.—Saturday.—The Battalion will parade at Wembley Park at 3.15 p.m. for drill under Company Commanders. "Derby" Recruits are invited to attend.

Sunday.—The Battalion will parade at Liverpool Street Station (low-level entrance, G.E.R.) at 9.30 a.m., and proceed by train for Entrenching duties. Members will carry their own lunch. The Battalion will return to town about 6 p.m.

Musketry.—There will be a shooting match at Bisley on Saturday next, the 11th inst., between Sergeant R. C. Davis's "A" Company team, and Acting Company Sergeant-Major Harper's "B" Company team. Targets will also be available at Bisley for other members of the Corps desirous of shooting.

All men proceeding to Bisley should report themselves to Sergeant Cotter, at the barrier of No. 6 Platform, Waterloo Station, at 12.45 p.m.

A. G. JOINER, *Major and Adjutant*, O.B.C.

Electric Power in Russia.—It is reported from Petrograd that a special commission, composed of representatives of the Government, commerce and industry, will meet shortly to examine the Bill prepared by the Ministry of Commerce to facilitate the development of the use of electric power in works and factories. The Bill has been prompted by the frequent crises in connection with the supply of coal in the country.

Appointments Vacant.—Shift engineers, junior engineers and attendants, station fitters, engine drivers (steam, oil and petrol), stokers and trimmers, linemen, wiremen, mates and labourers, for the Northern Command; engine driver, Llandudno electricity works; switchboard attendant, Borough of Nuneaton electricity works; resident assistant engineer, 3 p. 6 l. for the Bethnal Green Military Hospital. See advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—A smoking concert was recently held in the banqueting-room of the City Hall, Cape Town, for the purpose of making a presentation to Mr. W. F. LONG on his retirement from the position of city electrical engineer. The Town Clerk presided, and was supported by many of the City Councillors. The presentation took the form of a magnificent piece of plate. In connection with Mr. Long's retirement and the promotion of Mr. S. J. CLUNAS, the present station manager, to the position of acting city electrical engineer, Mr. PURVIS, who has been Mr. Clunas's assistant for some years, has been appointed station manager.

Winchester T.C. has appointed Mr. REGINALD AYTON engineer and manager of the electricity undertaking at £400 a year, increasing by £50 a year. For five years he has been resident engineer under the consulting engineers.

The Belfast Corporation has adopted the recommendation of the Tramways Committee "That Mr. A. NANCE be relieved of his duties as general manager of the Corporation tramways undertaking as and from September 1st, 1916, and appointed as consultant to the undertaking at a salary of £500 per annum."

Mr. J. W. DUGDALE, general manager of the Oldham Corporation tramways, has resigned his post.

Nelson Corporation has advanced the salary of Mr. WM. THOMPSON, station superintendent.

Peterborough T.C. has increased the salary of the acting electrical engineer from £3 10s. to £4 per week.

General.—Mr. W. H. PATCHELL has just removed his offices to 64, Victoria Street, London, S.W.

The prize of £10 and a silver medal, offered under the Peter Le Neve Foster Trust by the Royal Society of Arts, for an essay on "Zinc, its Production and Industrial Applications," has been awarded to Mr. J. C. MOULDEN, A.R.S.M., M.Inst.M.M. Honourable mention has also been awarded to Mr. E. A. SMITH, A.R.S.M., M.Inst.M.M., Deputy Assay Master of the Sheffield Assay Office.

Sub-Lieutenant JOHN KAYE, an electrician in the R.N.V.R., was married at Dunfermline last week to Miss Margaret Summerville, of Viewfield, Dunfermline. Sub-Lieut. Kaye formerly held a position at the Ashton electricity station, and recently was engaged at Dunfermline.

It will be remembered that the members of the board of the Manchester Chamber of Commerce resigned in a body a fortnight ago upon the rejection of a report expressing the views of the board on the question of trade after the war. For the new board 29 names have been nominated for 22 seats, and among them is Mr. HARRY VERNON KILVERT, electrical engineer, of the Lancashire Dynamo and Motor Co., Ltd.

In the list of aliens to whom letters of naturalisation were granted during February are the following:—W. B. Rommel (U.S.A.), London, consulting engineer; A. Sild (Russia), London, electrical and mechanical engineer.

Mr. S. MCFADDEN, traffic manager at the Norwich Telephone Exchange, who is leaving to take up an appointment at Bournemouth, has been presented by the staff with a china cabinet.

Mr. T. GLADDY, who for the past eight or nine years has had charge of the accessories section of the supplies department of Messrs. Siemens Bros. Dynamo Works, Ltd., 39, Upper Thames Street, E.C., is shortly leaving that firm to take up an appointment as commercial manager with Messrs Trevelyan & Co., manufacturers of electrical and general engineering accessories, at 155, Bracebridge Street, Birmingham.

Mr. PAKENHAM W. BEATTY has resigned his position as chief engineer to the Lacroze Tramway Co., of Buenos Aires, which he has held since June, 1913, in order to take up the post of chief engineer to the Buenos Aires Underground Railway, belonging to the Anglo-Argentine Tramway Co., of Buenos Aires.

We are informed that the arrangements which existed between Mr. CHAS. PULLAN, consulting electrical engineer, and Mr. C. H. BEST, accountant, both of Bradford, who had been for some time co-operating in connection with a number of village electric supply schemes, came to an end on February 4th. These two gentlemen will in future work quite independently of each other.

SIR H. LLEWELLYN SMITH is to resume active duty as Permanent Secretary to the Board of Trade. Mr. W. F. MARWOOD, C.B., has been appointed Second Secretary to the Board. These changes are consequent upon the departure of Sir G. BARNES for India to take up the position of Commercial Member of the Viceroy's Council.

Roll of Honour.—Rifleman A. J. SCOTT, 1st Surrey Rifles (21st London Regiment), a clerk in the St. Marylebone electricity department, was killed in action on January 23rd.

Torpedoman DODSON, who was awarded the D.S.M. for gallant service, recently visited his home in Accrington. It will be remembered the *Königsberg* was chased by British warships, and sought refuge in a river. While under fire Dobson (who held the position of electrician on his ship, hav-

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ing charge of the lighting, &c.) played a prominent part in preventing the German cruiser escaping.

Private J. Holliday, who has been killed in action, was employed at Blackburn electricity works.

Corporal P. J. Adamson, whose death has occurred, at Cairo, was well known in Rochdale as an electrical engineer. He was formerly employed at generating stations at Radcliffe and Middlesbrough, and on his return to Rochdale joined his eldest brother, Mr. G. L. Adamson, in the Ohm Electrical Works. He met his death in Egypt while engaged in fixing telegraph apparatus on the railway line, being knocked down by a train.

Private Leonard Wood, of the 10th Lancashire Fusiliers, who, prior to the war, was employed by the Lancashire Electric Power Co., has been killed in action.

Obituary.—Mr. R. A. Dawbarn.—We learn with deep regret that Mr. Robert Arthur Dawbarn, M.Inst.C.E., M.I.E.E., of Westminster, passed away on March 6th at the age of 55 years. Quite recently he suffered a complete breakdown in health, and his death occurred at a nursing home. After serving an engineering apprenticeship, and undergoing training at Glasgow, he, 35 years ago, entered the service of the British Electric Light Co., the owners of the Gramme patents. After three years he was employed on ship lighting work carried out by Mr. Raworth, and next spent a couple of years on Messrs. Siemens's electric light staff at Woolwich. He later returned to Mr. Raworth, who was then superintending engineer to the Brush Co., and while with this company he was responsible for the details of many Brush electric lighting schemes. He did not limit his attentions to this country, for, as a matter of fact, certain of his Brush activities took him to Australia, where he amalgamated several electrical concerns, and studied electrical affairs generally. Some 16 years ago Mr. Dawbarn left the service of the Brush Co. and joined Mr. W. M. Mordey in partnership, in the business of Mordey and Dawbarn, consulting engineers. He was in this capacity engaged at different times upon various public and other electrical projects and works, and the firm's operations frequently took him on visits to South America, South Africa, and elsewhere. Mr. Dawbarn was a man who until quite recently betrayed no signs of giving out, and we must reckon him among those who have succumbed to the stress and strain of trying years before the completion of what seemed to be the allotted span. His death will be regretted by a large circle of friends in the electrical world, and we tender our sympathy to his partner, Mr. W. M. Mordey.

Will.—The late Mr. Z. Merton (H. R. Merton & Co.) left £149,865 gross and £121,889 net.

NEW COMPANIES REGISTERED.

Company of Electric Caterers, Ltd. (143,181).—This company was registered on March 3rd, with a capital of £1,500 in £1 shares, to carry on the business of bakers, confectioners, and millers, dealer in flour, meal, and other breadstuffs, corn merchants, suppliers of refreshments, caterers, manufacturers of and dealers in aerated and mineral waters, tea, coffee, cocoa, and chocolate, grocers, tea dealers, &c., to conduct the business of the company for the benefit of the ticket holders, or associated as well as of the shareholders; to provide a public hall in the parish of Hendon or elsewhere, and to adopt an agreement with H. S. Cooper and A. G. Raymond. The subscribers (with one share each) are: H. Crump, Quarndon, 8, Ashbourne Avenue, Golders Green, N.W., chartered surveyor; J. M. Lickfold, Cross Roads House, Golders Green, N.W., solicitor. Private company. The number of directors is not to be less than five or more than nine; the first are H. S. Cooper, A. G. Raymond, W. L. Raymond, H. Crump, B. G. Drummond, H. A. Welch, and J. M. Lickfold. Registered office: The Refectory, Finchley Road, Golders Green, N.W.

Launa British Electrical Co., Ltd. (143,140).—This company was registered on February 28th, with a capital of £1,000 in £1 shares, to carry on the business of electrical and general manufacturers and contractors, designers, makers and producers of electrical glow lamps, appliances, fittings, cables, tubes, liquid, and solid compositions, powders, and flexible wires, &c. The subscribers (with one share each) are: D. Schofield, 208, Lauderdale Mansions, Maida Vale, W., advertising contractor; F. O. Langton, 61, Call Lane, Leeds, builders' merchant. Private company. The number of directors is not to be less than two or more than five; the first are F. Dove (permanent governing director) and D. Schofield. Qualification, £20. Secretary: M. J. Dove, 78, Louis Street, Leeds. Registered office: 61, Call Lane, Leeds.

Caton Electric Supply Co., Ltd. (143,150).—This company was registered on February 29th, with a capital of £2,000 in £1 shares (1,000 6 per cent. cum. pref.), to carry on at Caton and elsewhere the business of an electric light and supply company in all its branches. The subscribers (with one share each) are: C. H. Best, 72, Market Street, Bradford, incorporated accountant; J. T. Walker, Brookhouse, Caton, grocer, &c.; T. H. Mattinson, Caton, near Lancaster, boot and shoe store keeper; N. A. Foster, 1, Cheapside, Bradford, solicitor. Private company. The number of directors is not to be less than two or more than five; the first are C. H. Best and N. A. Foster. Qualification, 25 shares. Solicitors: Gaunt, Foster & Co., 1, Cheapside, Bradford. Registered office: 72, Market Street, Bradford.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Strode and Co., Ltd.—Particulars of £4,000 prior lien debentures, created February 23rd, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital, ranking in priority to £15,000 existing debentures, and a further issue of £2,500 like debentures. No trustees.

CITY NOTES.

Harrow Electric Light & Power Co., Ltd.

During 1915 80 new installations (126 kw.) were connected. The consumers now number 1,794, taking 1,862 kw. (aggregate), and the output for the year was 530,107 units. The net revenue balance, after deducting debenture interest and the interim preference dividend, was £2,402. The final preference dividend absorbs £375, 5 per cent. is to be paid on the ordinary shares, and £360 carried forward. At the annual meeting on February 22nd, Mr. J. N. Stuart, the chairman, said that in spite of the lighting restrictions the sales showed a falling off of only 8,000 units, about 1½ per cent., which had been almost compensated for by a slight alteration in the method of charging during the past half-year. As long as the war continued they must be satisfied if they could hold their own. He could offer no great prospects for the coming year; they would do their best to maintain the dividend until brighter days, and therefore brighter nights, came for the country. Mr. G. Spencer Hawes seconded, and said that for eleven consecutive years they had maintained their 5 per cent. dividend.

Waste Heat and Gas Electrical Generating Stations, Ltd.

For the year ended January 31st, 1916, the profit, after deducting administration expenses, was £39,819 (last year £39,001). There has been transferred to the credit of reserve account £11,000. The balance brought forward was £14,212, so that the available profit is £43,030, as compared with £40,612 for 1914. After paying 8 per cent. on the ordinary shares, as in the previous year, £17,430 is to be carried forward. The balance of the dividend now being paid is to be paid less income-tax. Additional plant for Weardale power station is making satisfactory progress at the manufacturers' works, and extensions to Grangetown power station will be completed three or four months' hence. The supply of waste heat and gas, and consequently the output of electrical energy, has been less than in 1914. The costs, however, have been less owing to the smaller amount paid to the owners of the collieries and ironworks. The company took up £10,000 4½ per cent. war loan, and exchanged its 3½ per cent. War Loan into 4½ per cent. Annual meeting: March 8th.

Lancashire United Tramways, Ltd.

Presiding at the annual meeting on February 29th, the Hon. Arthur Stanley, M.P., referred to the satisfactory result of the working for the year, notwithstanding the increase in expenditure caused mainly by the extra cost of materials, war bonuses to employés, and amounts paid to dependents of men with the Forces. 130 men were serving in the Colours, but up to the present the usual service of cars had been maintained through the employment of female labour, which was proving satisfactory. Since the early days of the war the staff and employés had made a regular monthly contribution to the funds of the British Red Cross Society, averaging over £25 per month, and amounting in all to over £300. Mr. Stanley (who is Chairman of the Joint War Committee of the British Red Cross Society and the Order of St. John of Jerusalem in England) took the opportunity of publicly thanking all those who had thus so generously helped in the work of transporting sick and wounded soldiers.

British Engine, Boiler, and Electrical Insurance Co., Ltd.

Presiding at the annual meeting, held at Manchester last Friday, Mr. R. C. Longridge commented on the substantial growth in income from inspection charges and premiums in all the principal departments of business, amounting to £117,112, against £112,465, which, occurring in the first year of management of Mr. Harry M. Longridge, gave great satisfaction, especially having regard to the disturbance of business conditions and the absence of 44 members of the staff with the Colours. The profit showed a slight reduction, outgo being a little in excess of the average owing to the increased cost of repairs and to a war bonus payment to the staff, while the company's charges remained unaltered. Provision was made for carrying £5,000 to reserve for current risks and writing £7,250 off investments and furniture, leaving a balance of £11,521, and after providing for the final dividend, the total funds amounted to £177,025.

Electrical Distribution Co. of Yorkshire, Ltd.

Mr. R. W. Wickham, presiding at the annual meeting on February 29th, said that in view of the increased costs, the lighting restrictions, and other difficulties due to the war, the results were very satisfactory. The capital expended during the year was £6,173; the policy of restricting such expenditure would, under the circumstances, be continued. The consent of the Treasury was being sought to make a further issue of capital, and, if approval were obtained, a *pro rata* allotment to present holders would be made. The last issue was over-applied for. They believed that future years would show the same steady progress as in the past. The new lighting restrictions would doubtless further affect the revenue, but their conservative policy would enable them to overcome present difficulties without any serious effect upon the year's trading.

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Bournemouth and Poole Electric Supply Co., Ltd.

During the year 1915 the revenue, after deducting generating and distribution costs, rent, rates, taxes, wages, &c., is £38,684, plus £3,829 brought forward. Debenture and other interest absorb £11,373, there is put to reserve for depreciation £8,000, 4½ per cent. is paid on the first and 6 per cent. on the second preference shares, also 6 per cent. on the ordinary, £3,607 remaining to be carried forward. The total applications received amount to 10,549 KW., an increase of 885 KW. for the year. The units sold for all purposes numbered 4,061,091. Units generated, 5,482,458; 161 public lamps used 9,034 units. The dividend declared by the Richmond (Surrey) Electric Light & Power Co., Ltd., was 6 per cent. on the ordinary shares.

India-Rubber, Gutta-Percha, & Telegraph Works Co., Ltd.

A circular has been issued to the debenture and shareholders respecting the £400,000 4 per cent. first mortgage debentures, which fall due for payment on March 25th. It is proposed (the Treasury raising no objection) to make a new issue of 4,000 first mortgage debentures of £100 each at 5 per cent. at the price of 93, repayable at £100 in March, 1926. Holders of the existing debentures will have the preferential right of taking up the new issue to the amount of their present holdings, so that each holder who exercises that right will receive a new £100 5 per cent. debenture and a payment of £7 in cash per £100 now held. The directors ask the shareholders to support the scheme, and point out that it is to their interest to make it a success. It is important that the company should not be hindered in its operations, and it is difficult for any company to raise fresh capital at present.

Northampton Electric Light and Power Co., Ltd.

Presiding at the annual meeting on March 2nd, Ald. F. H. THORNTON welcomed the shareholders to the new offices. The meeting was held in the new demonstration room. The company had experienced a very strenuous year. Twenty per cent. of the outdoor staff and 45 per cent. of the indoor staff had enlisted, and a great deal more work had devolved upon those who had been left behind. The company was supplying more motor power than ever before, and if it had not been for the fact that they were able to install it within 24 hours many shoe manufacturers would not have been able to complete their Government orders. Therefore they had not only served the town well, but also their country. The site for the erection of a new generating station was one of the most important that could have been obtained; it would give river water for cooling purposes, and they would be able to expand as necessity arose. The fact that the Town Council had now consented to allow them to take the mains along the towing path, the nearest route to the town, had saved them several hundreds of pounds. The site was rather subject to floods, but that would be got over by raising the works above the level of the floods. As to when they would go on with the erection of the station, that depended altogether upon circumstances. They had made arrangements to add another large engine to the works, but that could be put in at the present station or at the new one, as was most convenient. Alternating current would be generated at the new station, and it would be transformed at the present station. They did not raise the price of current until nine months after the Gas Co. had raised the price of gas, and not until a long time after many other companies in the country. That was due to the very advantageous coal contracts they had secured. 85 per cent of the current they supplied was for motor power. The board of directors proposed that Mr. A. E. Marlow, J.P., a prominent boot manufacturer, should be added to their number.

Telegraph Construction and Maintenance Co., Ltd.

At the annual meeting, on March 2nd, Sir JAMES PENDER, who presided, referred to the loss that the board had sustained by the resignation of Lord Selborne consequent upon his having accepted office in the Government. The profit for the year was £108,708, as compared with £109,186 for 1914 and £114,863 for the year before the war. Adding £111,406 brought forward, they had a total of £220,114. After paying dividend and bonus of 36s. per share, in addition to 12s. per share interim dividend already paid, and putting £20,000 to the reserved fund, £110,474 was to be carried forward. The past year had been far from normal. Contracts entered into before the war began had to be postponed on account of urgent Government requirements, and it was not until many months had elapsed after the contract dates that they were able to complete the work which they had undertaken. They had much for which to thank their clients in the way of patience and forbearance in face of the serious inconvenience to which they had been subjected by these delays. They had been working under exceptional difficulties all the year, both on account of scarcity of labour and shortage of supply of materials, and ever-increasing prices of both, but they had managed to keep their manufactured output quite up to the average of previous years. They had done a good deal of work for the Government as well as their ordinary business. Their profits had been comparatively small, rather less than last year, and considerably less than the year before the war, so they would have no excess war profits to return as payable under the Finance Act; in fact, but for the good rates of interest which they had been getting for money, and the profit realised on the sale of some American dollar securities, they would not have been able to show so good a result. Their ships had been actively employed throughout the year and had often had to carry on their work within the danger zone, but, thanks to the foresight of the Admiralty and their provision of the naval escort which was necessary for protection, the ships had gone through the year without any mishap.

London United Tramways, Ltd.

The gross receipts in 1915 were £300,166. After adding the balance brought forward and deducting all expenses chargeable to revenue, including an appropriation of £25,000 to reserve for reconstruction and renewals, there remains £2,327, which is to be carried forward. The reconstruction of the line between Brentford and Hounslow, commenced in 1914, was completed, and the entire cost of the work has been charged against the reserve for reconstruction and renewals. The car-repair work previously carried out at the Chiswick Depôt has been removed to other depôts. Passengers carried 63,145,226, as against 61,433,783 in 1914; car miles run 7,744,894, as against 8,996,891; average receipts per passenger 1.21d., as against 1.17d. Annual meeting: March 13th.

London and Suburban Traction Co., Ltd.

The revenue for 1915, consisting almost entirely of dividends and interest receivable from the subsidiary companies, amounted to £122,430, as against £118,580 for 1914. After deducting all expenses chargeable to revenue, including debenture and loan interest, and providing for the sinking fund charges on the 5 per cent. debenture stock, £80,755 remains, plus £2,886 brought forward. After paying the full dividend on the 5 per cent. cum. pref. shares, £3,483 remains to be carried forward. During the year £9,317 5 per cent. debenture stock was purchased and cancelled under the operation of the sinking fund provided for in the trust deed constituting the stock, thereby reducing the amount outstanding to £338,683. Annual meeting: March 15th.

Tramways, Light & Power Co., Ltd.

VISCOUNT CHILSTON presided on February 29th at the annual meeting, and said that they had represented in the accounts a full year's trading under war conditions. Notwithstanding the difficulties due to the war, the companies in which they were interested had made progress, but the progress was largely counteracted by progressive increases in the cost of production, and particularly in the cost of fuel. They were of opinion that they had lived through their worst year in 1915. The various undertakings had only to continue the present rate of earnings to show a considerable increase during the current year, and the increase should continue for some time unless, after peace was declared, a very substantial change for the worse came over the country. The Derbyshire and Nottinghamshire Electric Power Co. developed slowly during the year, but the increased receipts were rather more than offset by increased costs, the net receipts being about the same as in 1914. During 1916 increased returns would be derived from this company from business connected last year too late to affect the return for that year. The Leicestershire and Warwickshire Electric Power Co. last year showed considerable improvement, and during the last few months of the year a substantial increase in net earnings. Judging by present results, this property would contribute a substantial increase during the current year to the revenue of this company. Last year he said that a large additional revenue could be earned from the money already expended on the power properties, and this statement had been amply justified during the year, additional consumers having been connected to the Power Companies' mains equal to about £10,000 receipts per annum. Their various properties showed a substantial increase in earnings for the present year to date compared with the corresponding period of 1915. They might reasonably hope, therefore, that the current year, unless something very unforeseen occurred, would show a satisfactory increase over last year.

Metropolitan Electric Supply Co., Ltd.

The capital expenditure during 1915 was increased by £30,142. The gross revenue was £229,201, an increase of £13,656; working expenses £127,150, an increase of £12,538. The balance at the credit of the revenue account before providing for depreciation is £102,051. £27,000 has been set aside as an addition to the depreciation and reserve fund, which, after writing off loss on realisation of certain investments, now amounts to £337,359; the net revenue is £75,051, and adding the amount brought forward, interest and dividends on investments, and other receipts, the total is £87,089. After deducting debenture charges, preference dividend, &c., £34,978 remains. Out of this, 3 per cent. for the year is paid on the ordinary shares, and £4,978 is carried forward. New connections during the year represent 59,267 (25 C.P.) lamps (1,778 KW.), making the total 1,197,763. In October, Messrs. G. Blackwell, G. A. Moncrieff, and P. D. Tuckett were elected directors, and in January, Lord Avebury, Sir J. Pender, and Mr. Tuckett resigned. Mr. J. S. Highfield has resigned his position as engineer and manager, and has been appointed consulting engineer. Capt. W. R. Rendell has been appointed general manager. Annual meeting: March 22nd.

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Metropolitan Electric Tramways, Ltd.

The revenue for 1915 was £513,561. After adding the balance brought forward and deducting all expenses chargeable to revenue, including a provision of £22,715 for reconstruction and renewals, the available balance is £44,275. There is placed to reserve £13,000; preference dividend absorbs £25,000; a dividend of 1 per cent. is to be paid on the ordinary shares, and £1,532 is to be carried forward. £10,275 4½ per cent. and £4,020 5 per cent. debenture stock have been bought and cancelled. The strike in May last caused a loss in traffic receipts of £16,000. Wages will show a material increase as the result of further concessions granted to the staff in December last under an arbitration award. The output of the North Metropolitan Electric Power Supply Co., in spite of the decrease in the number of units supplied for traction purposes, has been satisfactorily maintained; the total units sold were 39,457,712, as against 36,869,118 in 1914. Owing, however, to the abnormal increase in the cost of fuel, the gross profits of the Power Supply Co. for the year show a decrease of £6,340 as compared with 1914. The company is promoting a Bill in Parliament to extend the times limited by certain Acts. Passengers carried 89,656,054, as against 93,325,170; car miles run 9,686,525, as against 11,479,592; average receipts per passenger 1.23d., as against 1.20d. Annual meeting: March 13th.

Notting Hill Electric Lighting Co., Ltd.

Sir W. Crookes, O.M., P.R.S., presiding at the annual meeting on February 29th, said that, notwithstanding the war, the result of the year's work had been satisfactory. The £1,556 spent on capital was almost entirely for meters and mains for new connections. They had only extended the mains where absolutely necessary, and at present they would keep expenditure on new work at the lowest possible figure. The revenue rose by £330, and the expenses by £779. The increase in revenue was partly due to new business and partly to an extra halfpenny per unit charged on the lighting supply during the last nine months. The total cost of generation and distribution advanced by £1,200, although the units sold were 100,000 less. The increase had been partly nullified by decreased management expenses due to Mr. Schultz's retirement; the secretary now combined the offices of manager and secretary. The net result was a drop of £450 in the profit for the year. The balance available for dividends was lower by £1,185, owing to the heavy increase in the income-tax. The total of the Kensington and Notting Hill Joint Debenture Stock sinking fund was £72,920 held in trustee securities. In view of the alarming fall in such securities, owing to the war, they had recently investigated their position in this respect. Owing to the fact that the bulk of the stock purchased was terminable, and was due to be paid off at par at maturity in or about 1931, and that that was the date at which the joint debenture stock had to be redeemed, although present-day prices showed considerable reduction, it would make no difference to the fund, as they would not have to sell the stocks, but just to encash them at par. In the case of the irredeemable securities, of which they had but a small amount, there was a loss estimated at about £1,900, so that they suffered very little by the shrinkage of value. The sinking fund was now being invested in the War Loan. The number of houses connected had risen from 4,293 to 4,358; the units sold fell from 2,539,412 to 2,436,496; the revenue rose from £45,591 to £45,921, and the expenses from £21,370 to £23,304. They had added the equivalent of 4,373 30-watt lamps to the system, and the profit was £22,617, against £24,221. They paid the same dividend as for 1914, but carried forward only £336, as against £655. They had suffered considerably owing to the restricted lighting, and although they had managed to maintain their revenue in the past he was not certain that they would be able to do so this year. When peace was proclaimed their output should largely increase, owing to the removal of restricted lighting regulations and the new lamps that were being constantly added. Expenses must necessarily be high for some time to come, and they were swollen to some extent by increases of wages and payments to employés with the Forces. They had now obtained delivery of the new steam turbine for Wood Lane works; it would save coal, and in a large measure counteract the high price of fuel. The company was doing its share in connection with the war. He hoped that a satisfactory peace would be obtained before their next meeting, and when that time came the company would maintain its prosperity. If the war were prolonged the temporary set-back in their accounts should not be serious. The chairman alluded to the debt of gratitude owing to the special constables who had guarded their stations.

Rushden and District Electric Supply Co., Ltd.—Presiding at the annual meeting, held at Northampton on March 2nd, Ald. F. H. Thornton said that few people realised what go-ahead places Rushden and Higham Ferrers were. The company were supplying many factories and workshops with power. Six boot factories were now completely lighted with electricity. The number of customers had been increased from 79 to 123. The revenue from sale of current had increased from £463 to £1,699, and the output had been doubled. For the first proper working year, he thought the company was doing well in being able to pay 3 per cent. interest.

Minehead Electric Supply Co., Ltd.—The directors report that 1915 was a difficult year. Public lighting restrictions led to a considerable reduction in lighting units sold. There had, however, been a good increase in units sold for heating and cooking, and the total units sold were 230,416, as against 224,629 in 1914. Units generated, 360,079. The average price obtained fell from 3.54d. to 3.40d.; there had also been an increase in cost of materials and working expenses, so that there was some reduction in profit. The result was, however, satisfactory. The profit on trading, after paying debenture interest, &c., was £1,753, plus £145 brought forward. After paying the preference dividend and 8 per cent. on the ordinary (less income-tax), and placing £1,000 to depreciation and reserve, £142 was to be carried forward.

British Electric Traction Co., Ltd.—The directors have declared the dividend on the 6 per cent. cumulative preference stock for the half-year ended September 30th. This dividend must be accepted as a payment on account of the dividend on the 6 per cent. cumulative participating preference stock to be issued in place of the 6 per cent. cumulative preference stock of the company upon the confirmation of the scheme of arrangement and reduction of capital by the Court.—*Financial News.*

Bruce Peebles and Co., Ltd.—The total profit for 1915 was £14,916, and after deducting administration expenses, interest on mortgage debentures, and allowing for interest on the unsecured debentures, the net profit is £7,096. Having regard to the abnormal times and difficulties, the results are considered satisfactory. £4,661 has been charged to profit and loss in respect of repairs and maintenance of buildings, plant, and machinery. Annual meeting: March 10th.

W. T. Henley's Telegraph Works Co., Ltd.—The directors recommend a final dividend on the ordinary shares of 10 per cent., less income-tax, making 15 per cent. for the year, and also a bonus of 10s. per share, less income-tax, as compared with 15 per cent. and a bonus of 5s. per share for 1914.

Dublin and Lucan Electric Railway Co.—For 1915 the gross receipts were £7,511, increase £144. Expenditure increased by £208. After providing for debenture interest, £528 is to be carried forward. Payment of the cumulative preference dividend is postponed for the present.

North Metropolitan Electric Power Supply Co.—According to the *Financial News*, the directors recommend a dividend of 6 per cent., with a bonus of 4 per cent., making 10 per cent. for the year. £15,000 is put to renewals reserve, and £6,043 is carried forward.

Midland Electric Corporation, Ltd.—Dividend of 3 per cent. on ordinary shares for 1915. £9,719 is put to depreciation, £4,275 to writing off new issue and construction expenses, and £8,932 is carried forward, subject to excess profits tax.

British Insulated and Helsby Cables, Ltd.—The dividend on the ordinary shares for 1915 is made up to 15 per cent., plus 2½ per cent. bonus. For 1914, 15 per cent. was paid. £98,500 is placed to reserve, and £160,000 carried forward.

Canadian General Electric Co., Ltd.—Quarterly dividend of 1¾ per cent. for the three months to March 31st on the common stock.

Manila Electric Railroad and Lighting Corporation, Ltd.—Dividend of 1½ per cent. for the quarter ending 31st inst. on the common capital stock.

Globe Telegraph and Trust Co., Ltd.—Interim dividend 2s. per share, free of tax, on ordinary shares for the quarter.

Brazilian Traction, Light and Power Co., Ltd.—Quarterly dividend 1½ per cent. on the cumulative preference shares.

British Electric Transformer Co., Ltd.—Dividend on the ordinary shares 7½ per cent. for 1915.

STOCKS AND SHARES.

Tuesday Evening.

The three principal factors in the Stock Exchange market at present are the battle of Verdun, the calling up of the Derby groups, and the new British War Loan. Such fierceness on the part of the enemy as he is displaying at Verdun is taken as a sign of his desperation to effect something brilliant in order to bring in subscribers to the latest German war issue, and to achieve some success that will cheer his people at home, sick of slaughter as they must be, and growing restive as they are beneath the burdens of taxation and privation. The enrolment of the further Derby groups checks Stock Exchange business from a large part of the community which provides it as a rule; while, as to the third factor, there is no need to emphasise its importance.

Taking them all round, markets are surprisingly firm; and amongst electricity sections, the splendid results secured by the Henley's Telegraph Works and the British Insulated and Helsby Cables Companies have led to further appreciation in the prices of the shares. Electric lighting issues are slightly easier. Falls of ¼ in Brompton ordinary, of ¼ in Charing Cross preference, and of 1/16 in South London shares, are the outstanding movements of the week.

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The South London report shows that the company did satisfactorily last year. The sale of current was higher, but gross revenue went down a trifle, and net income, at £27,200, is £2,400 down on the year, net profit being £14,900, or £1,600 less than in 1914. The dividend is maintained at 5 per cent., as already noted; and the carry-forward of £2,000 is about the same as before.

The County of London Electric Supply Co. has issued an excellent report. Gross receipts have risen £24,000 to £298,300, but these were countered by extra expenses, and the net revenue of £159,600 is £4,400 less. The dividend is maintained at 7 per cent., the same as that of the previous twelvemonth; and the carry-forward of £14,500 is £2,000 more than that of a year ago. The report shows that during 1915 supply was commenced in Romford, and that the company is now giving supply in bulk to Sutton, Carshalton, Wallington, and Cheam. Increased expenditure is beyond the power of any management to control at a time like the present, and the County of London shareholders may be congratulated upon the skilful way in which their company is being steered through so trying a period.

The new orders with regard to the lighting of London come into force at the end of this week, but it is not thought that they will have much effect upon the output of the electric lighting companies.

The domestic troubles to which we referred last week, in connection with one of the principal London companies, are made plainer; and it is expected that the meeting of the Metropolitan Electric Supply shareholders may show a "certain liveliness," to quote the Admiralty's classical phrase.

The W. T. Henley Co. has raised its dividend and bonus from 20 per cent. to 25 per cent., and the shares are nominally 10s. higher at 14½. In point of fact, however, it is extremely difficult to get the offer of any shares at all, which, in the circumstances, is not surprising. Having regard to the dividend accrued in the price, the return on the money is getting on for 9 per cent., allowing for the fact that the distribution is made free of income-tax.

The British Insulated & Helsby Cables, Ltd., has declared a dividend of 10 per cent., making 15 per cent. for the year, with a bonus in addition of 2½ per cent.; and here again, although the nominal price is 11, the difficulty is to get the offer of shares. In both concerns the appropriations are large, and assist substantially in fortifying the financial positions of the undertakings.

The market for Manufacturing issues as a whole is naturally a good one, in view of these fine results. British Westinghouse preference recovered 6d. to 44s. 6d., and British Aluminium ordinary are 9d. better, although there is not much change in other shares. India-Rubber ordinary are not affected by the notice just issued to holders of the company's 4 per cent. first mortgage debentures, who can exchange into new debentures, bearing interest at 5 per cent., at the price of 93. Holders of the existing debentures will have the preferential right to take up the new issue, as they are offered £7 per cent. in cash upon their making application to the company. Having regard to the nature of the security, we should imagine that there will be little hesitation on the part of the holders in exchanging their old 4 per cents. into the new fives; and the return of £5 7s. per cent. on the money is raised to 6 per cent. by the new debentures being redeemable at par in 11 years' time.

The various stocks of the Underground Electric Railway companies keep comparatively steady, but attract little attention from investors—speculative or otherwise. It is noticeable, however, that a good many people are picking up low-priced railway stock, particularly that of the District order, regardless of dividends, evidently with the intention of putting it away to await a rise in price (that shall be equivalent to a dividend) after the conclusion of peace.

Underground Electric income bonds at 81¾ are ex their £3 dividend, and the shares are a trifle easier, as will be noticed in our usual list of electricity stocks and shares.

Brazil Tractions have receded to 50½, and the Mexican group is still decidedly dull. British Columbia preferred is rather harder. Of the Colonial issues, Melbourne Electric debenture stock is wanted, and has been done at 95½. The Anglo-Argentine Tramways group is steady. Rio Tramways first mortgage bonds are firm at 88½, and the seconds are changing hands on the basis of 74.

The telegraph list is unusually free from fluctuation. Indo-Europeans are ½ higher at 49½. Anglo-American Telegraph deferred went back ⅛, and this is the sum of the changes on the week. American Marconi's hardened to 15s. 9d. For New York Telephone 4½ per cent. bonds the Government bid is still 100¾. The Eastern group is firm, with little stock on offer; and the Globe issues hold their previous improvements.

The Stock Exchange followed with keen interest the suspension of dealings in the baser metals used in connection with the war, and the Government action in re-establishing the market afterwards came as something of a relief, inasmuch as the House was slightly apprehensive lest the same sort of treatment might be meted out to itself. The copper group is a little heavy. In rubber shares there is continued animation and strength. Business is not on quite as large a scale as it was a fortnight ago, but the rubber market is the busiest section of the Stock Exchange, and all classes of shares are wanted by the speculative investor as well as by the speculator pure and simple.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price March 7, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	—	7	— ½	£7 2 10
Charing Cross Ordinary	5	5	8½	—	7 2 10
do. do. do. 4½ Pref.	4½	4½	8½	— ½	6 18 6
Chelsea	5	4	8½	—	6 13 4
City of London	9	8	11⅞	—	6 14 9
do. do. 6 per cent. Pref.	6	6	10½	—	5 14 8
County of London	7	7	11⅝	—	6 15 0
do. 6 per cent. Pref.	6	6	10½	—	5 14 8
Kensington Ordinary	9	7	6	—	7 10 0
London Electric	4	3	1⅛	—	7 18 0
do. do. 6 per cent. Pref.	6	6	4½	—	7 1 2
Metropolitan	3½	3	2⅜	—	8 4 8
do. 4½ per cent. Pref.	4½	4½	3	—	7 10 0
St. James' and Pall Mall	10	8	5½ xd	—	8 13 10
South London	5	5	8⅞	— ⅛	6 10 9
South Metropolitan Pref.	7	7	1⅛	—	6 14 0
Westminster Ordinary	9	7	5½ xd	—	6 1 9
Telegraphs and Telephones.	Dividend, 1914.				
Anglo-Am. Tel. Pref.	6		100	—	6 0 0
do. Def.	33/6		21⅛	— ⅛	7 16 0
Chile Telephone	8		6⅜	—	6 5 6
Cuba Sub. Ord.	5		7⅜	—	6 9 0
Eastern Extension	7		12½	—	*6 6 0
Eastern Tel. Ord.	7		127	—	*6 5 6
Globe Tel. and T. Ord.	6		10⅜	—	*6 10 6
do. Pref.	6		10	—	6 0 0
Great Northern Tel.	22		84½	—	6 7 6
Indo-European	18		49½	+ ½	6 12 6
Marconi	5		1⅛	—	6 8 1
New York Tel. 4½	4½		100¾	—	4 9 4
Oriental Telephone Ord.	10		1½	—	5 18 6
United R. Plate Tel.	8		5⅛	—	*7 19 0
West India and Pan.	1		1⅞	—	9 10 6
Western Telegraph	7		12½	—	*6 5 0
Home Rails.					
Central London, Ord. Assented	4		67½	— ½	5 18 6
Metropolitan	1½		23	+ ⅛	4 7 0
do. District	Nil		16	+ ⅛	Nil
Underground Electric Ordinary	Nil		1⅛	— ⅛	Nil
do. do. "A"	Nil		6/-	—3d.	Nil
do. do. Income	6		81¾ xd	— ¼	*8 9 0
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6		4⅞ xd	—	6 8 1
Anglo-Arg. Trams, First Pref.	5½		4½	—	6 18 6
do. 2nd Pref.	5½		8⅜	—	7 17 2
do. 5 Deb.	5		78	— ½	6 8 2
Brazil Tractions	4		50⅜	— ½	6 18 7
Bombay Electric Pref.	6		10 xd	—	6 0 0
British Columbia Elec. Rly. Pfce.	5		55	—	9 1 10
do. do. Preferred	—		38	+1	Nil
do. do. Deferred	—		34	—	Nil
do. do. Deb.	4½		64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—		29	— 1/	Nil
do. 6 per cent. Bonds	—		35	—	Nil
Mexican Light Common	Nil		22	—	Nil
do. Pref.	Nil*		35	—	Nil
do. 1st Bonds	—		41	—1	—
Manufacturing Companies.					
Babcock & Wilcox	14		28	—	5 6 8
British Aluminium Ord.	5		22/9	+9d.	4 8 9
British Insulated Ord.	15		11	+ ½	7 19 1
British Westinghouse Pref.	7½		44/6	+6d.	8 14 6
Callenders	15		11½	—	6 10 6
do. 5 Pref.	5		4½	—	5 17 8
Castner-Kellner	20		5⅛	—	6 8 0
Edison & Swan, £3 paid	Nil		7/-	—	Nil
do. do. fully paid	Nil		1½	—	Nil
do. do. 5 per cent. Deb.	5		60	—	8 6 8
Electric Construction	6		14/9	—	8 1 6
Gen. Elec. Pref.	6		9⅜	—	6 4 8
Henley	20		14⅛	+ ½	*9 10 1
do. 4½ Pref.	4½		4	—	5 12 6
India-Rubber	10		9½	—	*12 19 0
Telegraph Con.	20		37	—	*7 8 6

* Allowance made for dividends being paid free of income-tax.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month.		No. of weeks.	Total to date.		Route miles open.	Inc.
		£	£		£	£		
Blackpool-Fleetw'd	Feb. 29	1,216	+ 18	8	2,572	+ 128	8	..
Bristol (Trams)	„ 25	17,788	+1,560	8	36,893	+ 2,633	30·5	..
Cork	„ 24	1,791	+ 57	8	3,583	+ 175	54·25	..
Dublin	„ 25	23,807	+1,242	8	46,956	+ 3,082	9·89	..
Hastings	„ 25	2,808	+ 25	8	..	+ 288	19·8	..
Lancashire United	„ 23	6,381	+ 377	8	12,590	+ 829	42	..
Llandudno-Col. Bay	„ 25	758	+ 30	12½	2,338	+ 146	6·5	..
Tyneside	„ 16	2,005	+ 78	7	3,857	+ 14	11	..
Anglo-Argentine	„ 25	99,170	— 975	8	395,241	— 7,666	..	..
Auckland	Jan. 14	22,868	+ 704	28½	148,708	+ 1,612	25·42	1·66
Calcutta	Feb. 26	17,905	+ 602	..	..	+ 1,838	..	..
Kalgoorlie, W.A.	Dec.	3,018	..	..	83,420	..	..	..
*Madras	Feb. 15	1,990	+ 162	6	6,118	+ 761	..	..
Montevideo	Feb.	32,502	+2,494	9	126,466	+ 8,818	..	..
Dublin-Lucan Rly.	Feb. 25	457	+ 10	8	915	+ 5	7	..

Two weeks.

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WHAT TO DO WITH OUR CANALS.

By W. N. Stewart.

In the coming trade regeneration of the nation it is certain that a reform of existing methods of internal transport will be a question demanding serious consideration, as present conditions too seriously handicap the business and industries of the country. With railway rates for goods traffic from three to six times greater than similar rates in America and on the Continent, with unused canals and with common roads not utilised to their full value, it is small wonder that British trades have fallen far behind their rivals in the race for commercial supremacy, especially when they have had to compete with nations in which the study of transportation problems has reached the dignity of an exact science.

Before considering the matter which is the subject of this article, let us study the transportation problem as it affects one small community which is typical of thousands of others throughout the land.

The present writer lives in a market town located some 35 miles from Manchester, which, for the purposes of this article, we will call by the name of "X." This town is modern and up-to-date in all its municipal undertakings, has a population of some 18,000, and is both a manufacturing and agricultural centre. Its principal market is Manchester, the great distributing point for Midland trade. "X" is served by a single railway system and by a canal belonging to the railway company, this canal being so little used that it scarcely counts as a factor in the transportation problem. Therefore, the inhabitants of "X" and the towns round about, including several large cities, have to pay toll to the railway on nearly everything they buy, sell or consume, this toll amounting to £2 6s. 8d. on each ton of goods sent, *at owner's risk*, by passenger train to or from Manchester, and from 15s. to 30s. per ton by goods train, according to class of goods. Parcels of limited weight, by passenger train, are delivered in from four to eight hours after sending, while merchandise sent by goods train may arrive in from two to four days after dispatch. To make this situation clearer, it may be fairly considered that it costs as much to send a ton of provisions from Manchester to "X," a distance of 35 miles, as it does to send the same ton from New York to Manchester, a distance of 3,000 miles, that is, at pre-war rates. The charge in the first case is due to the action of a monopoly, while in the second case the seas are free to all, and competition follows the natural law.

How can the canals be best used to reduce these excessive costs, to eliminate the question of monopoly, and to secure the modern requisite of greater speed in delivery?

In the report of the late unlamented Canal Commission, as published in the Electrical Review at the time, it was shown that the best system of canal electrification now in use is one in which rails are laid on the towing path of the canal, electric locomotives supplied with current from generating stations through trolley wires being used to tow boats at a preferable speed of *two miles per hour;* that such a system would cost something like £8,000 per mile to establish, and that an average traffic of at least two million tons per annum would have to be obtained in order to pay expenses. These estimates evidently did not take into full consideration the fact that in many places British canals would have to be entirely reconstructed, as in some places no towing paths exist through tunnels, while to propose a speed of two miles per hour in this twentieth century smacks a bit of the farcical. The principal difficulty, however, was never even considered, and probably was not even discerned, by this sapient Commission, and that is that a canal system, like a railway system, does not do the *whole* work of transportation between the producer and the consumer, but only forms one link in the chain. For example, in order to send a ton of groceries from the wholesale dealer in Manchester to the retailer in "X," the goods must be loaded on a lorry in Manchester, then unloaded at the goods station in Manchester, then loaded on boat or train, then unloaded at "X" goods station, then loaded on a lorry, then unloaded at the premises of the retailer. That is, the ton of groceries has had to be handled *six times* over, and if the transit over the streets of Manchester and "X" has been effected by means of horsed vehicles, this part of the work has cost *more than twice* the cost of that part of the work performed by rail or canal, a cost which, of course, comes out of the pocket of the man who consumes the tea, sugar, or bacon so transported.

There is, however, thanks to the growing understanding of modern methods, a much better system.

Let us at once drain the canals and abolish their use as water-ways. Then pave them for use as motor roads, filling in the locks in such manner as to form gradients not exceeding one in twenty. Let the value of the canals be suitably appraised, and to this value add the cost of necessary alterations, which would not exceed £800 per mile, this sum to be found by the Government. From each vehicle using these roads exact a toll varying with the load capacity of the vehicle, this toll being divided between the owner of the canal and the Government on an equitable scale, thus avoiding an actual expropriation of the canals and giving their owners a substantial income in place of the small return at present obtained. Then confine the use of the canal roads to *electrically propelled commercial vehicles only*, pleasure, passenger, and petrol cars being absolutely excluded. The reasons for this exclusion are that the roads would be intended for commercial purposes only; that it is inexpedient to interfere with the passenger and long-distance goods traffic of the railways; that the scheme is intended to benefit British trades and not to fill the pockets of the Standard Oil or other foreign petrol producers; and, last but not least, because experience in the use of electrically propelled vehicles has conclusively demonstrated the fact that their cost of operation is far below that of petrol cars, and their reliability greater. As the use of the canal should be based on sound economic principles, the cheaper power must be employed. Plenty of statistics are available as to the relative economy of petrol and electrical systems, but with these the present article need not be cumbered.

In the operation of such a system, the Manchester wholesaler would load the electric truck at his warehouse, and using the streets of Manchester, the canal road and the streets of "X," the truck would unload at the door of the retailer in "X," the goods thus being handled *twice* in place of *six* times as at present, while in some cases the retailer would be able to deliver goods to the actual user without any rehandling. During the greater part of the journey from Manchester the vehicle would run on the almost dead level surface formed by the canal bed instead of having to climb the terrible hills prevalent in this part of England, the former condition being almost ideal for accumulator traction. The time of transit from Manchester to "X" would not exceed four hours, giving quicker delivery than is now usually obtained from the passenger train service, while the cost would vary from 6s. to 15s. per ton, in place of the £2 6s. 8d. now paid for small parcels by passenger train, and from 33⅓ to 60 per cent. less than what is now paid for the slow service by goods train.

Another advantage of this proposal is that the Government would in no case be called upon to face an enormous expenditure, such an expenditure being only justified by absolute knowledge in advance that sufficient tonnage would be available to enable the scheme to pay its way. In the scheme above outlined, the heaviest cost—that of the vehicles—would

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be borne by the users thereof and be incurred gradually as the economy secured became known, the large firms buying their own vehicles and smaller ones combining on the co-operative system. The Government would, therefore, contribute only the small cost of making the road on a bed already graded. As the roads would be national and free to any electrical commercial vehicle paying the toll, no traffic monopoly could be established, as is now the case at sea. And as Britain's external trade has been built up on this freedom of the seas, which freedom Britain has latterly been at some cost to maintain, so would internal trade be built up by a system of transit which could not be monopolised. This is true because goods would not only be transferred *from* Manchester and other distributing points, but manufactured goods, farm produce, etc., would be carried *to* the distributing and shipping centres, the canal roads forming the arteries of a vast collecting and distributing system, the common roads—reaching every hamlet and every farm in the land—forming the veins.

The effect on the electrical industry would be most salutary. Thousands of workmen would find employment in the construction of motors, vehicles and batteries, while the generating stations, municipally owned or otherwise, would find "peak" loads a thing of the past. In fact, it might prove that the sale of current for lighting would become quite subsidiary to the sale of current for charging accumulators.

But over and above the interests of any one industry, the welfare of the nation should be first considered, and efforts should be made by Chambers of Commerce, municipal authorities, and trade societies in general to show our rulers that *Great Britain now has in existence the finest system of highways in the world*, ready excavated, graded and tunnelled, which can, at insignificant cost and with minimum delay, be made available for the use of the *cheapest known form of traction*, and one which does the *whole job* of transport between manufacturer or wholesaler and retailer or consumer. And not only home trade would get the advantage of these roads: export business would likewise benefit by cheap transit from factory to dock, thus helping to maintain British trade supremacy over seas.

CONTINUOUS-CURRENT RAILWAY MOTORS.

By E. V. PANNELL, A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

The railway motor is a piece of machinery liable to very severe usage, and its design and construction in accordance with its service conditions form an interesting study.

The object of this paper being to consider general tendencies in design, the curves and tables should be regarded as representative of such tendencies rather than of precise quantities.

In the last few years considerable improvements have been effected in design. In figs. 1 and 2 the dotted curves represent the average weight of the railway motors in general use up to about the year 1909, whilst the full lines show the weights of motors of similar output designed since this date and in operation to-day. The latter are almost all of the commutating-pole type.

Dead-weight is an objectionable feature in the motors where these are suspended directly upon the trucks. The nose form of suspension in general use throws about half the weight of the motor upon the axle without any intervening springs. Moreover, owing to the motor armature rotating from three to four times as fast as the wheels, the energy stored up in it during the accelerating periods will be very considerable, and for this reason minimum weight and armature speed are desirable. A typical calculation for the value of this momentum has been worked out by Mr. F. W. Carter.

A motor introduced in 1910, rated at 48 kw., weighed 2,735 lb., or 800 lb. less than a motor of the same output, but six years older.

This reduction has been secured partly by the increase of rated speed made possible by the adoption of commutating poles, but to a greater extent by the use of more carefully chosen material of higher weight efficiency, and a ventilated structure; moreover, owing to its ventilated design the new motor will have a sustained capacity not less than 50 per cent. in excess of that of the older type of machine.

A closer investigation of the curves in fig. 1 will show the desirability, from the weight-efficiency point of view, of employing a few motors of high capacity, rather than a greater number of low capacity. The total cost is also much less if this is done.

The best practice is to employ the largest motors which can be economically loaded on the lightest service. Rheostats, contactors, reversers, and train cables require to be duplicated for every additional pair of motors; the disparity in costs of the complete equipments is therefore far greater.

The limitations of linear dimensions are of even more strict a nature than those governing the weight. On the standard rail-gauge of 4 ft. 8½ in. the maximum distance between the inside of the wheel flanges is 52 in., which positively limits the length of the motor casing. In the other direction the wheel diameter is the limiting feature; the size in use on the majority of electric suburban, elevated, and subway railways is 33 in. Recently there has been a more liberal tendency in this direction, and wheels of 36 in. to 42 in. will become standard except where tunnel limitations are too severe. With the 33-in. wheel the maximum armature diameter is 20 in., and the maximum practical length of core for a 600-volt motor of about 200-kw. rated capacity is about 15 in.

In fig. 3 curve A represents a series of interpole designs worked out by the author, whilst the points indicated refer to machines in actual service. The step at the end of the curve relates to motors with duplex gears. It is interesting to compare the curve relating to railway motors with that plotted for stationary machines; the great disparity is due mainly to the system of rating employed.

Railway motors, being invariably series wound, attain high rotational speeds at light loads; the free-running speed in service usually coincides with about one-third the rated load, and is nearly double the rated speed. 600 r.p.m. is a good average value for satisfactory designs.

In general the efficiency of the high-speed motor is better at rated load and inferior at light loads as compared with the lower-speed design.

Practically all motors of 100 kw. and over are designed for one armature turn per segment in order to reduce the reactance per coil, but even with the most careful design the reactance voltage at rated load is of the order of 9 or 10, or four times that of a reasonably good generator.

A device which has found universal adoption is the grooving out of the commutator mica to a depth of about 1/16 in. below the surface of the copper. This avoids any trouble due to high mica and has a remarkable effect in keeping the commutator surface clean and cool. With the hard carbons in common use centrifugal force is found quite sufficient to keep the slots free from particles.

Commutating-pole motors are now being regularly supplied with 2,400-volt insulation and 1,200-volt commutators for running two in series on a 2,400-volt line. The broad advantage obtained by the use of interpoles is the greatly reduced chance of flash-overs. The reactance voltage being practically neutralised and the sparking proportionately lessened in severity, there remains little to start an arc from brush to brush or to frame. The commutating-pole machine therefore becomes a stronger type of motor, capable of heavier short-time overloads and higher speed and voltage, whilst its maintenance charges are greatly reduced.

It is found that the traction motor is no larger and, as already seen, is lighter than the pre-interpole machine. On the Moselhütte mineral line in Lorraine, the locomotives are operated at 2,000 volts, the pressure on each motor being 1,000 volts. The gauge of the line is only 39½ in., notwithstanding which it has been found possible to equip the locomotives with motors rated at 120 kw., the armatures being of 26 in. diameter with a core length of only 6½ in.

It is frequently the case that a certain type of motor will be called upon to perform widely different classes of service, possibly interchanging local service with as many as two stops per mile with express schedules running five miles or more without a stop. The use of sectional or tapped field control affords one method of effecting the compromise and operating a system of diverse characteristics with one type of motor. More valuable still is the use of field control for notching up on the controller during acceleration. A motor designed for this principle will probably have at its full field a speed 10 per cent. lower than the average machine, whilst with the short field this speed is increased by some 25 per cent. The motor is thus able to run upon either of two speed curves at the will of the motorman.

The commutating characteristics are so improved in the interpole machine that reduction of the main field by 50 per cent. does not appear to affect the collection of current. Typical speed curves for a field-control motor are shown in fig. 4.

Speeds of 450 r.p.m. for the rated load speed at full field, and 550 or 600 at short field, are typical of what has been found most satisfactory practice for a 200-kw. motor. Too great a disparity in the speeds at any given armature current leads to a pronounced current "kick" when changing, and would probably tend to induce flashing over.

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The field-control motor provides a shorter rheostatic period and a much longer period of motor speed-curve running. The lower the full-field speed of the motor the quicker will the rheostats be cut out, and the less the rheostatic losses for a given acceleration rate. On one of the suburban railways in Christiania, Norway, the field windings of the 1,200-volt motors are not only divided for short and full fields, but are grouped for series and parallel connections. This gives four different running speeds all with the motors directly on the line. By this means nearly half of the controller notching may be performed free of rheostats, and a good approximation to alternating-current tapped-transformer control is effected. The mere tapping-off from a single point near the middle of the field winding is becoming standard practice, however, in view of the simplicity of the necessary controller connections.

The overall efficiency of a motor allows for losses in the copper, core, and commutator, together with gear and bearing friction and windage. As factors in the temperature rise, all

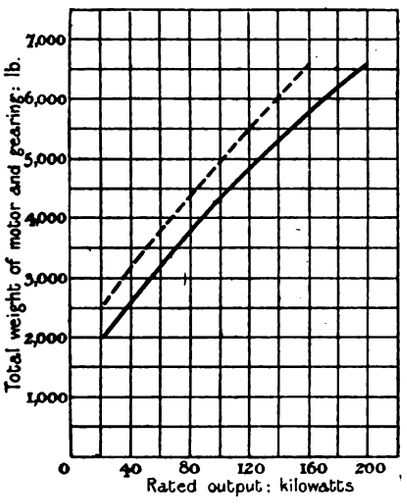

Fig. 1.—Weights of Continuous-current Railway Motors at 600 r.p.m. Rated Speed.

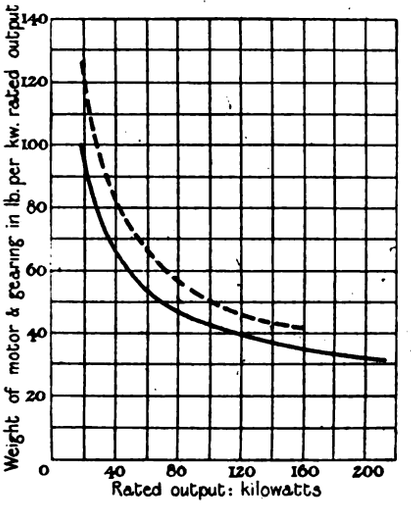

Fig. 2.—Unit Weights of Railway Motors corresponding to Fig. 1.

but the gear losses are effective. In the short 1-hour heat run these are absorbed in the mass of the machine, there being little radiation with heavy motors. The output of a railway motor at rated load is, however, being superseded as a criterion of its service capacity. What is far more important than the 1-hour rating is the capacity for continuous operation of five or six hours or even longer periods.

From the curves in fig. 5 it will be seen that although two different machines may have exactly the same rated 1-hour output, efficiency, and possibly weight, their performance on runs of longer period is radically different. Motor A will take much heavier loads to reach its 75 deg. C. rise than motor B for two, three, or four hours' running. The former is representative of the recent ventilated designs, and the latter of the totally enclosed carcass motors which are only

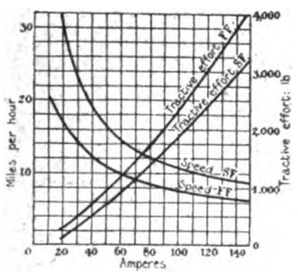

Fig. 4.—Speed and Tractive-effort Characteristic for a 45-kw. Motor on Short (S F) and Full (F F) Fields.

just being superseded by type A. The heating in actual service may be assumed to be some 15 per cent. lower on account of the positive draught produced by the motion of the train.

In fig. 6 are shown the approximate values of the losses in a 180-kw. railway motor, and fig. 7 shows the thermal characteristic of the same machine running on stand test. The preponderating factor in the temperature rise at rated load is the copper loss, and at light loads the core and stray losses; consequently a motor for frequent stops and accelerating service should be designed with a view to the lowest possible copper loss, whilst the machine which is expected to run for one or more hours continuously at about one-third rated load should have the lowest possible core loss in order to operate within its temperature limitations.

It is impossible to specify for a railway motor on the basis of its 1-hour rating alone. Specifications should call for the value of the various losses at two or three different loads, particularly for the average load at which the motor is expected to operate in service.

The basis of both the American and European methods of rating railway motors is the 75 deg. C. temperature rise in a 1-hour run on the test bed with covers removed and no artificial ventilation. Without having been standardised in England, this system is in very general use here and might quite well be officially adopted. It is usually recognised that the 1-hour rating represents the maximum desirable current input for acceleration, and that the average load for a complete day's running should not exceed 30 per cent. rated load for

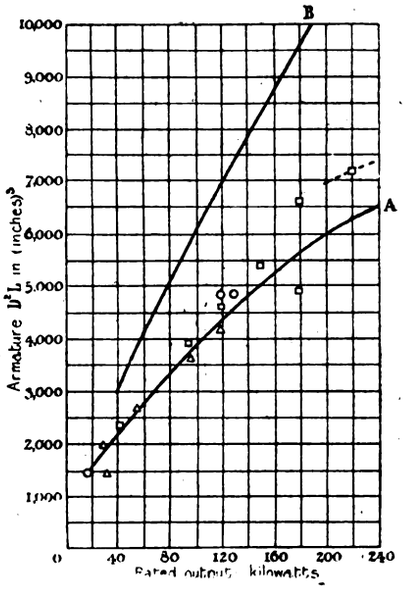

Fig. 3.—Relation of Output to Dimensions of Armature.

Curve A: Geared railway motors, 600 r.p.m.
Curve B: Hobart's curve for d.c. machines, 600 r.p.m.
○ indicates British, □ American, and △ Continental designs.

unventilated, or 50 per cent. rated load for ventilated, machines.

In more than one instance on electric railway systems in America ventilated motors rated at 50 kw. are doing the same work as the 80-kw. non-ventilated machines which they have superseded, with a net saving of 50 per cent. on the equipment weight and of 30 per cent. on its cost. Ventilated motors have been found to operate satisfactorily even under the most adverse circumstances of dusty and gritty ballast.

In recent designs radial ducts in the core have been quite abandoned in favour of longitudinal passages. Recently, multiple fans have been introduced by which the air is all

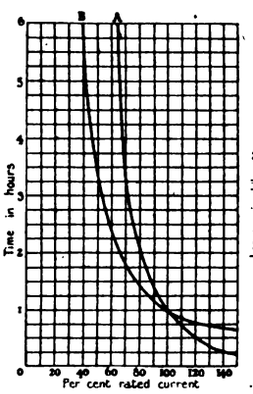

Fig. 5.

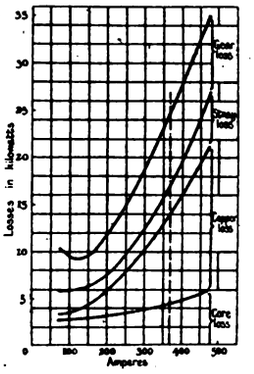

Fig. 6.

Fig. 5.—Time taken to attain 75 deg. C. Temperature Rise on Hottest Accessible Part.
(A) Ventilated; (B) Non-ventilated motors.

Fig. 6.—Losses in a 180-kw. Motor.

drawn in at one end of the carcass through all the passages in parallel and expelled at the other end.

The air circulation is effected by an exhaust fan of very compact type, usually of aluminium or pressed steel, which is bolted to the armature core and actually forms the end core-plate. The velocity imparted to the air is sufficient to retain in suspension any dust which might enter the casing and to carry it out again. The drawback to the earlier semi-ventilated motor was that no positive velocity was given to the air, and also that the structure of the machines provided dead-ends and pockets into which the dust, grit, iron oxide, and other particles were driven and permitted to accumulate. The present type of motor with its strong induced draught

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and clean-cut and direct air passages overcomes these drawbacks entirely.

Forced ventilation by means of air compressors does not seem to be justified except where it is required to force the output of a motor beyond that obtained by internal ventilation. The device is at present almost wholly confined to locomotives.

The increase in rated voltage to values higher than 600 followed immediately upon the introduction of commutating poles into railway-motor design; commutation was thereby so much improved that an increase of 100 per cent. in the average volts per commutator segment was found permissible.

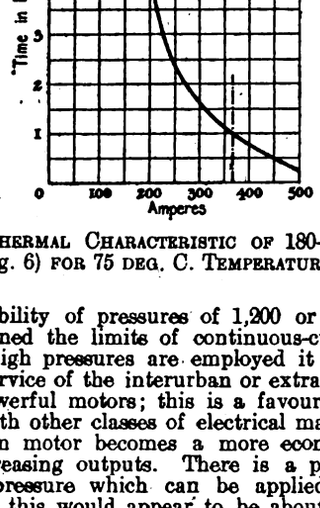

Fig. 7.—Thermal Characteristic of 180-kw. Motor (see fig. 6) for 75 deg. C. Temperature Rise.

The practicability of pressures of 1,200 or 2,400 volts has greatly broadened the limits of continuous-current working. Where these high pressures are employed it is generally for fairly heavy service of the interurban or extra-suburban order demanding powerful motors; this is a favourable feature, as in common with other classes of electrical machine the high-voltage traction motor becomes a more economical proposition with increasing outputs. There is a perfectly definite limit to the pressure which can be applied to the motor terminals, and this would appear to be about 2,000 volts for car motors of the type under review.

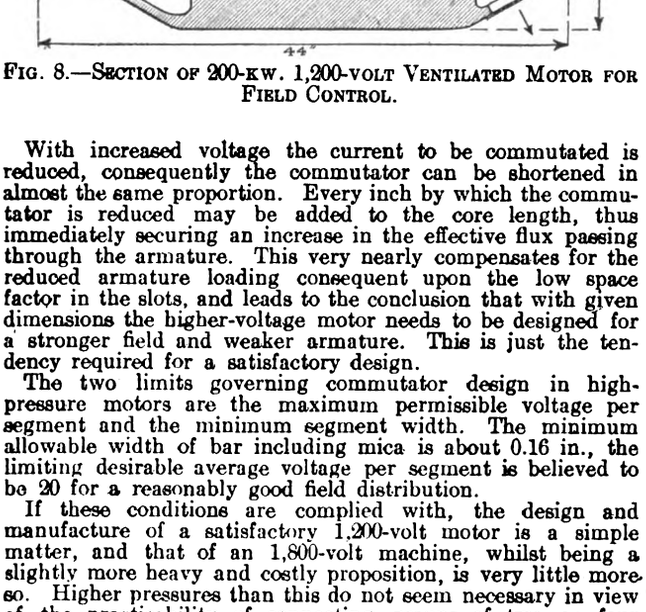

Fig. 8.—Section of 200-kw. 1,200-volt Ventilated Motor for Field Control.

With increased voltage the current to be commutated is reduced, consequently the commutator can be shortened in almost the same proportion. Every inch by which the commutator is reduced may be added to the core length, thus immediately securing an increase in the effective flux passing through the armature. This very nearly compensates for the reduced armature loading consequent upon the low space factor in the slots, and leads to the conclusion that with given dimensions the higher-voltage motor needs to be designed for a stronger field and weaker armature. This is just the tendency required for a satisfactory design.

The two limits governing commutator design in high-pressure motors are the maximum permissible voltage per segment and the minimum segment width. The minimum allowable width of bar including mica is about 0.16 in., the limiting desirable average voltage per segment is believed to be 20 for a reasonably good field distribution.

If these conditions are complied with, the design and manufacture of a satisfactory 1,200-volt motor is a simple matter, and that of an 1,800-volt machine, whilst being a slightly more heavy and costly proposition, is very little more so. Higher pressures than this do not seem necessary in view of the practicability of connecting groups of two or four motors permanently in series.

The same motor carcass which will give 200 kw. at 600 volts will yield 180 kw. at three times this potential. Fig. 8 shows a longitudinal section of the 1,200-volt motor.

CHATTERING WHEEL SLIP IN ELECTRIC MOTIVE POWER.

A paper on this subject was read at the Midwinter Convention of the American Institute of Electrical Engineers, New York, by Mr. G. M. Eaton, of which the following is an abstract:—

The fundamental difference between the running gear of steam and electric motive power is that in the steam locomotive, the only moving parts having relatively high moment of inertia are the driving wheels.

In an electric locomotive, the moment of inertia of the rotors, especially when operating through a gear reduction, may be as great as or greater than that of the driving wheels.

The combined inertia of connecting rods, cross-heads, piston rods and pistons is practically negligible in so far as it affects acceleration of driving wheels after slipping starts. In an electric locomotive, when slipping occurs, the sequence of events is as follows, regardless of the type of drive:—

Current is applied to the motor and the rotor starts to turn. Clearances in the entire transmission mechanism are first eliminated. Then, as the torque is increased, the metal of the transmission, framing, &c., is bent and twisted, or otherwise deflected. This stressed metal becomes a storage battery of energy. Finally the tractive effort reaches a value sufficient to overcome the existing adhesion at the rail (coefficient of friction of repose), and the wheel starts to slip. The instant relative movement occurs between wheel and rail, the coefficient of friction drops from that of repose to that of relative motion. There is, therefore, an opportunity for the stressed metal to start discharging its stored energy, since part of the resisting force has disappeared. This energy is expended in

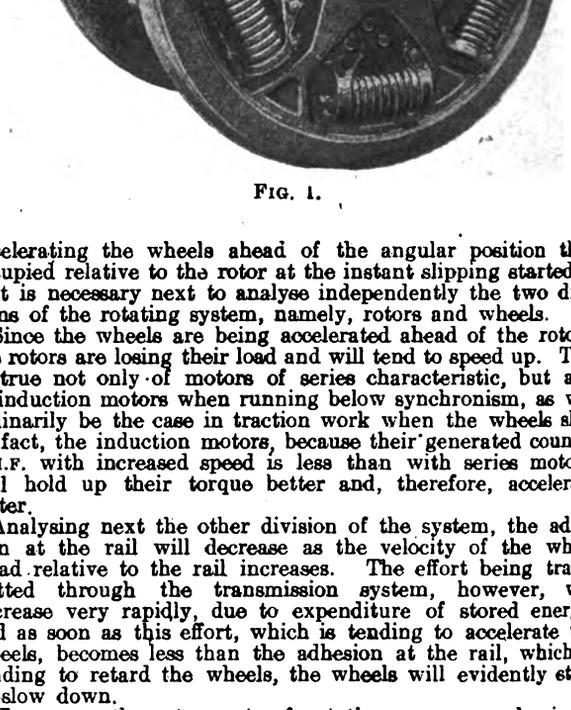

Fig. 1.

accelerating the wheels ahead of the angular position they occupied relative to the rotor at the instant slipping started.

It is necessary next to analyse independently the two divisions of the rotating system, namely, rotors and wheels.

Since the wheels are being accelerated ahead of the rotors, the rotors are losing their load and will tend to speed up. This is true not only of motors of series characteristic, but also of induction motors when running below synchronism, as will ordinarily be the case in traction work when the wheels slip. In fact, the induction motors, because their generated counter E.M.F. with increased speed is less than with series motors, will hold up their torque better and, therefore, accelerate faster.

Analysing next the other division of the system, the adhesion at the rail will decrease as the velocity of the wheel tread relative to the rail increases. The effort being transmitted through the transmission system, however, will decrease very rapidly, due to expenditure of stored energy, and as soon as this effort, which is tending to accelerate the wheels, becomes less than the adhesion at the rail, which is tending to retard the wheels, the wheels will evidently start to slow down.

There are, then, two sets of rotating masses mechanically coupled, the masses at one end of the system accelerating, and those at the other end retarding. As soon as clearances in the transmission are taken up, there is liable to be a jolt on the mechanical system, accompanied by a recoil. This gives the setting for chattering action, and such action has been experienced in practically every type of electrically-driven rolling stock where the motors are sufficiently powerful to slip the wheels at high adhesion.

In the case of a geared freight and passenger locomotive, the quill arms at the point marked A hit against the wheel spokes at the point marked B (fig. 1), and more or less break-

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age of these arms occurred, but this was traced to defective castings.

In later locomotives in the same service equipped with two motors per axle, the change in armature inertia eliminated this striking.

The same characteristic is occasionally observed in city and interurban cars, although this is much less frequent than in heavy hauling electric locomotives.

In the case of freight locomotives where the motors are geared directly to the axles the same phenomenon has been observed.

On the Norfolk and Western locomotives, chattering slip occurred in the running gear shown in fig. 2. After the locomotives had been in service for some months, evidences of failure were detected in the crank pins. The cause was traced to chattering slip by means of a rough oscillograph. The brakes were set on three trucks, and the oscillograph frame

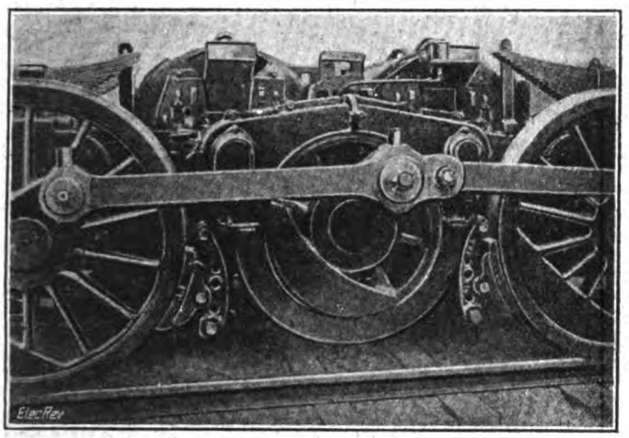

Fig. 2.

was set up on the fourth truck. The characteristic diagram of the chattering slip was obtained, as shown in fig. 3. The analysis in the figure is self-explanatory.

To check the oscillograph figures, extensometers were arranged, as shown in fig. 4, by means of which the connecting rods indicated their own stresses. The extension and compression of the rods were recorded by means of the compression of blocks of lead.

The two methods checked within a very few per cent. On the basis of the results, new rods, pins, &c., were applied on the locomotives. These have proved adequate for the service.

This chattering slip was more evident on the Norfolk and Western locomotives than could have been anticipated, since this was the first time electric haulage had been applied in service where such extremely high tractive efforts were required.

In all heavy hauling electric motive power, this problem must be considered, with every type of drive. The great number of variables entering and the wide fluctuation of certain of these variables render broad experience necessary in securing a successful solution of the problem.

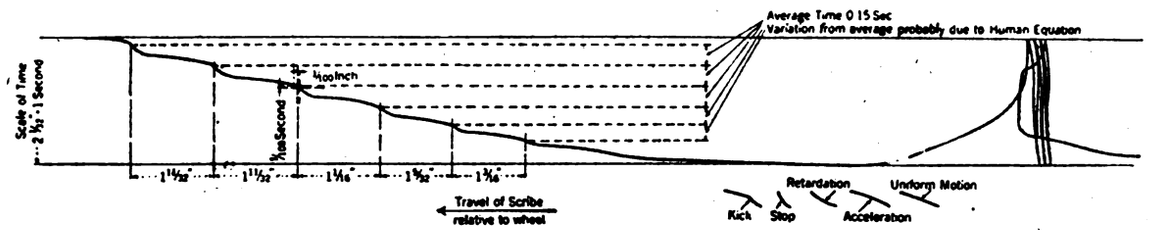

Fig. 3.—Oscillograph Record showing Motion of Wheel during Chattering Slip.

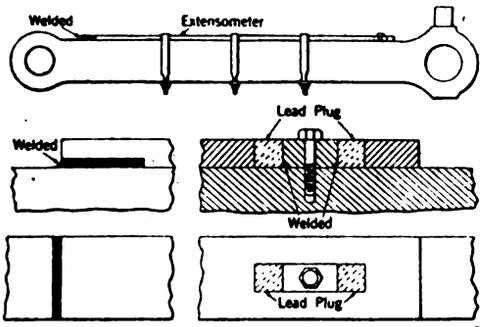

Fig. 4.—Extensometer to indicate Connecting-rod Strains.

IMPORT TRADE OF CEYLON.

The following figures, showing the value of the imports of electrical and allied material into Ceylon during 1914, are extracted from the recently-issued official statistics. The values for the previous year are given for purposes of comparison, and notes added of any increases or decreases:—

	1913. Rupees.	1914. Rupees.	Inc. or dec. Rupees.
Manufactures of copper.—			
From United Kingdom ...	45,000	30,000	– 15,000
,, India	33,000	29,000	– 4,000
,, Germany	45,000	22,000	– 23,000
,, Other countries ...	5,000	1,000	– 4,000
Total	128,000	82,000	– 46,000
Electrical materials.—			
From United Kingdom ...	209,000	160,000	– 49,000
,, Germany	15,000	5,000	– 10,000
,, Other countries ...	14,000	16,000	+ 2,000
Total	238,000	181,000	– 57,000
Scientific instruments.—			
From United Kingdom ...	31,000	19,000	– 12,000
Lamps.—			
From United Kingdom ...	140,000	135,000	– 5,000
,, Germany	105,000	72,000	– 33,000
,, Other countries ...	39,000	26,000	– 13,000
Total	284,000	233,000	– 51,000
Machinery, foundry and workshop.—			
From United Kingdom ...	1,075,000	651,000	– 424,000
,, United States ...	15,000	12,000	– 3,000
,, Other countries ...	5,000	2,000	– 3,000
Total	1,095,000	665,000	– 430,000
Other machinery, dutiable, not including tea, textile, and oil-making.—			
From United Kingdom ...	53,000	41,000	– 12,000
,, Germany	2,000	2,000	—
,, Other countries ...	3,000	3,000	—
Total	58,000	46,000	– 12,000
Ditto, free.—			
From United Kingdom ...	1,407,000	696,000	– 711,000
,, Germany	145,000	96,000	– 49,000
,, United States ...	78,000	50,000	– 28,000
,, Other countries ...	105,000	30,000	– 75,000
Total	1,735,000	872,000	– 863,000
Telephone materials.—			
From United Kingdom ...	43,000	6,000	– 37,000
,, Germany	—	1,000	+ 1,000
Total	43,000	7,000	– 36,000
Railway carriages and trucks.—			
From United Kingdom ...	6,000	6,000	—
Rails and fishplates, &c.—			
From United Kingdom ...	83,000	58,000	– 25,000
,, Other countries ...	17,000	2,000	– 15,000
Total	100,000	60,000	– 40,000

(N.B.—15 Rupees = £1.)

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SIERRA LEONE.—A Sierra Leone Ordinance has been passed imposing increased duties on certain articles imported into the Colony, with effect from January 1st, 1916. Electrical machinery and apparatus (and all parts and appliances thereof) consisting of a combination of moving parts or mechanical elements which may be put in motion by physical

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or mechanical force, and admitted as such by the Collector of Customs, remain free of duty; the duty on all other electrical apparatus has, however, been increased from 12½ per cent. *ad valorem* to 15 per cent. *ad valorem*.

SWEDEN.—The exportation of the following, among other articles, has been prohibited from Sweden as from January 18th:—Asbestos, unworked; manufactures of asbestos, not specially mentioned; insulating compositions (for protection against heat or cold) with or without admixture; also manufactures of such insulating compositions, such as slabs, segments, and other shaped pieces.

FRENCH INDO-CHINA.—A concession which cannot fail to be of the greatest assistance to British traders who export goods to Indo-China has recently been announced. Hitherto, British goods, in order to obtain the benefit of the "Minimum" Tariff rates on importation into Indo-China, have had to conform to the condition that the goods be transported *direct* to that country. The official announcement, however, states that as an exceptional measure, and for the period of duration of the war, goods of British origin will be entitled to the "Minimum" rates *even if the goods are transhipped en route* at Singapore, subject to the production of certificates of origin as required by the regulations.

MOROCCO.—The Board of Trade have received a copy of a Tariff showing the valuations of the principal articles of merchandise imported into Morocco. These valuations form the basis on which duty is to be assessed by the Moorish Customs Administration during the first half of 1916. It should be remembered that, with certain exceptions, goods imported into Morocco by sea are subject to duty at the rate of 10 per cent. *ad valorem*, and also to the special tax of 2½ per cent. *ad valorem* imposed as a temporary measure by Article 66 of the Algeciras Act. The new valuation tariff may be inspected at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

UNITED STATES OF AMERICA.—The following decision respecting the application of the United States Tariff Act of 1913 has recently been rendered by the Board of General Appraisers:—

Metal Flash-light Cases.—The outer casings of electric flash-lights, composed wholly or in chief value of metal, lacking only batteries and light bulbs to render them complete articles, valued above 20 cents (10d.) per dozen pieces, are not like articles to those enumerated in paragraph 356 of the Tariff, and are, therefore, not within that paragraph. They are properly dutiable as manufactures of metal not plated with gold or silver, under paragraph 167 of the Tariff, at the rate of 20 per cent. *ad valorem*.

VENEZUELA.—In virtue of a Presidential Decree, dated December 17th, 1915, pocket and portable electric lamps when imported into Venezuela are to be declared in the Consular Invoice, and to pay duty, as follows:—

Declaration for Consular invoice.	Class of the Tariff under which dutiable.	Total import duty (including surtaxes).
Lámparas eléctricas portatiles y de bolsillo	IV, plus 30 p.c. specific.	1.526 bolivares per kilog. (gross).

It is important to preserve the exact (Spanish) wording shown above in the "Declaration for Consular Invoice." (Bolivar = 9.6d.; kilog = 2.2046 lb.)

GAMBIA.—A new Customs Ordinance (No. 21 of 1915) came into force on January 1st, 1916, in the Colony of the Gambia, which makes provision for the levying of import duties differing in many instances from those formerly in operation. Among the articles *exempted* from import duty may be mentioned electrical plant and apparatus, and industrial and manufacturing machinery for use in connection with the preparation of any natural product of West Africa, and spare parts imported at the same time; scientific and surgical instruments and apparatus; telegraph materials imported for the use of the African Direct Telegraph Co. The duty on all goods not specified and not exempted from duty has been increased from 5 per cent. to 7 per cent. *ad valorem*.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

2,536. "Carbon electrodes." H. Levy. February 21st.

2,546. "Electrically-operated valves." E. C. St. John. February 21st.

2,547. "Dynamo-electric machinery." Lancashire Dynamo and Motor Co. and H. B. Whitmore. February 21st.

2,551. "Thermostats for attaching to urns, mullers, &c." E. L. Bernard. February 21st.

2,552. "Miners' electric hand lamps." A. E. Ancold & A. H. Railing. February 21st.

2,556. "Electrode holders for electric welding." Quasi-Arc Co. & A. P. Strohmenger. February 21st.

2,569. "Dynamo-electric machines." British Thomson-Houston Co. (General Electric Co., U.S.A.). February 21st.

2,576. "Remote control of search-lamps and ordnance." J. Brockie. February 21st.

2,580. "Telephone systems." Relay Automatic Telephone Co. & H. J. Herink. February 21st.

2,582. "Dynamo-electric machines." R. V. Morse. February 21st.

2,584. "Electric furnace." W. J. Wrightson. February 21st. (United States, February 19th, 1915.)

2,598. "Devices for generating, in an aerial for wireless telegraphy and telephony, electric oscillations having a strictly single frequency." E. Bellini. February 21st.

2,600. "Ampere-hour meter with friction-compensating device." Landis and Gyr. Soc. Anon. February 21st. (Germany, February 22nd, 1915.)

2,609. "Means for completing the connection of tubular electrical conductor conduits to switch boxes, &c." H. W. Cox. February 22nd.

2,615. "Electric heating apparatus." J. H. Farthing & M. J. Railing. February 22nd.

2,616. "Electrical ignition apparatus for starting internal-combustion engines." M. S. Conner. February 22nd.

2,639. "Amplifying electrical variations." British Thomson-Houston Co. (General Electric Co., U.S.A.). February 22nd.

2,641. "Projector arc lamps." J. Brockie. February 22nd.

2,660. "Automatic telephone exchange systems." C. A. W. Hultman. February 22nd. (Sweden, February 23rd, 1915.)

2,672. "Shading electric, &c., lights." J. W. Anderson & L. Loukes. February 23rd.

2,681. "Terminals of electrical machinery, &c." F. J. Hadfield. February 23rd.

2,697. "Automatic electric fog signals." W. A. Jeboult & H. J. S. Stobart. February 23rd.

2,701. "Ignition dynamos." C. T. Mason. February 23rd. (United States, March 15th, 1915.)

2,704. "Manufacture of electric incandescence lamps with metallic incandescence body." Deutsche Gasglühlicht Akt. Ges. (Auerges). February 23rd. (Germany, May 4th, 1915.)

2,714. "Elastic fluid turbines." British Thomson-Houston Co. (General Electric Co., U.S.A.). February 23rd.

2,725. "Electrical impulse responders or selectors." H. J. Herink & Relay Automatic Telephone Co. February 23rd.

2,752. "Fire bars for electric heaters." A. S. Blackman & S. R. Windle. February 24th.

2,756. "Means for attaching flexible conductors to electrical apparatus." W. H. Sturge. February 24th.

2,780. "Electrolytic processes and apparatus." F. W. Gauntlett. February 24th.

2,857. "Electric ignition of internal-combustion engines." C. W. Tidmas. February 25th.

2,858. "Electric ignition of internal-combustion engines." C. W. Tidmas. February 25th.

2,861. "Receivers for wireless signals." Marconi's Wireless Telegraph Co. & F. P. Swann. February 25th.

2,864. "Fluid-flow meters." British Thomson-Houston Co. (General Electric Co., U.S.A.). February 25th.

2,891. "Telephone receivers." G. A. Nussbaum. February 26th.

2,895. "Telephone transmitters." E. A. Petithory. February 26th.

2,896. "Electrical sounders, hooters, &c., for telephones." E. A. Laidlaw. February 26th.

2,901. "Measuring instruments." British Thomson-Houston Co. (General Electric Co., U.S.A.). February 26th.

PUBLISHED SPECIFICATIONS.

1914.

17,851. Electric Transformer Motors. D. Suchostawer. July 28th. (February 13th, 1915.)

1915.

1,774. Apparatus for Electrically Operating Planing Machines and the like Reciprocating Tools. Lancashire Dynamo & Motor Co. and W. Hargreaves. February 4th.

2,045. Electric Accumulators. J. P. Haworth. February 9th.

2,180. Electric Switch Panels. Igranic Electric Co. (Cutler-Hammer Manufacturing Co.). February 10th.

2,226. Steam Accumulators. British Thomson-Houston Co. & C. H. Naylor. February 11th.

2,356. Means for Intermittently Starting and Stopping as desired Electrical Machines. W. Brown. February 15th.

2,390. Electricity Meters for Multi-wire Circuits. F. A. Nield. February 15th.

2,489. Portable Electric Lamps. H. J. C. Forrester (J. W. Dunham). February 16th.

2,786. Electric Transformers. J. Torner. February 20th. (February 21st, 1914.)

2,894. Heating Tools or Dies by Electricity. W. J. Readett. February 23rd.

3,366. Telephone Exchanges. International Electric Co., R. G. le Noir and E. Funccius. March 2nd.

4,110. Means for Connecting Electrical Conduits to their Fittings. F. L. Broughton. March 16th. (Cognate application 4,885/15.)

4,681. Apparatus for the Electrolytic Production of Zinc. M. Perreur-Lloyd. March 25th. (May 28th, 1914.)

6,642. Combined Electric Switches and Connecting Plugs. R. Moore. May 4th. (Cognate application 8,736/15.)

7,003. Method of and Device for Kindling Mercury Vapour Electric Apparatus. Quarzlampen G.m.b.H. May 10th. (June 15th, 1914.)

7,622. Electric Lamps as applied for Advertising Purposes. W. C. Jeans and Jeans, Ltd. May 21st.

7,868. Rontgen or X-ray Apparatus. C. B. Burdon (Siemens & Halske Akt Ges.). May 27th.

8,272. Arc Lamp with Electrodes of Highly Refractory Metals, Tungsten in particular. Allgemeine Elektricitats Ges. June 3rd. (June 3rd, 1914.)

8,412. Electrical Safety Fuse Devices. C. B. Burdon (Siemens & Halske Akt. Ges.). June 7th.

9,246. Electric Relay. W. R. Sykes Interlocking Signal Co. & G. H. Sykes. June 23rd.

14,548. Electro-mechanical Driving Arrangements for Vehicles and other purposes. H. Reik & Oesterreichische Daimler-Motoren Akt. Ges. October 14th. (September 2nd, 1913.)

15,750. Process for Electrolytically Reducing or Oxidising Organic Substances. O. Imray (Society of Chemical Industry in Basle). November 8th.

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VOL. LXXVIII. MARCH 17, 1916. No. 1,999.

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THE I.E.E. WIRING RULES.

IN spite of the prevalence of war conditions, the Institution of Electrical Engineers has found time to carry out a revision of its wiring rules, and issued the 7th edition last week. The Wiring Rules Committee is a Standing Committee of 20 members, on which all the interests involved are represented, including the fire insurance companies, and we are glad to be able to state that *all* the latter have now adopted the rules; these are also accepted as standard practice by most of our electricity supply authorities, so we may congratulate the Institution and the industry on the excellent progress that has been made towards the universal acceptance of a single standard code, in place of the heterogeneous and chaotic mass of local regulations with which the contractor was confronted some ten or twelve years ago. The rules have been extended to include medium pressures (up to 650 volts)—a very necessary step in view of the amount of power that is supplied from the outers of three-wire systems and on three-phase networks at pressures between 400 and 500 volts—and it is interesting to note that provision has been made for the use of conductors with "tough rubber compound protection," under which disguise may be detected cab-tire sheathing. A table showing the capacity of conduits forms a very welcome addition, and an attempt is made to secure uniformity in the use of colours for distinguishing the conductors. Where possible, too, the work of the Engineering Standards Committee has been utilised.

The wording of the rules has evidently been very carefully revised, with great advantage in precision and lucidity, and numerous minor changes have been effected. One very commendable change is the abandonment of the definition of grade of insulated cable in terms of its insulation resistance—a misleading system, which was also to a great extent meaningless, owing to the wide range of values of the megohms per mile between the large and small sizes of cable. In place of this, V.R. cables are now to be graded as "I.E.E. 250-volt cable," and "I.E.E. 650-volt cable," a much more reasonable system.

Many changes have been introduced into the definitions and rules regarding conductors, etc., in the direction of greater safety and reliability; thus the size of insulated wire above which stranded conductors must be employed is reduced from No. 14 to No. 16 S.W.G., and in the case of flexible conductors No. 36 S.W.G. is made the minimum instead of the maximum size for each wire; for medium pressures heavy-gauge screwed conduit is specified;

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switches having a handle projecting through an open slot in the cover are forbidden; the use of "hard metal" for fuses is no longer recommended, nor is it suggested that soft metal fuses should be soldered to metal plates; the "Home Office" pattern of wall plug is recommended, and the use of a cord grip for flexibles connected with wall plugs is specified, while it is advised also on portable appliances in no fewer than three identical clauses on three consecutive pages; and heaters consuming over 1,000 watts—as will the majority in future—must be fitted with double-pole switches.

The printing of the wire table in the rules instead of on a separate sheet is a distinct improvement; the only other change in it appears to be the elimination of the superfluous figures in the column giving the resistances of conductors per 1,000 yards, which were formerly carried to four significant figures—a useless refinement, seeing that a variation of 2 per cent. is allowed; in most cases two digits, and in the remainder three, are now employed, and are sufficient for all practical purposes.

On the whole, while the rules are not yet beyond criticism, we must congratulate the Wiring Rules Committee upon the results of its last revision; the wording, the composition, and the arrangement of the rules have been very greatly improved, and the changes that have been introduced in the regulations are such as will, we believe, command general approval.

"To Be Wound Up."

To all who desire to see success attend the British fight against German trade, the *London Gazette* has been of abundant interest during the last few months. Several issues have contained lists of companies, firms, and individuals with whom it is permissible to trade in China, where German scheming during the war has been extremely active. The reader naturally draws his own conclusions as to what his connections should be with those whose names do not so appear. In another issue, as we recently stated, there appeared lists of persons and bodies of enemy nationality or associations in Greece, Morocco, Netherlands, Norway, Portugal, Portuguese East Africa, Spain, and Sweden, with whom or which trading is prohibited. In these lists a number of electrical names are condemned. But last of all we have a number of issues of the *Gazette*, publishing the names of businesses in this country which, under the Trading with the Enemy Amendment Act, have been ordered by the Board of Trade to be wound up. Here, again, a number of electrical and allied names are recorded. We have quoted such of the 44 companies as appear to interest our readers, in our "War Items," but the announcement which will be welcomed most of all by the electrical trade is that which concerns the Electrical Co., Ltd. So long as the law permitted a business in which practically the whole of the capital was German owned, and the main purpose of which was to represent the Allgemeine Elektricitäts Gesellschaft, to continue trading, the matter was one of extreme difficulty, but it was, nevertheless, a blot on our escutcheon. We have watched the A.E.G. activities in this country, so far as it was possible to keep track of its operations, for many years. Its representatives came over here at a time when they were not viewed either with suspicion or with serious misgiving, and they laboriously and enterprisingly built up an organisation at great cost, which resulted in millions of pounds' worth of contracts being sent out of the country. Our industry was not in a state to resist the competition. The A.E.G. agents went in and out amongst us as respected gentlemen, notwithstanding all that we say to-day about the Teuton of these days not having the word "gentleman" in his vocabulary. They were, or seemed to be, Germans of the "old school"—if we may use the expression. We hope that, when the anti-German sentiment is so strong within us all, we shall not be misunderstood for stating these facts, for among other things that this disappearance of a company from our registers suggests to us, is the illustration that it affords within our own industry of the gross stupidity and shortsightedness of the Prussian scheme for world domination. There will not be a British electrical man who will regret the passing into oblivion of a concern which stood for the letters A.E.G. in England while that vast German organisation was engaged in manufacturing war supplies of so many kinds for the enemy. The senseless mutterings of its head, Dr. Walther Rathenau, recorded in our pages, about war being waged in the old Roman way, and the desires held in that quarter for making war on the British Empire, have not been without their effect upon the British electrical mind. They will not soon be forgotten after the war. Much blood has flowed on the Continent, and a record of infamy and shame has been written which has shocked the world. The Colonies are as determined as we are that neither this nor any other German organisation shall have things so much its own way in our markets in future as it has had in the past. The announcement now made gives final dismissal to A.E.G. activity in this country so far as it was represented by the Electrical Co. Parts of its organisation may have passed into other hands, and some of its staff and employés may be employed by indisputably British and neutral concerns, but the Electrical Co., Ltd., as such, in its capacity for earning profits whether on the sale of British or other goods, for German capital, is ended. The company's doings formed the subject of a good deal of correspondence in these pages a short time ago, and those who took part therein will not be disappointed at the course that events have taken. Further, those who were legally bound under contracts to supply goods to them will, doubtless, feel relieved that by the process of forced liquidation they are freed from their contractual responsibilities. The question that will naturally occur to many minds will be: Will the A.E.G., after the war, be permitted to "raise its head" again in the British Isles or in the Colonies? We wonder!

British Finance for Italian Trade.

British observers in Italy have been very definite in their warnings to British manufacturers that unless they take swift advantage of the opportunity, it will slip through their fingers. Italian buyers who long for freedom from Teutonic economic influence, and are determined that, if they have it in their power to decide, German penetration in Italian commercial and industrial affairs shall never again be what it was before the war, have shown signs of impatience with us because we have talked so much of bold intentions, but have seemed to delay the taking of appropriate action. But all movements are not shown upon the surface, and plans are often maturing for many months before the outside world knows anything about them. We believe that it will gratify our Italian brothers-in-arms as much as it will please the British commercial and industrial world, to learn that two of the best English banks—(the London County and Westminster, and Lloyd's)—as representatives of what is described as a "financial group," have entered into an agreement for the formation of an Anglo-Italian Bank for the purpose of developing the economic relations between the two countries and promoting commercial and industrial undertakings in Italy. The new concern will be made up of two companies—the British Italian Corporation in this country, and the Compagnia Italo-Britannica in Italy; the former will have a capital of

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£1,000,000 and the latter £400,000. The financial group which is acting in the matter is very strongly backed. This move on the part of our financial leaders should give great encouragement to all who are desirous of assisting as traders in the fostering of commercial relations. And more than that, it augurs well for the strengthening of British financial facilities, and a more general co-operation with industry, in other countries where enlightened finance is unquestionably going to be one of the most important factors assisting us to be even with Teutonic competitors when the world is open to them again.

Lead.

The position of pig-lead has again been the subject of considerable interest lately. The price of this metal has kept at a very high level for some considerable time past, and most consumers were rather inclined to believe that this was partly the result of aggressive speculative buying. Recent developments, however, have certainly tended to dissipate that impression. With the intervention of the Government in placing lead, like most other metals, under the Defence of the Realm Act, thus eliminating all speculative transactions, business was naturably brought for a time to a complete standstill until the metal market was reopened under the new regulation. The market was then put to a test, and in a temporary absence of inquiries the price was depressed to the extent of 25s. a ton to about £31 15s., but there were not many sellers near that level, and the law of supply and demand reasserted itself to an extent which has soon resulted in the price being restored to the level at which it stood prior to the Proclamation. The strong underlying conditions having thus been more readily recognised, the ease with which the recent fairly large supplies were taken care of has tended to stimulate the covering of prospective needs over the spring. The market was in rather an excited condition in the course of the past week, with successive jumps in the price to about £34 a ton for next month shipment, the highest figure recorded since the years which followed the Napoleonic wars, and there was a further rise early this week. The price is admittedly extravagantly high, but it is well to bear in mind that the enormous war requirements now absolutely dominate the position. Never before in the history of the trade has there been so much lead wanted as at the present time, in spite of the comparatively reduced industrial requirements on this side. The present lofty level of values certainly affords every inducement for producers to push mining operations, but there is, of course, a limit to the forcing of the output, while, at the same time, efforts in that direction are liable to be frustrated by labour troubles as happened in the early part of this year in Australia. Operations in that quarter are now again running pretty smoothly, but labour tribulations have lately occurred in one of the chief mining districts in Spain, and this has not been without effect upon the temper of the market, though the latest news regarding the Spanish strike is a little more hopeful. In the course of the past year, the unusually large American surplus diverted to this country, following upon the huge increase in the American output in 1914, had the effect of keeping prices down for a time, but the American position is now much stronger. Domestic consumption has been considerably on the increase, so that the exportable surplus has been correspondingly reduced. The British market is thus more dependent upon the shipments from Spain and Australia in order to keep pace with the huge requirements largely in connection with munition work. Our imports for the first two months of this year were over 7,000 tons short of the same period last year, this deficit representing the shortcomings from America and Spain. The fact has to be remarked that the total Spanish exports for the past year show only an increase of about 9,000 metric tons against the previous year's returns. The position of lead has undoubtedly been complicated by shipping difficulties and labour scarcity in this country which tend to handicap smelters' operations, and Government action in that direction would possibly assist in affording some relief from the present stringent conditions.

THE ENGINEER IN THE TROPICS.

By GEO. R. ARCHDEACON, A.M.I.E.E.

It not infrequently happens that "in search of that bubble reputation" the electrical engineer penetrates the deadly swamps and forests of Africa, India, South America, or the Malay Straits. Before finally deciding upon the acceptance of an appointment in any tropical district the young engineer (who has been hitherto full of the wild desire to get out of England), when faced with the grave decision of accepting or refusing what at first sight seems a very tempting offer, will probably be troubled by such matters as (*a*) The high death rate obtaining in that particular district; (*b*) The outfit necessary; (*c*) The cost of living; (*d*) Social life.

The author has frequently been faced with these posers, and ofttimes has found his geography too weak to enable him even to locate the place offhand. To the untravelled engineer the tropics are wrapped in an atmosphere of mystery and death, and all his future success therein seems to hang upon the odds whether he will manage to live three years, or die within three months. The prospects of success and affluence are alluring, yet provokingly indefinite.

Upon one occasion, when a lucrative position in South America was offered to the writer, the managing director said, "If you stay in England you will have a fair amount of comfort and bread and butter; if you come with me you will have plenty of discomforts, but you will have jam upon your bread."

Let the young engineer bear this well in mind; in the Tropics he will not only have "jam on his bread," but he will live a freer life, and find unbounded opportunities for experience and progress. He will occupy a higher social position than a similar berth would carry at home, and the opportunities for saving are considerably greater than at home; but there are many pitfalls for the unwary. To save a reasonable percentage of one's salary necessitates a very strong will, and the exercise of that will must never be relaxed, for nowhere in Europe are the temptations so manifold as in the Tropics, coupled to which is the effect of a bad climate, which is constantly working upon one's health, and so reducing the vitality that gradually one's power of resistance decreases.

The question of total abstinence, or moderate indulgence in alcoholic drinks, in the Tropics, is perhaps one of the most vexed questions of the day. Each side has its strong adherents; each side possesses its convincing and conclusive statistics. The author does not pose as an authority on this subject, but, from personal observation and experience in various tropical districts, he advises total abstinence from all alcoholic liquors between sunrise and sunset; after sunset a moderate indulgence usually does no harm, but seems to act as a necessary stimulant.

The care of one's health in any tropical country must at all times occupy a serious portion of one's thoughts. Constipation at all times has evil effects, but in a tropical country its effect is simply deadly. Try and imagine the effect of the climate upon the average young Britisher who has all his life been used to cold fresh breezes, when he is suddenly dumped down, say, in the malarious and malodorous district of the river Amazon, where the temperature in his bedroom throughout the night is about 90° F., while the hydrometer shows about 85 per cent. to 95 per cent. humidity. One can well understand that living under those conditions one loses all desire for movement or exercise, and only cares to lounge about in pyjamas, with a long iced drink at hand. Exercise must be the watchword, and plenty of it, yet that is just the thing that one does not feel inclined to indulge in. This, again, is the occasion when the strong will must be exercised.

Another vexed question is quinine. Should one fortify oneself against malaria by taking, say, five grains per day, or not? If one takes quinine each day, trouble arises in the administering of it if one does (in spite of being charged with the drug) contract malaria. Here, again, we find the experts taking sides on this grave issue. Beyond doubt a daily consumption of quinine does appear to reduce the risks of malaria; therefore, on the principle of

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"prevention is better than cure," the author is of the opinion (in spite of slight deafness frequently caused by the habit), that one should never neglect the daily dose of quinine when in a malarious district.

As regards the most suitable "first aid" remedies to carry, it depends largely upon what district is being considered—tropical diseases vary very much in the various districts; for example—

Yellow fever in Brazil, but never in India, Malay Straits or China.

Sleeping sickness and blackwater fever in West Africa, but never in Brazil, China, or India.

Malarial fever, however, is found in all tropical countries. Perhaps the most useful items to be observed are :—Vaccination against smallpox; inoculation against enteric fever; chlorodine for cholera and dysentery; quinine for malarial fever; corrosive sublimate for wounds and scratches; ice-cap in case of sunstroke.

Apart from the mosquitoes, chills are the most fruitful causes of illness, and they frequently lead to serious results. It is most important to avoid chills; many a man has gone to his grave through kicking off his sheet during the night and sleeping with the fan blowing a draught of cool air on to his body. A cholera belt should *always* be worn during the night.

The all-important question of clothes will, doubtless, require a considerable amount of thought. Again, local conditions must be inevitably the guide. Many districts have a fierce tropical summer, yet during the winter it is necessary to wrap up in thick furs and have a roaring fire in the bedroom. The style of one's clothes must be carefully considered. In India, Africa, and Malay Straits, white patrol jackets buttoned up to the chin are usually worn, whereas in Brazil, Hong-Kong, and Shanghai, white jackets cut in a similar style to our lounge jackets at home, showing white soft shirt, collar and tie, are considered the only possible wear for a gentleman.

To sum up the whole subject, life, to be fairly certain and healthy in the Tropics, should be (with a few reservations) maintained in a manner similar to that followed at home. The most important items to be observed are :—Plenty of exercise, plenty of sleep, plenty of good food, and plenty of optimism.

THE TESTING OF UNDERGROUND CABLES WITH CONTINUOUS CURRENT.

Mr. O. L. Record's paper on this subject was read before the Manchester Local Section of the Institution of Electrical Engineers on February 8th. An abstract of the paper appeared in our issue of February 18th. In the discussion the Chairman (Mr. B. Welbourn) said that the present knowledge of insulating materials dictated that A.C. overhead lines could only be constructed for a maximum pressure of 150,000 volts, but the information given in the paper would suggest that D.C. pressures of even 300,000 volts would be practicable for overhead lines. It would be interesting to know the highest limit of D.C. pressure which could be used.

Mr. C. J. Beaver said the distribution of stress with continuous current was quite different to that with alternating current; it depended upon different factors, viz.: resistance in the former case and capacity in the latter, therefore the effects would be quite different. The object of testing cables after laying was mainly to ensure that any damage incurred in laying was rectified. He did not entirely agree that there was no relation between the dielectric strength and the insulation resistance. The only advantage in size and weight of the Delon transformer lay in the fact that it had only to be designed for a small current. Sound dielectrics were not affected by pressures several times the working pressure, and the factors of safety employed ensured that the dielectrics were far removed from any such effects. Dielectric fatigue was simply the reaching of the limit of disrupture voltage of some component of the dielectric The fatigue stage would, therefore, be far removed from any effect which could be brought about by such voltages as were likely to be applied to the cable under working conditions. A manufacturer might show some disinclination to take the responsibility for a cable suffering from things over which he had no control, but otherwise it would not interest him very much if the cable were tested repeatedly at twice working pressure. The most important question in connection with the D.C. apparatus was whether it would satisfactorily burn out faults. Wet cables were extremely difficult to break down, and the more water-logged the cable the more difficult the task.

Prof. E. W. Marchant said the relationship existing between the breakdown strength of material tested by direct current and alternating current was one of the most remarkable phenomena met with in electrical work. A cable having a non-uniform dielectric would have an entirely different distribution of stress in the two cases, the D.C. case depending upon the specific resistance of the material, and the A.C. case depending upon the specific inductive capacity. This was one of the reasons why the direct-current method of testing could not be regarded as entirely satisfactory. A number of tests had been made at Liverpool on the dielectric strength of ebonite, with the object of determining the amount of fatigue, which in ebonite appeared to be extremely small. He had tried to find what might be styled "mechanical fatigue," but the tests had failed to reveal it. He described a Wimshurst machine designed by Mr. Watson for direct-current testing, and giving an output of 4 or 5 milliamperes at 150,000 volts. Mr. Watson had also designed a special voltmeter reading up to 100,000 volts. The instrument was of the reflecting type, and was only a foot in diameter, the moving parts being arranged in a chamber filled with compressed air at 200 lb. per square inch pressure.

Mr. H. A. Radcliff thought the continuous-current test did not meet the requirements of a test under working conditions on alternating-current cables. The application of an excess alternating pressure was undoubtedly the correct method of testing A.C. high-tension cables before being put into service, and where possible it was advisable, before applying the excess pressure, to warm up the cables for several hours by circulating through them the maximum load current. This could easily be done using a suitable low-voltage transformer. Any test which ignored the effect of dielectric losses was necessarily incomplete. He agreed that there was no definite relationship between dielectric strength and insulation resistance. Insulation resistance or excess pressure tests were in themselves insufficient, and in future all tests of any value would include accurate measurements of the dielectric losses. In the case of sample lengths tested at the manufacturers' works, the pressure should be applied for several hours, and, if possible, a superposed low-voltage current equal to the maximum load should be passed through the conductors, all tests being made at normal working frequency. Whilst a high insulation resistance was not necessarily an attribute of a good high-tension cable, it greatly facilitated the location of leaky joints and fittings. The difficulties of testing with alternating pressure seemed rather magnified, as 12 miles of cable would never be tested at 40,000 volts with portable equipment. Tests after laying were usually made in lengths of about a mile, and after locating defects and making the joints, excess pressure was applied to the full length from the generating station or sub-station. Such a final test was required by the Board of Trade, and despite the energetic opposition of the cable makers it was likely to be repeated. He could not understand how a continuous pressure could ever be regarded as the equivalent of an alternating one.

Mr. F. Fernie considered that the curve showing the relation between breakdown voltage (A.C.) and duration of test was not always true. A certain paper-insulated cable broke down under test at 91.5 KV., but when 90 KV. was applied to another portion of the same cable for some hours there was no breakdown. The pressure was again applied and raised steadily until 91.5 KV. was recorded, and the cable again broke down. Other cables tested at the same time gave similar results. Similarly, the statement regarding the decrease of breakdown voltage with increase of frequency was not true for frequencies below 100; any decrease which did occur would certainly be under 5 per cent. Nearly all statements regarding dielectrics were to be accepted as true for a specimen rather than a substance.

Mr. H. M. Crellin said that experiments had shown that heating a cable to the temperature of boiling water did not perceptibly reduce the breakdown voltage. In the case of a cable damaged in laying, assuming the dielectric to be partially cracked so that it was composed partly of air and partly impregnated paper, with D.C. pressure the drop across the dielectric would be directly proportional to the resistance of the layers. It might easily happen with continuous pressure that the potential gradient would so adjust itself across the dielectric that the presence of a crack would remain undetected. On the other hand, with alternating pressure the voltage drop across the dielectric would be fixed by the capacities of the layers, and not the leakage current. Impregnated paper had a dielectric constant approximately three times that of air; consequently, as the potential gradient was inversely proportional to the capacity, the alternating pressure would easily spark across the crack, and so break down the fault. Regarding the ratio of D.C. to A.C. pressures referred to in the paper, it was not generally realised that the ratio of secondary to primary pressure of a transformer was considerably increased by the charging current of a cable due to the effect of the leading current on the magnetic leakage of the transformer.

Mr. J. L. Langton said the Delon apparatus would have a good application to the testing of line insulators *in situ*. His experience during the past year had shown that cracks due to temperature variations, expansion of cement, &c., were really the cause of the so-called fatigue in porcelain. Defects in insulators, which would break down with the usual transformer test, would not be disclosed by the Delon apparatus.

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The smallest crack required alternate stress and heating in order to develop into a distinct fault. In air and in a solid insulation of mineral origin there was no relation between insulation resistance and dielectric strength. In the case of a solid insulation of vegetable origin, however, there seemed to be some relation, as moisture was a predominant factor when present in fibrous material. An increase in temperature would drive out moisture and increase the insulation resistance, but diminish the dielectric strength. Regarding the effect of frequency on dielectric strength, his experience with solids of mineral origin showed no difference between 33 and 100 cycles.

Mr. H. Alcock referred to the statement that the tests in question were only intended to show up faults produced in laying cables. The provision of a metallic test sheath interposed between the conductor and the lead sheathing already achieved this object, and further refinements seemed quite unnecessary.

Mr. J. W. Record thought the word "rectified" should be substituted for "continuous" in the title of the paper. The use of the cables instead of small condensers might easily involve a transformer of 300-K.V.A. capacity, such as was required in testing with alternating current. If such a test as was described should appear advantageous in future, it could only be put into operation after some competent authority had established the relationship between D.C. and A.C. pressures. The author's figures might certainly be laid down provisionally.

The Author, in a brief reply, said that in the case of cables for voltages at present in vogue, the margin of safety was so great that the question of fatigue was negligible. He cited a case where a 10,000-volt cable was subjected to 80,000 volts, after which the engineer had no qualms of conscience in testing at 20,000 volts, *i.e.*, double working pressure, every time there was trouble with the joints. With 50,000 or 60,000 volts the margin of safety was much smaller, and special precautions had to be taken. He did not advocate replacing the A.C. test altogether by the D.C. test. The capacity of the transformer was 3 KW., and this was actually effective power in the case of the D.C. test. Considering the extremely low power factor in the case of the A.C. test, it would be obvious that, in spite of the large capacity of the testing transformer, the effective power would be very small.

REVIEWS.

The Principles of Dynamo-Electric Machinery. By B. F. Bailey. London: Hill Publishing Co. Price 12s. 6d. net.

Much may be said in favour of the principle that professors and lecturers should expand their lecture notes into a text-book for the use of their students. When the lectures and text-books are co-ordinated in this way, advantages of uniformity of method and terminology in the instruction are much facilitated. If the resulting text-book is of sufficient originality and merit, it may prove valuable to a larger class than the one which is more immediately addressed by its author, and its wider publication is fully justified.

We take the work before us to be of the type which represents in somewhat expanded form a course of lectures on elementary electrical engineering addressed to a class of the author's students. Judged from this standpoint, the book is well written, and will doubtless serve a useful purpose. When regarded from the wider aspect of the more general public, it is more difficult to foresee a sphere of usefulness.

While it may be regarded as a well-written text-book for elementary students, there seems to be no marked characteristic or originality in treatment which is likely to render it more helpful to the ordinary student than the several excellent text-books covering similar ground which have been published in this country at a fraction of the price of Prof. Bailey's book. In fact, the reviewer would not feel justified in advising any student to invest so large a sum as the price asked for this volume on a purely preparatory text-book, unless he is more than usually fastidious in the matters of binding and typography—both of which are excellent in the present case.

Turning to the contents of the book, the author believes that the material which it contains will satisfy the needs of students who do not intend to follow electrical engineering as a profession, while he also anticipates its utility as a first course for students who expect to proceed further in the subject. Sparing use has been made of mathematical demonstration, and the author has generally explained his subject by reference to physical principles and employed methods of general reasoning, rather than rigid proofs. In this manner he has covered the field represented by the most important types of electrical generators, motors, and transformers, and has succeeded in conveying an idea of the main principles underlying their behaviour and use. His diagrams are clear, and where illustrations of actual machines and instruments are introduced they are generally well chosen and helpful.

It is obvious that when such a large amount of material is dealt with in a book of 300 pages the treatment of many portions is necessarily very slight, and it would be unfair to find fault with many omissions. It seems, however, a pity that no reference is made to magnetic leakage when dealing with field systems—especially as the student is asked to make calculations on the ampere-turns necessary to produce a given armature flux.

In view of the non-analytical treatment adopted in most parts of the book, it seems of doubtful utility to approach the principles of the alternating circuit in such an academic manner as is done in Chapter XII. Indeed, in this chapter the author seems to have departed somewhat widely from his plan of emphasising physical conceptions and avoiding such demonstrations as depend only on abstract mathematics and are wanting in appeal to the physical sense.

A good deal of the conventional mathematical treatment at this stage seems misplaced in a book intended mainly for the general and non-mathematical student, and such quantities as impedance and reactance need not have been introduced for the first time in the form of mathematical symbols and without any reference to their significance in practice. There seems to be no particular need to introduce the subject of electrostatic capacity and conditions for resonance at this stage, especially if the student is not distinctly warned against supposing that capacity and inductance are equally important factors in determining the impedance of the electrical circuits met with in the later chapters of the book.

Again, a certain number of rather advanced subjects are introduced, but treated in such general and superficial terms that the wisdom of referring to them at all seems open to question. One example of this is the single-phase induction motor, which is dealt with in three pages; even this short discussion seems to the reviewer to be lacking in clearness, which, it is only fair to add, is unusual in Prof. Bailey's book as a whole.

The reviewer's general impression is that for the non-electrical *student* the book may prove useful in conveying a general knowledge of the most important principles involved in electrical machinery; though, for the non-expert *user* of electrical machines, the treatment adopted is hardly the best. For the electrical student who hopes later to proceed further in his studies of electrical machinery, the book suffers from the fact that it deals too exclusively with principles and general statements, and provides an insufficient basis of concrete examples and definite results to enable the beginner to lay a good foundation for future studies.

The reviewer refuses to believe that it is wise to present the serious student with "the principles of dynamo-electric machinery" in a compass of 300 pages, especially when mathematical aids to abbreviation are little used.

Relativity and the Electron Theory. By E. Cunningham, M.A. London: Longmans, Green & Co. Price 4s. net.

This little work is one of the series of monographs on physics edited conjointly by Sir J. J. Thomson and Prof. F. Norton. As the author states, it is an attempt to set out as clearly and simply as possible the relation of the principle of relativity to the generally-accepted electron theory, showing at what points the former is the natural and necessary complement of the latter. Mathematical analysis has been omitted as far as possible with the object of rendering the account useful to the general reader, especially to the experimental physicist.

Of course, to the practical man the principle of relativity has very little bearing. He is apt to consider it and allied subjects as mere abstractions suitable as a study for those who have nothing better to do. Nevertheless, there are many desirous of keeping up-to-date with modern conceptions, and to such this little book of 90 odd pages can be commended.

The author, after discussing space and time in Newton's dynamics and the relativity of Newton's dynamics, goes on to show that time is not an absolute or independent concept. He then traces the advent of the æther theory and mentions Fresnel's convection-coefficient, and describes Fizeau's verification of Fresnel's hypothesis. The Michelson-Morley experiment is described and discussed at some length.

Towards the end of the work there is an interesting chapter on Minkowski's four-dimension vectors. Minkowski speaks of space by itself and time by itself as being mere shadows, and of only a kind of blend of the two as existing in its own right. He thinks of his four-vector as a single entity, just as we think of force as a single entity. The components of a force do not exist of themselves. They are only convenient means of specifying the force, which is one and definite. So space and time co-ordinates are to Minkowski only particular, complementary, and inseparable means of specifying a single fact or occurrence. Analytically, Minkowski transports himself to a space of four dimensions, in which the distinction between space and time vanishes. In this four-dimensional region the whole of space and time is portrayed in one construct.

The A.S.E.—The membership of the Amalgamated Society of Engineers has increased by 2,560 during the month of February to 208,825. This is a record for the society, which has secured about 30,000 new members since the war.—*Times.*

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THE IMPORTS AND EXPORTS OF SWEDEN.

The following figures, showing the imports and exports in 1913 into and from Sweden of electrical and similar goods, are extracted from the official trade statistics which have just been issued. Unfortunately they are not as up-to-date as we should desire, the detailed 1914 figures not yet being available, but they are of interest as showing the course of Swedish business just before the war.

IMPORTS.

	1912. Kronor.	1913. Kronor.	Inc. or dec. Kronor.
Electric meters.—			
From Germany	808,000	1,068,000	+ 260,000
,, Great Britain ...	81,000	68,000	− 13,000
,, Other countries ...	7,000	10,000	+ 3,000
Total	896,000	1,146,000	+ 250,000
Electric incandescent lamps.—			
From Germany	1,016,000	1,166,000	+ 150,000
,, Austria-Hungary ...	16,000	32,000	+ 16,000
,, Holland	—	36,000	+ 36,000
,, Other countries ...	26,000	22,000	− 4,000
Total	1,058,000	1,256,000	+ 198,000
Dynamos and motors over 500 kg. in weight, and parts thereof.—			
From Germany	200,000	174,000	− 26,000
,, Great Britain ...	14,000	38,000	+ 24,000
,, Switzerland	—	63,000	+ 63,000
,, Other countries ...	8,000	23,000*	+ 15,000
Total	222,000	298,000	+ 76,000
* United States 12,000.			
Dynamos and motors up to 500 kg. in weight, and parts thereof.—			
From Germany	389,000	502,000	+ 113,000
,, Great Britain ...	16,000	22,000	+ 6,000
,, Switzerland	13,000	16,000	+ 3,000
,, United States ...	19,000	15,000	− 4,000
,, Other countries ...	34,000	40,000	+ 6,000
Total	471,000	595,000	+ 124,000
Electric cables covered with lead.—			
From Denmark	35,000	—	− 35,000
,, Germany	3,976,000	3,429,000	− 547,000
,, Holland	59,000	6,000	− 53,000
,, Great Britain ...	405,000	99,000	− 306,000
,, Other countries ...	33,000	41,000	+ 8,000
Total	4,508,000	3,575,000	− 933,000
Turbines.—			
From Germany	No details.	27,000	—
,, Great Britain ...		—	—
,, Other countries ...	—	106,000*	—
Total	4,000	133,000	+ 129,000
* Switzerland 105,000.			
Telephone and telegraph apparatus.—			
From Germany	47,000	87,000	+ 40,000
,, Great Britain ...	32,000	59,000	+ 27,000
,, Other countries ...	29,000	11,000	− 18,000
Total	108,000*	157,000	+ 49,000
* Includes wireless apparatus 11,000 kronor.			
Transformers and parts thereof.—			
From Germany	97,000	407,000	+ 310,000
,, Other countries ...	14,000	125,000	+ 111,000
Total	111,000	532,000*	+ 421,000
* Includes rotary converters.			
Accumulators.—			
From Germany	999,000	470,000	− 529,000
,, Great Britain ...	—	13,000	+ 13,000
,, Other countries ...	7,000	21,000	+ 14,000
Total	1,006,000	504,000	− 502,000
Rheostats, switches, &c.—			
From Germany	657,000	877,000	+ 220,000
,, Other countries ...	38,000	20,000	− 18,000
Total	695,000	897,000	+ 202,000

EXPORTS.

	1912. Kronor.	1913. Kronor.	Inc. or dec. Kronor.
Transformers.—			
To Norway	400,000	372,000	− 28,000
,, Spain	72,000	69,000	− 3,000
,, Other countries ...	59,000	102,000	+ 43,000
Total	531,000	543,000	+ 12,000
Electric dynamos and motors.—			
To Russia	85,000	153,000	+ 68,000
,, Great Britain	353,000	293,000	− 60,000
,, Norway	265,000	916,000	+ 651,000
,, Finland	147,000	213,000	+ 66,000
,, Denmark	173,000	241,000	+ 68,000
,, Spain	221,000	360,000	+ 139,000
,, Germany	72,000	21,000	− 51,000
,, Canada	375,000	557,000	+ 182,000
,, Other countries ...	625,000	922,000	+ 297,000
Total	2,316,000	3,676,000	+ 1,360,000
Electric incandescent lamps.—			
To Germany	32,000	—	− 32,000
,, Denmark	46,000	15,000	− 31,000
,, Great Britain	28,000	13,000	+ 15,000
,, Russia	13,000	—	− 13,000
,, Other countries ...	46,000	76,000	+ 30,000
Total	165,000	104,000	− 61,000
Telephone apparatus.—			
To Norway	107,000	43,000	− 64,000
,, Finland	419,000	223,000	− 196,000
,, Russia	1,069,000	334,000	− 735,000
,, Denmark	78,000	43,000	− 35,000
,, Holland	424,000	418,000	− 6,000
,, Great Britain	628,000	97,000	− 531,000
,, Mexico	177,000	86,000	− 91,000
,, British South Africa ...	373,000	210,000	− 163,000
,, Other countries ...	1,884,000	1,616,000	− 268,000
Total	5,159,000	3,070,000	− 2,089,000
Telegraph apparatus.—			
To Russia	51,000	1,131,000	+ 1,080,000
,, Holland	153,000	329,000	+ 176,000
,, Finland	54,000	182,000	+ 128,000
,, Egypt	—	152,000	+ 152,000
,, British South Africa ...	59,000	199,000	+ 140,000
,, Australia	—	110,000	+ 110,000
,, Other countries ...	145,000	615,000	+ 470,000
Total	462,000	2,718,000	+ 2,256,000
Water turbines.—			
To Finland	58,000	30,000	− 28,000
,, Great Britain	56,000	27,000	− 29,000
,, Canada	107,000	—	− 107,000
,, Japan	67,000	91,000	+ 24,000
,, Other countries ...	110,000	215,000	+ 105,000
Total	398,000	363,000	− 35,000
Cranes, &c.—			
To Finland	90,000	170,000	+ 80,000
,, Russia	175,000	198,000	+ 23,000
,, Other countries ...	245,000	401,000	+ 156,000
Total	510,000	769,000	+ 259,000
Copper wire.—			
To Russia	70,000	179,000	+ 109,000
,, Finland	100,000	193,000	+ 93,000
,, Norway	32,000	122,000	+ 90,000
,, Other countries ...	76,000	122,000	+ 46,000
Total	278,000	616,000	+ 338,000
Steam turbines.—			
To Russia	265,000	406,000	+ 141,000
,, Finland	47,000	28,000	− 19,000
,, Holland	20,000	49,000	+ 29,000
,, Great Britain	56,000	28,000	− 28,000
,, Other countries ...	126,000	101,000	− 25,000
Total	514,000	612,000	+ 98,000

Kronor = 1s. 1¼d.

Insulating Tapes.—We have received from the Wholesale Electrical Co., Ltd., of 54-56, Oxford Street, W., samples of the insulating tapes made by the Canfield Rubber Co., for which they are sole agents in this country. The "Voltite" rubber jointing strip is stated to be superior to pure rubber for insulating joints and requires no rubber solution, the warmth of the hand sufficing to make a perfect union between the layers; it is a highly elastic material, and certainly appears to adhere to itself very tenaciously. Another sample of standard black adhesive tape has equally clinging propensities, and is closely woven and well coated with compound.

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THE INSTITUTION OF ELECTRICAL ENGINEERS AND ALIEN ENEMY MEMBERS.

The informal meeting of Corporate Members to discuss the question of expulsion of alien enemies from membership of the Institution was held on Wednesday last week; there was again a good attendance, though many of the provincial members who attended the previous meeting were unable to be present. The President, Mr. C. P. Sparks, read a number of letters from members for and against the proposal, and stated that before calling the special general meeting to consider the resolution, the Council would ascertain the views of all the members by a post-card plebiscite.

Col. R. E. Crompton, who had to leave early, was the first speaker; he said he thought that the proposal to take the matter out of the hands of the Council indicated a want of confidence in the Council, and showed signs of hysteria, of which he was ashamed; they could afford to take the slight risk involved by having Germans amongst their members, but they could not afford to take the risk of displaying timidity or cowardice. He then left the room.

Mr. J. S. Highfield said he regarded the question as of intense importance; they might take hasty action now of which they would be ashamed in the future. The Council had not the power to expel aliens, but ought to be provided with such power. They had alien members who had become British subjects, and no *bona-fide* British subject should be ejected. Under the old German law, after a period of residence abroad for ten years a German automatically lost his original nationality, and, similarly, he lost it on taking out letters of naturalisation abroad; but a law was enacted in 1913 under which a German might obtain the permission of his Government to become a naturalised British subject and yet retain his German nationality; such a person was the worst kind of alien, and should certainly be expelled. He agreed with Col. Crompton that the powers of the Council should not be curtailed.

Mr. J. H. Rider, after reading a letter from Sir John Snell expressing his approval of the proposal, said that genuine naturalised British subjects ought not to be expelled; but alien enemies should be expelled, and never re-admitted. He disclaimed the possession of hysteria. He would have supported the original resolution if it had clearly covered all subjects of an enemy State without dispute. He concluded by proposing a resolution to expel all enemy subjects, and to exclude them permanently, also placing the onus of proof that he had ceased to be an enemy subject upon the shoulders of an applicant for membership.

Mr. C. H. Wordingham, declaring that the Council was by no means pro-German, said that they must consider only the interests of the Institution as an Institution. To him it was an offence to have to associate with a German; if not all Germans had committed crimes, at any rate, no German had dared to protest against them, or would refuse to commit them if ordered to do so. He would exclude all Germans, now and after the war, until the present generation had had time to die out. Some naturalised Germans unquestionably ought to rank as Englishmen; but there were no means of finding out whether a German had been denaturalised or not. Those who got naturalised in order to work for their own country were infinitely more dangerous than avowed Germans who were not naturalised. If a man became naturalised for the purpose of gain, was he worth having? Most naturalised Germans were closely connected with Germans in Germany, and it might be necessary to sacrifice the genuine in order to make sure of removing the traitors. There was no hysteria about him—he had always felt an aversion to Germans. Let them show signs of repentance; then we might consider the question of forgiveness. They should beware lest the trouble were allowed to recur.

Mr. W. Rutherford sympathised with the proposal, but felt that they must differentiate between those who had done many years' good work for this country and others who had not. He asked what was to be done about "neutrals" who were working in Germany against us, and pointed out that an Englishman was regarded as innocent until he was proved to be guilty.

Mr. A. Gay raised the question of voting by ballot on the resolutions, and proposed that all aliens of enemy origin, even though naturalised, should be expelled. He would not trust *any* German.

Mr. W. L. Madgen drew attention to the benefits which this country had derived from alien immigration, but supported the proposal to expel subjects of enemy States.

Mr. Ll. B. Atkinson said that the most hysterical speaker was Col. Crompton, and it was not fair that he should run away from the meeting. As for taking power out of the hands of the Council—the Council had not adequate powers at present to deal with the matter, and there was no question of want of confidence; they wanted an automatic process of exclusion. He would retain naturalised members if they were also denaturalised in Germany. His aim was to show that they would not associate with people who were hand-in-glove with this "den of thieves."

Mr. A. A. Campbell Swinton also maintained that a really naturalised alien who retained no allegiance to his native country could not be expelled. Mr. L. Joseph thought that all enemies should be dealt with, including neutral members known to be working against us in Germany, and that it was important to keep them out of the Institution. Mr. Berkeley suggested that all of enemy origin might be swept out, and those afterwards reinstated who were worthy. Mr. W. M. Mordey pointed out that a large meeting could not possibly settle a form of words; it would be better to agree on principles and leave it to the Council to embody them in a resolution.

Mr. J. C. Wigham protested against the whole of the proceedings, which he thought would not help to end the war; would the amenity of Europe never be restored? and should they imitate the Germans in petty actions, rather than risk retaining one or two dangerous members? Mr. Irwin also advocated moderation.

Mr. Frank Gill supported Mr. Mordey's proposal, and asked whether they were legislating for the present war only, or for every future war. He would prefer to leave the matter in the hands of the Council. Reading the letters of naturalisation, he pointed out that the question was a very difficult one, but that it would be better to suffer some injury than to tear up the agreement made with naturalised aliens. Britain had entered the war because Germany broke her agreement with Belgium.

Mr. J. E. Kingsbury thought they should abide by the laws, and obey the rules by which the Institution was governed. The German nation was not a member of the Institution; they had to deal with individual Germans. To expel naturalised Germans, he thought, would be improper and unlawful. A middle course was advisable, and was provided in the resolution that had been put before them at the previous meeting.

Mr. G. W. Partridge thought that not the Council, but the members should decide what ought to be done. Dr. S. P. Thompson associated himself with Mr. Kingsbury and Mr. Mordey, and thought that they should not deal with aliens *en bloc*, but should give power to the Council to act. He believed that there were no German members who had been naturalised since January 1st, 1914. The whole thing was, in his opinion, a petty matter; but he would support the resolution if the responsibility of acting was left with the Council.

Mr. T. O. Callender said that Dr. Thompson's remarks to some extent justified the suggestion that the Council was pro-German. The members clearly wished to relieve the Council of the necessity of picking and choosing aliens for attention.

The President pointed out that at the previous meeting he represented the Council, whereas on this occasion he had called upon individual members of the Council to speak, and would also speak for himself as a Corporate Member. Most divergent views were held inside the Council. Personally, he would not vote for the exclusion of naturalised members; he drew from history arguments in support of the *bona-fide* immigrant. He then put to the meeting in rotation the various points that were in question, taking the resolution which Mr. Rider had prepared as the basis. First, voting by ballot was almost unanimously rejected; the expulsion of subjects of enemy countries and of "naturalised" aliens who had retained their original nationality was approved by an enormous majority; it was decided that naturalised aliens who were formerly subjects of a State now at war with this country, but who could prove to the satisfaction of the Council that they had lost their alien nationality, should not be excluded, and finally, by a majority of 2 to 1, it was agreed that no subject of an enemy country should be eligible for election to membership of the Institution in the future.

On the proposal of the President, it was agreed that a committee consisting of the Vice-Presidents, Messrs. Highfield, Smith, and Wordingham, and Dr. Russell, and four members should settle the wording of the final resolution to be submitted to the Institution, and Messrs. Atkinson, Swinton, Gill, and Rider were nominated for this purpose. The meeting was then adjourned.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

After the War: British Engineering Trade with China.

The Electrical Review of December 24th, 1915, reached Hong-Kong only a couple of days ago. It arrived on New Year's Day, Chinese Calendar (our February 3rd). In the Far East, China New Year's Eve is the most important day of the year; not only in business, but in family circles. For on that day every debt transacted during the previous twelve months must be settled. The Chinese shopkeeper is most patient concerning credit at all other times of the year, but he does expect, and demands, payment on, or before, China New Year's Eve. The reaction follows. During New Year's Day, and almost for a week afterwards, all business is suspended. A perfect orgy of cracker firing and feasting marks the beginning of the holiday. If you are fortunate enough to have friends among the Chinese, you pay numerous calls in the morning of their New Year's Day; then, when that duty

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is done, you may enjoy that greatest of all delights for the exiled engineer, read and digest the technical papers from "home."

During the morning of February 3rd the writer called upon some prominent local Chinese. In all cases the conversation flowed mainly along trade channels. It had been a good settlement. There was plenty of money about. It seems that the Chinese are anxious to invest their money in British companies in Hong-Kong and Shanghai. There has been a most extraordinary "boom" in shipping. The Chinese are born gamblers, and they rush to the fluctuating share market. Shipping and rubber companies have been entertaining them in a manner which causes them ecstasy. My friends, who are fortunate, tell me of shipping shares which have trebled in value in the past year. Even that staid and steady institution, the Hong-Kong and Shanghai Bank, which we Britishers think as stable as the Bank of England, even that has presented to the Chinese opportunities for gambling or speculation, whichever you like to call it. When the war commenced there was a fall in the shares. If, in that August of 1914, you had faith in the British Empire and bought "Banks" at 700 dollars, you can sell them to-day for 830 dollars. Which, together with the demand for, and rise in, the shares of the British shipping companies, goes to show that faith in the British Empire has greatly increased in the Far East. It must be very annoying to those Germans who are spending all of their Boxer indemnity money, and a good deal of their own spare cash, in proving to the Chinese that the British Empire is a back number.

It is quite useless to expect the Chinese to do any work during their New Year holiday. If they were at war they would most certainly refuse to fight at such a time. There is an enforced vacation, not only for students, but for all contractors and mechanics. Since the writer is employed, normally, either in teaching Chinese students the hidden mysteries of British machinery, persuading contractors to install the same in his laboratories, or seeing that mechanics and coolies keep it in working order, he took a compulsory holiday from such things. Having paid his respects to his Chinese friends, he spent the rest of the vacation with those best of all English companions, the technical papers. And it seemed that wherever his eyes wandered, the home journals were full of trade problems and discussions.

In the issue of the Electrical Review mentioned above, the following, from the list of contents, proved of an enticing nature: First of all came the article "British Business Methods which must go." Then "Trade Statistics of the Straits Settlements." Next "Exports and Imports of Electrical Goods during November, 1915." Finally, the two pages devoted to "After the War," which gave the views of members of those two very dissimilar British institutions, the House of Lords and the B.E.A.M.A. Although the report of the discussion by members of the B.E.A.M.A. was only awarded small type, it seemed more entertaining than the opinions of Earls and Viscounts.

The first-mentioned article deals with problems of finance as applied to engineering schemes. So much has been written on this subject with reference to the market in China that little else remains to be said. It may be of interest, however, to repeat that the Chinese people do not like to pay in advance. One reason why the theatre does not flourish in their country is that they don't like paying for an entertainment of whose value they are uncertain. There is the story of the German who introduced a kinematograph at Chengtu, a place many hundreds of miles inland. It is situated in the province of Szechuan, which European geologists and mining engineers report as containing in abundance almost all the minerals used by engineers. When the picture show commenced no one would patronise it. "Fancy paying money for a thing you cannot see before you part with your cents," they said in amazement. Finally the thing succeeded; but only because money was lost at first. The astute Teuton gave a few free performances, and probably collected his money as the people left the entertainment, well pleased with themselves and the show.

The "Trade Statistics of the Straits Settlements," which give the imports of electrical and other materials into the various Straits Settlements during 1914, are important, for the people who have made the Straits Settlements are the Chinese, aided by the British Government. The latter has ensured for the former a fair field and just taxation. The former have developed the natural resources of the place. The largest individual donor to the Hong-Kong University is a Chinese millionaire in the Straits Settlements. He emigrated from a place about 100 miles away from Hong-Kong, with less than the proverbial sixpence. A combination of stable government, undeveloped natural resources, and the amazing industry which is a characteristic of the Chinese, has made this man a millionaire. One of my students tells me that even he, a great example of up-to-date enterprise in the Straits, uses the most elementary methods for working his valuable tin mines. Apparently, nearly a quarter of a million pounds' worth of electrical machinery and similar materials was sent from Great Britain in 1914. A great deal was sent from other countries. It is the Chinese who are creating the demand.

The "Exports and Imports of Electrical Goods during November, 1915," show, as a feature, the large Russian business. China and Siam—where the Chinese also flourish—took about the same as Canada. But Hong-Kong took nearly twice as much, and Hong-Kong is the distributing centre for South China. Again, the Straits Settlements took more than Hong-Kong. Japan and Korea took more than twice as much as the Straits. It is very probable that a great proportion of the goods for Japan were re-shipped to North China. The writer has evidence of the Japanese buying quantities of expensive surveying instruments in England for use on Chinese railways. These places, in the Far East, took 10 per cent. of the British exports of electrical goods, despite the fact that, during the same month, Russia took 20 per cent. of the total. After the war . . . it seems feasible that, with all of the money available at China New Year, 1916, with knowledge of the fact that money is to be made in engineering enterprise in the Far East, with the natural resources available and undeveloped—it is feasible that after the war the electrical imports to the Far East will increase.

The report of the discussions under the title "After the War" shows that, despite the terrific strain of the awful struggle in Europe, our Statesmen and our business men are really thinking out these problems of overseas markets. "Viscount Haldane . . . prophesied that when peace came we should be found less prepared for it and its problems than we were for war." But were we really so unprepared for war? It apparently took our Statesmen several months to reach a conclusion which Mr. Lloyd George announced with all the pride of a man making a wonderful discovery. "This is an engineers' war," he said, months and months after the technical papers had reminded their readers of what every engineer knew instinctively in August, 1914. The Statesman will be unprepared for the realisation that when the fighting in Europe is over there will be another war in the markets of the world. That, also, will be an engineers' war.

At the B.E.A.M.A. meeting Mr. Lee Murray put the great problem which must be solved by Britishers in a dozen words: "Having got the equipment," he said, "it was necessary to get the foreign market." This was perhaps a less explicit way of saying what Mr. T. C. Elder pointed out earlier in the meeting: "British engineering had given an amazing example of industrial development. Its productive capacity had increased enormously during the past 15 months, and the shock of peace would be more staggering if the industry did not make timely preparations. The capital invested, the plant laid down, and the workers trained, to meet war needs, must all be utilised." This is a real problem which needs carefully thinking out. The solution involves the development of the natural resources of other parts of the world. It dazzles the imagination to think of the trade boom which will come about when the natural resources of China are utilised for the use and convenience of man. Mr. Dunlop was not strictly accurate when he said "Japan had secured virtual control of Chinese internal trade." There is still plenty of opportunity for British manufacturers. The market must be cultivated.

We have seen the seamy side of German morality, even in the Far East. We have read of the Bryce Commission, the *Lusitania*, and the other infamies. In 1912—two years before the war—the writer spoke about the need for Britishers to combine against these traders. We know their brutal outlook, and we loathe them. But, just as we have copied their lead in the matter of high explosives and machine guns, so must we copy some of their enterprising methods to secure trade.

When the German Government established themselves in Shantung Province, North China, they quickly discovered that the Chinese farmers were poor. They found out that the soil was worked out, and fertilisation was done in an elementary and crude fashion. They sent out fertilisers from Germany. They notified manufacturers, and they provided a market for them. German moneylenders supplied the necessary credit. When the money came in from the first crop, which was a splendid one, they obtained good interest. Thus the Chinese farmer benefited; so did the German manufacturer of fertilisers, the German moneylender, the German shipping company. The prestige of the German increased with his trade.

Just as in this war in Europe, the British engineering manufacturer is overhauling, and will finally smash, Krupps, so will he obtain his full share of the trade which must be obtained when the war is over. He has done well in the past, but he will do much better in the future.

Wherever you go in China you will find the seven cent Mei Foo (amiable and trustworthy) lamps of the Standard Oil Co. These lamps have created an enormous demand for kerosene, so that all over China you find the kerosene tin used as a receptacle for the household fluids. A certain firm of tobacco manufacturers are as ubiquitous. Just at present China has awakened to the advantages of electric light. The metallic filament lamp is competing with the seven cent Mei Foo, even in places where they seldom see a white man. The beat of the steamship and motor-boat is heard on the inland waterways. It is all pioneer work, but it is encouraging to those who believe in progress. It was Great Britain who first saw the possibilities of trade with China, in the days of King George III. We have sufficient faith in the British manufacturing engineer to believe that he will reap a good crop in the Chinese market after the war. He will do so because he will make the necessary effort.

C. A. Middleton-Smith, M.Sc.

Hong-Kong University, *February 6th*, 1916.

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An Engineer's Wages.

I have read with interest the remarks passed under the above heading in your current paper, and as a graduate of similar qualifications as the advertiser in question, I wish to state since the conclusion of my college training, that is last June, I have been unable to obtain a suitable position, whether of a technical or practical character.

Twice my applications were not favoured even with a formal reply. All I am offered is a mechanic's work with "low wages," and I have come to the conclusion that experienced, mostly practical, men are those wanted, while qualified technical men, fresh from the college, find little encouragement in their work.

Experience.

London, *March 12th*, 1916.

"Wireless Wiring."

I see in your issue of the 3rd inst. that you have reproduced my letter to Mr. F. Miller, of the G.E.C., and I only hope that those who read it will not be led away with the idea that we are having a time of all play and no work. The original intention was to give an entertainment to our own men at Christmas, and to run the show for three evenings, but owing to the huge appreciation it met with we continued for the week. Afterwards we were commanded to run a week at each of two other places where English troops were congregated. This we did, and, I am pleased to say, gave a pleasant evening to an aggregate of over 15,000 men. . . .

I have been out here since the very commencement and am fairly well hardened, but am looking forward to that much-spoken-of period—"after the war."

Arthur E. Watts (Corpl.).

[Corpl. Watts need have no misgivings; our readers well know that their friends and brothers at the Front are not out there for fun, and there is not one who would grudge them the pleasure of an entertainment on the rare occasions when Corpl. Watts and other enterprising and able organisers have the opportunity to provide it. We only wish such opportunities were more frequent, and we congratulate our correspondent upon the striking success of his efforts.—Eds. Elec. Rev.]

Meter Transformers.

I should be extremely obliged if you or any of your readers could tell me the name and publisher of any book dealing exhaustively with the design and special characteristics of small current and potential transformers for meter work only.

Meter Engineer.

The I.E.E. and Alien Enemy Members.

The signatories to the following letter addressed to the Institution prior to last Wednesday's meeting will be obliged if you will be kind enough to publish it in your next week's issue.

W. T. Anderson.

[*Copy.*]

P. F. Rowell, Esq., *Secretary*,
The Institution of Electrical Engineers,
Victoria Embankment, London, W.C.

Dear Sir,—Several members of the Institution who cannot attend your meeting in London to-morrow feel that it may assist those present to arrive at a satisfactory resolution if they have before them a copy of the addition to the rules of the Engineers' Club, Manchester, which was adopted when the members had the same problem before them. The rule in question reads:—

"No one of German, Austrian, Turkish, Bulgarian, or other alien enemy birth or nationality, whether naturalised or not, may be introduced into the Club, either as a member or as a visitor."

It is agreed that this wording is not suitable for the Institution, but they suggest it might be modified somewhat as follows:—

"No one of German birth or nationality, whether naturalised or not, may remain a member of this Institution after (*date*) or be introduced into the Institution in the future, either as a member or a visitor."

Further wording will be necessary to bring this rule into general conformity with the existing Articles, but this may safely be left to the Council's legal advisers.

(Signed) S. L. Pearce.
W. Walker.
H. T. Wilkinson.
H. Allcock.
W. T. Anderson.

Manchester, *March 7th*, 1916.

Reflectors for Half-Watt Lamps, Etc.

In your issue of December 17th, 1915, we offered for sale by fig. 8 a pattern of reflector for half-watt lanterns, subsequently alleged by the Benjamin Electric, Ltd., to be an infringement of one of their Registered Designs. At the time of said issue we were unaware of the existence of said registered design. Without prejudice to any rights we may have, we entirely withdraw said pattern fig. 8, and all lists which may contain said pattern. Said lists by numbers 6,811-2, 6,819-20, 6,808 and 6,809 also show additional patterns alleged by the Benjamin Electric, Ltd., to be infringements of certain of their registered designs, and these additional patterns we also, without prejudice, entirely withdraw.

Townshend's, Ltd.,
E. Townshend, *Director.*

Birmingham, *March 10th*, 1916.

WAR ITEMS.

Exemption Applications.—The Trafford Park Estates Co., Ltd., appealed to the Stretford Tribunal last week for the exemption of a consulting electrical engineer on the ground that he was employed in an occupation in which it was in the national interest that he should be retained. He had attested, and was in group 21. In answer to the Tribunal, he said he resided and had his business in London, but for the greater part of each week he was in the service of the company in Manchester. The point was raised whether the attested man, being a consulting engineer, was an employé of the company, and one member suggested that the point might be referred to the Central Tribunal in London. In the end, however, the claim was disallowed.

Among a number of conscientious objectors to military service, who appeared before the Oldham Tribunal last week, were two men employed as instrument makers at the electrical works of Messrs. Ferranti, Ltd. They said they had not left their employment because they were on civil work, and the meters they made were for private houses. It was pointed out to them that they could not tell whether the work was civil work or not, and that the logical position for them was to have left their employment and found other work which they could be certain had nothing to do with the war. The members of the Tribunal made it clear that they did not suggest that the men were doing wrong in working at the electrical works named, but it was suggested that they were not acting consistently. The men were referred for non-combatant service.

At the Wigan Tribunal application was made by Mr. H. Bull, assistant electrical engineer, for the exemption of a meter inspector and repairer and tester of installations. It was stated that his services were of great value. There were men doing twelve hours' shifts in several of the departments, and if they left it was not known how they would be replaced. The electricity department had already lost 25 to 30 per cent. of its employés. Three months' postponement was granted.

The Cardiff Tramways and Electric Lighting Committee was asked to consent to an appeal being made to the Tribunal for three lighting attendants. The request was made on the ground that the department was already much depleted in staff, and that male labour could not be obtained for the work, which was unsuitable for women. The Committee declined to appeal for the men, and Councillor J. Taylor said that if the need came and the work must be done, Councillor F. W. Blower and himself were prepared to help to do it.

At the Herne Bay Tribunal Mr. A. R. J. Creasey, electrical engineer, asked for absolute exemption on business grounds, and because he was doing work of national utility. On his application the case was heard in private. On the re-opening of the court the Tribunal allowed a fortnight's exemption, adding: "This will give you, with the two months which you have got under the Act, ten weeks in all."

The "Times" states that, at the County of London Tribunal, an assistant electrical fitter and storekeeper, whose firm is engaged on an Admiralty contract, was allowed a month's postponement so that he may complete the job on which he is at present engaged.

At the Darlington Tribunal an application by an electrician, carrying on business on his own account, was refused. It was stated that since his case was heard on a previous occasion he had made no effort to wind up his business.

At Eastbourne an electrician claimed that he was in business for himself, and if called to the Colours he would have to "close down." His application was refused.

At the Bury St. Edmund's Tribunal application was made on behalf of the manager of the electricity works, and exemption granted so long as he remains in his present position. Exemption was sought on behalf of the chief working electrician employed at the works, and in his case also exemption was granted so long as he continued in his present employment.

Before the Clacton Tribunal the electrical engineer engaged by the Urban Council applied for exemption in respect of an electrician and switchboard attendant. The application was based on the grounds that the man was

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employed in public service as a temporary substitute for an enlisted man, that it took seven months to train him for the work; and that the staff at the electricity works was already reduced to a minimum. Exemption was granted conditionally on the man remaining at the present occupation.

Before the Hampstead Tribunal, an electrician engaged in business at Kilburn applied for exemption for an employé. Asked whether his application was made on the ground of national importance, he replied that he would have to give up the whole of his business. He had tried to get somebody else to do the work, but mechanics could not be found. The Tribunal said that no appeal on the ground of national importance had been made, and exemption was not granted.

The "Times" states that a manufacturer of dry batteries applied to the Islington Tribunal for the exemption of a young man to whom he had imparted his trade secret. The applicant said the making of dry batteries was largely a German business, and there were only two manufacturers besides himself in this country who had been successful in making the proper article. He had three sons at the front. He was negotiating for Government contracts. Rather than instruct another stranger in his secret he would give up the business, which employed 80 to 100 people, and sacrifice £70,000. The Tribunal decided that the applicant must get a badge for the man if he was to be exempted.

The Wolverhampton Tribunal granted a three months' extension to the managing director of a firm of manufacturers. The applicant stated that he had discovered to some extent a secret process in the treatment of steel for electrical purposes, which had been previously exclusively used in Germany.

The Imperial Tramways Co., Ltd., applied to the Stockton-on-Tees Military Tribunal for the exemption of the company's chief storekeeper and cashier on the ground of indispensability. One hundred and ninety-eight members of the staff had joined the Forces, and there was not now an unattested man of military age in the company's employ. The Chairman granted postponement for three months, with liberty to apply again.

At Nelson Tribunal, on March 9th, the Tramways Committee appealed in respect of the traffic clerk. Captain Smith (for the military) said the clerk was not fully experienced, and was only put in the position recently. The Tramways Committee could put a rejected man in his place. The tramways manager said the trams would have to stop if the man went. It was absolutely impossible to go on working. The department had been reduced materially. Only 13 were employed on work similar to that they did before the war. A month's exemption was granted.

At Blackpool Tribunal, on March 9th, Mr. Furness, electrical engineer, appealed for four single men employed in his department. The Mayor said the men were indispensable. There were 107 men at the beginning of the war, and 43 had enlisted. Mr. Furness had been one of the keenest recruiters on the committee. These were technical men whom it would be impossible to replace. Mr. Furness said the men were sub-heads of departments. He was not there on personal grounds, but as representing the Corporation. One was engineer-in-charge, and when on shift duty was responsible for all the machinery. If he could replace them with married men or men unfit for service he would do so. It was beyond human endurance to expect men to go on week after week doing two men's work. There were 30 to 50 advertisements appearing every week in the electrical papers seeking engineers and offering them war badges as a protection from military service. He would not keep any man out of military service if his place could be filled. Conditional exemption was granted.

At Southport, last Friday, Messrs. F. W. Smith & Co., Ltd., electrical engineers, of Southport and Manchester, sought exemption for James W. Smith, the manager of the Southport office and a director of the firm. It was urged that he was in a "starred" trade, but the military representative said that he could find nothing in the list of reserved occupations except relating to electricians connected with public electricity supply works. Postponement to May 1st was granted.

Electrical and other Companies to be Wound Up.—Further orders, issued by the Board of Trade under the Trading with the Enemy Act, 1916, require the following businesses to be wound up:—

Electrical Co., Ltd, 122-124, Charing Cross Road, London, W.C. Controller: Maurice Jenks, 6, Old Jewry, London, E.C.

Balashol Belting Co., Ltd., 13, Lambton Street, Sunderland. Controller: William Swan, 31, Moxley Street, Newcastle-on-Tyne.

British Graetzin Light, Ltd., 26-36, Chapter Street, Westminster, S.W. Controller: Thomas Wise, Bassishaw House, Basinghall Street, E.C.

Jaeger Bros., 9, Rathbone Place, Oxford Street, W., manufacturers and suppliers of electric lighting accessories. Controller: Maurice Jenks, 6, Old Jewry, London, E.C.

Hanover Rubber Co., 105, Goswell Road, London, E.C., rubber goods merchants. Controller: Geoffrey Bostock, 21, Ironmonger Lane, E.C.

Exports to China.—The "London Gazette," of March 10th, contains a further list of seventeen bodies or persons to whom articles to be exported to China may be assigned.

Women in Industry.—The President of the Board of Trade, after consultation with the Home Secretary, has appointed an advisory committee with the following terms of reference:—

1. To advise the Board of Trade and Home Office on questions arising from time to time out of measures required to be taken by those departments to give practical effect to the policy of His Majesty's Government of extending the employment of women in industrial occupations so as to enable essential industries to be maintained in spite of the depletion of their supply of male labour by recruiting for war purposes; and

2. To watch and report from time to time on the progress made in different localities and industries in the extension of the employment of women.

Mr. F. Lavington, of the Board of Trade, and Mr. M. H. Whitelegge, of the Home Office, have been appointed joint secretaries to the committee.

Birmingham and Enemy Contracts.—At Birmingham City Council last week Sir William Bowater, replying to a question, stated that the Manchester resolution urging that no contracts should be entered into with enemy firms, had been discussed by the General Purposes Committee, but it was not considered necessary to deal with the question. "Some councils in the country," he added, "seem to have time to pass abstract resolutions, but we have not here." The General Purposes Committee thought the best thing to do was to order the resolution to lie on the table.—"Morning Post."

An Ediswan Piano.—A concert was recently held at the Edmonton Military Hospital, at which a piano, stool, and invalid chair were presented by the Ediswan staff and employés. The idea of the presentation originated with Miss F. Wootton, a member of the Ediswan staff at Ponders End, who started a collection amongst the staff and employés of the company, a grand total of £33 being got together. The talent on the occasion of the concert was chiefly contributed by those in the service of the Edison and Swan Co.

An Electrician!—At the Richmond (Yorks.) Tribunal, an electrician applied for exemption on conscientious grounds. Replying to questions, he declared that he would do nothing to oppose the landing of Germans in England, and expressed the opinion that he would be as well off under German as British rule. If women were violated he would not interfere, but would look upon such incidents as accidents. At this stage the Tribunal declined to listen further, and refused the appeal.

Enemy Trade in Egypt.—The "Times" correspondent at Cairo says that the Egyptian Government has appointed a special Commission on Commerce and Industry to examine the extent to which the industries and commerce of the country have been affected by the war, and to propose measures for opening up new markets for Egyptian products and for replacing articles formerly obtained from enemy countries by articles either locally produced or imported from non-enemy countries.

War Relief Funds.—Since September, 1914, the employés of the India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd., at Silvertown, have been contributing to various funds, and the total is now £1,300. Nearly £700 has been sent to the Prince of Wales's Fund, nearly £350 to the British Red Cross Society, £260 to the Belgian Relief Fund, and lately contributions to the Serbian Relief Fund and the Anglo-Russian Hospital at Petrograd, have been started.

"No Room for Germans."—This is a familiar battle-cry of our Australian brothers in their fight against German trade influence, and we read that the Sydney Legislative Assembly has passed the first reading of a Bill to disqualify, during the period of the war, all enemy-born subjects from voting at municipal and parliamentary elections.

The Foreign Trade Department.—The daily press states that a list of business men to act in an advisory capacity has been submitted, at the request of the Foreign Trade Department, by the London Chamber of Commerce.

Swansea Corporation Contracts.—A special committee of Swansea Corporation has resolved that no contract shall be entered into with any person of German or Austrian birth, or with any firm controlled by such persons.

Russia and the Trade War.—More than a thousand members of the Russian War Industries Committees have assembled in Petrograd to report progress and to concert more intensive action.—"Times."

No German Members.—The Council of the London Chamber of Commerce has resolved that no German or Austrian born subject, naturalised or not, shall be eligible for election as a member of the Chamber until otherwise determined by the Council.

Electric Motor Vehicle Construction in the United States.—**According to a report lately issued by the U.S. Bureau of the Census, in Washington, the number of electric motor vehicles constructed in the United States during the year 1914 was 4,715, an increase of 22·9 per cent. over the output in 1909.**

Electrical Trades Benevolent Institution.—**The annual meeting of this Institution will be held at the Institution of Electrical Engineers, on Monday, 27th inst., at 2.30 p.m. The report and accounts for the year will be submitted, and members of the Committee of Management and the auditors will be elected.**

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NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Lineman's Shoe.

An American company has developed a new insulating shoe for electrical workers; throughout their entire life a pair of these shoes, the manufacturer states, will provide the wearer protection against circuits at pressures up to 20,000 volts, and will not cause the discomforts of many rubber shoes.

The shoes contain no cement and have no seams, but are vulcanised into a solid piece under high pressure on aluminium molds. No hand work is employed in the process.

The white soles are made of a rubber composition like that employed in certain types of coal miner's shoes, which have been found to give 18 months of constant wear. When this white sole wears through, a layer of red rubber, which will itself withstand a pressure of 20,000 volts, is exposed. The appearance of the red rubber is a signal or reminder to the wearer that, although his shoes will still withstand 20,000 volts, a new half sole should be immediately cemented or vulcanised in place. No metal is used in any part of the shoe.—*Electrical World.*

Western Electric Interphones.

The Western Electric Co., Ltd., of Norfolk House, Victoria Embankment, W.C., have brought out a neat and well-made pattern of intercommunication telephone, as illustrated in fig. 1.

The case is of walnut, with plated fittings, and the hand microtelephone switch is arranged so that the same instrument can be adapted for use either as a table set or wall pattern; pressing the button of the line required, both selects the line and rings up the station, and to answer it is only necessary to remove the hand-set from the switch. Replacing the hand-set automatically restores all the keys to the normal. The system is arranged for central-battery working, so that only two batteries are required, one for speaking and the other for ringing. Standard sizes are made for 6, 12, 18 and 24 buttons. It is claimed that by the judicious combination of light metal framework, light woodwork and ornamental plated fittings, an instrument strong enough to stand the heaviest service, and yet neat in appearance and of small dimensions, has

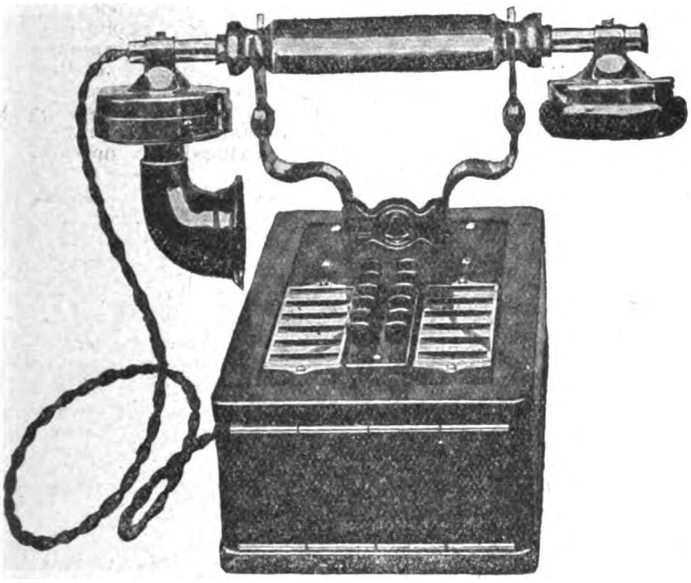

Fig. 1.—Western Electric Co.'s Interphone.

been devised, and certainly we can find no fault with the result, either inside or outside the case. For convenience of examination and adjustment, the top cover opens on a hinge, and, for access to the cabling, the whole body is hinged to the backboard. The hand-set is fitted with a capsule transmitter and a bipolar receiver.

Electric Invalid Chair.

There has recently been illustrated in the *Daily Mirror* and elsewhere, an electrically-propelled invalid chair of a type which is excellently adapted for the use of convalescent patients in hospitals, and, indeed, for use on the sea-front promenades around our coast and at inland health resorts.

This chair, which has been constructed by the Elieson Electric Traction Co., of 85, Newman Street, W., and is the invention of Mr. C. P. Elieson, is equipped with an Elieson 40-volt traction battery, carried under the seat, which supplies current to a low-speed motor, of about ¼ H.P. rating, which is fitted under the hood in front of the vehicle, and drives by means of a vertical shaft and worm gear, giving a 20 to 1 speed reduction, the two front wheels of the chair. The occupier of the chair controls its movements by a small lever placed on one side of the chair, which gives four speeds, and in a fifth position applies a band brake sufficiently powerful to hold the vehicle on a hill. A small interlocked reverse switch near the control lever provides for the same speeds, &c., being obtained by the latter in a reverse direction.

The chair weighs roughly 2¼ cwt., the battery accounting for 60 lb., and the apparatus over the front wheels about 80 lb., of which the motor weighs 35 to 40 lb.

On a normal charge the carriage will travel some 20 miles on a level surface, the battery discharging at the rate of 4 or 5 amperes

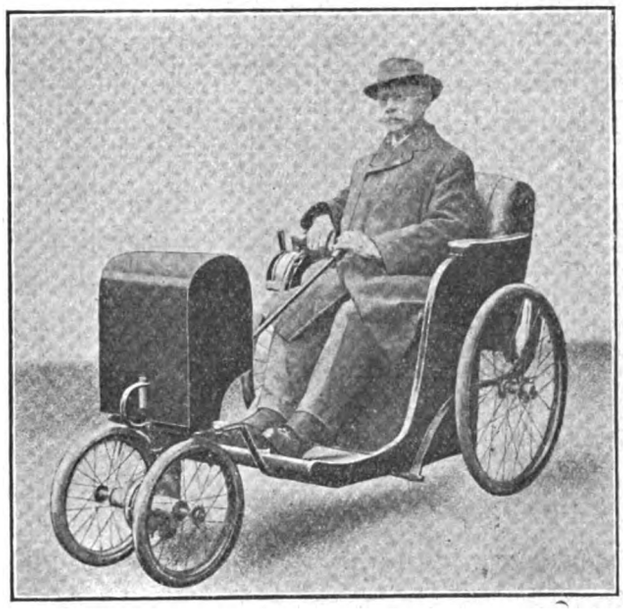

Fig. 2.—Elieson Electrically-Propelled Chair.

under such conditions and the speed being 4 or 5 miles an hour. We illustrate in fig. 2 the electrically-propelled chair, with the inventor, Mr. Elieson, at the helm; we understand that the vehicle attracted considerable attention at one London hospital where its capabilities were informally demonstrated, and judging by the interest taken in the first announcement of its appearance, there should be a considerable future for it.

LEGAL.

The War and German Telephone Contracts.

In the King's Bench Division, on Monday, Mr. Justice Bray had before him an action brought by the Birmingham Private Telephone (New System) Co., Ltd., against the Deutsch Privat Telephon Gesellschaft and H Fould & Co., of Frankfort-on-Main, and Mr. Alfred Gunz, formerly chairman and managing director of the plantiff company, and now interned as an alien enemy, for a declaration that three contracts, dated January 4th, 1911, were determined by the outbreak of war, and ceased to be binding.

Mr. Disturnal, K.C., appearing for the plaintiffs, said that they were an English company incorporated in August, 1911, and carried on business as dealers in private telephone installations. The company was promoted by Mr. Gunz to take over and work in the Midland Counties three contracts between himself and the German company, by which he held the exclusive right to dispose of the German company's goods in the counties of Stafford, Worcester, Warwick and Salop, and agreed not to buy or deal in any other apparatus than that sold by the German company. The contracts were to last for 35 years, and they were terminable by six months' notice. Mr. Gunz also undertook to form a company to take over the obligations and benefits of the contracts. Though the plaintiff company was formed in 1911, Mr. Gunz did not make a formal assignment of the benefits and obligations of the contracts before the outbreak of the war, but the companies worked together as if such an assignment had been made and the plaintiff company had been substituted for Mr. Gunz. In November, 1914, however, he purported to execute an assignment of the contracts to the plaintiff company. Mr. Gunz had since got rid of his shares in, and ceased to be a member of, the company, which was now being worked with English capital and by English directors. But it was impossible for the company to carry on business unless it could enter into contracts for the purchase of goods from English manufacturers. Therefore, the company came to the Court and asked for a declaration that the contracts between Mr. Gunz and the German company were determined by the outbreak of the war.

Mr. F. T. Jackson, managing director of the plaintiff company, said that the capital of the company was £2,500. Up to the outbreak of war the plaintiff company had disposed of about 2,000 instruments and the average price was about 55s. each. Since the war Mr. Gunz had ceased to be a director and shareholder of the company. The present directors and shareholders were all British subjects. There were about seven similar companies in this country.

Mr. Hogg (for Mr. Gunz) said his client had no interest in the contracts, and did not want to do anything to interfere with any right the plaintiff company might have to any declaration his Lordship thought fit to grant. But, as he had been made a

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defendant to the action, he desired to take the point that German contracts should be construed according to German law.

Mr. Justice Bray thought that unless the contrary was proved the presumption was that the German law was the same as the English law.

Mr. Hogg said there might be a difference between the German law and the law of this country on the point whether the contracts were dissolved or suspended by the outbreak of war. As to the royalty of 1·60 mark, counsel submitted that the liability to pay that sum was not extinguished by the war. Under the contracts certain apparatus had to be supplied by the German company to Mr. Gunz, who had a specified time within which to take them over. At the outbreak of hostilities a great deal of stock belonging to the defendant company was in the possession of the plaintiff company. If it had not been taken over that stock remained the property of the German company, and the plaintiffs had no right to take it. Therefore in any declaration his Lordship made it was necessary to safeguard the position with regard to apparatus not taken over by the plaintiff at the outbreak of war.

Mr. Justice Bray granted a declaration that the contracts were determined at the outbreak of the war. The royalty of 1·60 mark, he said, formed no part of the price of the goods, but was part of the consideration which the German company received as long as the contracts continued. As the contracts had been determined, the right to the 1·60 mark ceased. He did not think it was necessary for him to deal with the last question raised by Mr. Hogg with regard to the goods consigned by the German company.

Judgment was entered for the plaintiff company, without costs.

British Thomson-Houston Co., Ltd., *v.* Stonebridge Electrical Co., Ltd.

Mr. Justice Younger in the Chancery Division on March 10th heard a procedure summons taken out by the plaintiffs in this action asking for further and better particulars of the defendants' particulars of objection to the plaintiffs' patent.

Mr. Hunter Gray, for the plaintiffs, said they were suing in respect of an alleged infringement of patent, and by the present summons they were asking for further particulars of the objections raised by the defendants against the validity of the plaintiffs' patent. The point raised by the summons was a somewhat important one, and dealt with the objection of the defendants that the plaintiffs' invention was not good subject matter for a patent by reason of the common and public knowledge at the date of the letters patent. There was a difference, contended counsel, between common and public knowledge. Common knowledge was what was known to be in the possession of every person in a particular trade or business. On the other hand, public knowledge was only something that was available to everybody who desired to possess it. No particulars of common knowledge were required. Where a patent was alleged to be bad because certain knowledge was to be found in some document, then, he argued, particulars of the document should be given. He submitted that on every ground on which a patent was disputed the defendant must give such particulars as would enable the issue to be brought properly before the Court. It would not be right that the plaintiffs should be met at the trial with a document of which they had never heard.

Mr. Frost, representing the defendants, submitted that there was no such distinction to be drawn between common and public knowledge as that attempted to be drawn by Mr. Gray, because public knowledge was common knowledge. There it was enough for the defendants to say it was public knowledge that tungsten could be drawn, and it was not necessary to give page and passage in some document. Plaintiffs did something so obvious that it could not be an invention. There was no need to give the reference on which they relied.

Mr. Justice Younger: Must not the plaintiffs know the basis or grounds for your objection that it was public knowledge?

Mr. Frost said he would prove that by evidence. The plaintiffs asked for documents, as if public knowledge could only be proved by documents. If they had to give particulars the plaintiffs would say that having alleged a specific document they were not entitled to rely on any other document unless they amended their pleadings.

Mr. Gray was heard in reply, and at the conclusion of the arguments his Lordship reserved judgment.

Belfast Slander Action.

The Master of the Rolls, in the Irish High Court, refused, with costs to the plaintiff, an application on behalf of the defendant in the action by Mr. A. B. Farrell, resident superintendent of the Belfast central electrical station, against Mr. T. W. Bloxam, Belfast city electrical engineer, for alleged slander in connection with work at the station, for leave to issue an interrogatory. It was urged that plaintiff had obtained an order for interrogatories, and that defendant had complied with the order. Defendant now wished to interrogate the plaintiff as to the reason why he believed the alleged slanderous words were spoken maliciously. The application was opposed on plaintiff's behalf.

British Electric Traction Co., Ltd.
[Capital Reduction.]

In the Court of Appeal composed of the Master of the Rolls and Lords Justices Phillimore and Warrington on Friday, the hearing was resumed of the appeal of the Public Trustee, as the executor of the late Mr. Leopold Salamons, the holder of £12,960 non-interest bearing income certificates of the British Electric Traction Co., Ltd., from an order of Mr. Justice Astbury, sanctioning, upon the petition of the company, a reduction of its capital, and also sanctioning the scheme of arrangement so as to bind the various classes of shareholders and also the holders of income certificates issued by the company. By the scheme of arrangement as sanctioned by the judge, the non-interest bearing income certificate holders were given in full satisfaction of their certificates 10 per cent. of their face value in new cumulative fully-paid preference shares, and 25 per cent. of their face value in fully paid ordinary stock. The case for the appellant was that he was not bound by the scheme, as it might be that the acceptance by him of the shares as fully paid would involve him in some future liability.

At the conclusion of the arguments of Counsel, their Lordships dismissed the appeal with costs.

BUSINESS NOTES.

American Electrical Exports.—The American *Electrical Review and Western Electrician* says that the total value of the electrical exports for last November broke all previous monthly records. The November total exceeded that of a year ago by nearly 67 per cent. For the four electrical classes for which quantities shipped are given in the Government reports, there were exported last November the following:—Electric fans, 3,943; arc lamps, 114; carbon-filament lamps, 121,672; metal-filament lamps, 658,005. The classified electrical figures for the month are as follows:—

	Nov., 1915.	Nov., 1914.
Batteries	$184,903	$44,136
Dynamos or generators	58,850	112,784
Fans	55,849	3,825
Insulated wires and cables	302,089	78,652
Interior wiring supplies, &c. (including fixtures)...	79,580	53,189
Lamps—Arc	2,115	860
Carbon-filament	13,186	5,408
Metal-filament	98,703	22,379
Meters and other measuring instruments	85,113	32,061
Motors	293,540	337,792
Telegraph instruments (including wireless apparatus)	12,154	3,350
Telephones	30,308	143,777
Transformers	170,632	115,955
All other	1,357,825	690,555
Total	$2,744,847	$1,644,723

Book Notices.—*Universal Electrical Directory.* 1916. London: H. Alabaster, Gatehouse & Co. Price "A" Edition, 12s.; "B" Edition, 21s.—The thirty-fifth annual edition of this directory has just been published. It takes its now very familiar form, and is divided up into a number of sections, giving home, Continental, Colonial, and general, also American, names and addresses in alphabetical order, and arranging the principal of these in classified trades' sections. The British geographical section appears as usual, and should prove as useful as ever, as should also the exhaustive and valuable collection of particulars concerning electric light and power systems in all parts of the world. For those at home who are interested in Colonial and foreign trade development it possesses a special usefulness at such a time as this, and for the buyer abroad it brings together in an up-to-date form all the particulars that he requires in order to get into touch with makers of British manufactures of which he is in need.

"*Proceedings* of the Physical Society." Vol. XXVIII, Part 2. February 15th, 1916. London: The *Electrician* Printing and Publishing Co., Ltd. Price 4s. net.

"Electrical Apparatus-Making for Beginners." By A. V. Ballhatchet. London: Percival Marshall & Co. Price 2s. net.

The Central, Vol. XII, No. 38, contains articles on "The Hardening and Annealing of Metals," by R. G. Parker, and "The Photographic Industry," by F. F. Renwick, as well as the usual "Old Student Notes," Reviews, &c.

"Wiring Rules" of the Institution of Electrical Engineers. Seventh edition. London: The Institution, or Messrs. E. & F. N. Spon, Ltd. Price 6d. (post free, 7d.).

Electric Light Switching Competition.—We are informed by Messrs. A. P. Lundberg & Sons that all past records have been well beaten in regard to the number of answer papers received in respect of the examination questions sent out by them last month. We also understand that the quality of the papers is exceptionally high in all three grades. For the first time the ladies have entered the field. There are still the papers to come in from oversea competitors, who are naturally given a longer time to compete.

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Patent Restoration.—An order has been made restoring Patent No. 24,949, of 1910, granted to Heenan & Froude, Ltd., and Fred. Harrison, for "Improvements in Dynamometers."

Bankruptcy Proceedings. — J. R. Whitehouse, managing director of an electrical company, Golder's Green. Receiving order made on March 9th at Barnet, on a creditor's petition.

G. J. T. J. Parfitt, consulting electrical engineer, Keynsham. —Trustee released, February 10th.

German Samples from Brazil.—The Board of Trade Commercial Intelligence Branch in London has received from the Acting British Consul-General at Rio de Janeiro samples of German electrical goods imported into Brazil. These may be seen at the Foreign Samples Section at 32, Cheapside, E.C. They include brackets, lamp sockets, porcelain rose sockets, porcelain insulators, fuses, commutators, bell accessories, reflectors, &c.

Trade Announcements.—Messrs. Ernest G. Denner and Co., wholesale electrical engineers, of West Street, Sheffield, have taken new premises with stores, at 284, Glossop Road, where all communications should be addressed. The stores are in Victoria Street.

Messrs. Thermit, Ltd., with a view to centralising their business, have removed their registered offices to new premises recently erected at the works, 675, Commercial Road, London, E. Telephone No.: "East 4157."

C.T.S. Authorised. — The St. Helens Cable and Rubber Co., Ltd., draw our attention, with pardonable pride, to the fact that under the title "tough rubber compound protection" the Institution Wiring Rules, as newly revised, recognise and approve of the use of cab-tire-sheathed cable without conduits or wood casing (Rules 33 and 65). The company, however, do not propose to substitute "T.R.C.P." for the well-known "C.T.S."

Catalogues and Lists.—Messrs. D. Hulett & Co., Ltd., 55 and 56, High Holborn, London, W.C.—Illustrated circular stating prices of special shades for screening electric lamps.

Teleklyt Cable and Para Rubber Co., 38, Bath Street, Glasgow.—Illustrated circular giving prices and particulars of pocket voltammeters and voltmeters, also switchboard surface meters.

LIGHTING AND POWER NOTES.

Accrington.—Ald. Higham speaking recently on the subject of the electricity department, said the minimum of extensions were being carried out to enable them to cope with increasing demands, and would only partly remedy their difficulties, the plant being seriously overloaded. If the gas plant was not doing all that was expected, it was due to inability to get suitable fuel for the producers and to by-products being commandeered. He anticipated a heavy and unavoidable loss on the year's working.

Ashton-under-Lyne.—Price Increase, &c.—After the current quarter, charges for current are to be increased by 10 per cent. for lighting purposes and by 25 per cent. for direct-current power and heating purposes.

The borough electrical engineer, his assistant, and the mains superintendent have applied for remuneration for extra services necessary through the depletions of the staff caused by enlistments, and it has been decided to grant a bonus of £100 for the year commencing March 25th next.

Bradford.—The Finance Committee of the Guardians recommends agreement with the proposal to light the new buildings at Bowling Park Colony with electricity, and that a guarantee be given to the Corporation ensuring a minimum revenue of £150 per annum for a period of seven years.

The Electricity Committee has given instructions for the preparation of the foundations for the proposed new cooling plant, and to obtain quotations for the requisite additional feed pumps; application is to be made to the L.G.B. for the necessary borrowing powers for the additional plant.

Burton-on-Trent.—Price Increase.—To meet the extra cost of coal, amounting to about £2,000, the Electricity Committee has decided to increase the price of electricity by 15 per cent., as from March 31st. The question of insuring both the electricity and gas works against air raids has been considered and they are to be fully covered.

Canada.—The Ontario Government has decided to purchase, for £1,670,000, the Consolidated Electric Power Co. and 22 subsidiary companies operating in Central and Eastern Ontario. The acquisition of these concerns will enable the Government to duplicate in Eastern Ontario the work already done by the hydro-electric system in Western Ontario.

Church Stretton.—Prov. Order.—The U.D.C. has given its consent to the Church Stretton Electric Supply Co.'s application for a provisional order for the supply of electricity within the urban and rural districts of Church Stretton.

Continental. — Italy. — Half-Watt Lighting. — According to the Italian journals a good deal of attention is being given to the substitution of half-watt lamps for arc lamps in the streets of Italian cities. As mentioned on p. 286 of our last issue, the authorities in Rome have largely adopted this type of lamp and a similar substitution of lamps is occurring at Brescia, Parma, Naples, &c. At Brescia some 400 ½-watt lamps, of 600-c.p. size, are now in use in the principal streets, the lamps being supplied in groups through 24-kw. transformers, or in emergency from the private supply network. It is held that there are considerable operating advantages in this type of lamp, but it requires more current and the light falls off in time. At Parma there are installed 250 680-c.p. lamps, which are run in series groups and provided with supplementary resistances. About 50 100-c.p. lamps have also displaced gas lamps, and the results are regarded as technically and economically satisfactory. At Naples an experimental installation of 60 ½-watt lamps is being made in place of arc lamps in the city's principal street; these will be run in series of 10, with supplementary resistances, with a view to using existing lighting circuits.

Owing to avalanches in the Agondo Valley, the Falcade electric works and many other buildings, have been destroyed.

Dover.—The Government has renewed a loan of £157,000 for seven years from May 6th, with power to pay off at six months' notice after five years, the rate of interest to be ½ per cent. above the rate payable on the last War Loan, with a minimum of 5 per cent. The L.G.B. has sanctioned a loan of £3,814 for new cable.

Dublin. — Estimates.—A report submitted by the Electricity Supply Committee to the Estates and Finance Committee in connection with the general rate estimates for the coming year, states that the sales to March 31st should work out at 8,529,826 units, comprising 4,339,364 lighting units and 4,190,462 power units, the former a decrease, compared with 1915, of 69,167 units, and the latter an increase of 345,595 units. The receipts should work out at £113,297, an increase of £18,386 over 1915. Taking into account the surplus brought forward from the 1915 accounts of £7,940, together with the anticipated surplus from the current year's working, it is expected that the income for 1917 will meet the running and maintenance expenses, and provide for the annual capital charges, provided that the cost of coal does not exceed 27s. 6d. per ton. The estimated increase in expenditure is £11,325, and it is pointed out that the cost of coal increased by £11,523 over the previous year, and the cost of carbons by £645, while the cost of general maintenance materials rose by from 25 per cent. to 65 per cent. The Estates and Finance Committee concurs in the views expressed in the report.

Eastbourne.—Price Increase.—The T.C. has decided to increase the charge for electricity for lighting purposes from 5d. to 5½d. per unit, as from April 1st next.

Edinburgh.—Heating Charges. — The E.L. Committee has decided, with a view to abolishing duplicate wiring and meters, to adopt the system in use in Glasgow for charging domestic consumers, *i.e.*, to charge the consumer for a fixed number of units for lighting, the amount being based on the average use by such consumers, and to charge all units in excess at a low rate, in this case 1½d. per unit. The scheme will come into force on May 15th.

Exeter.—Workhouse Lighting.—The B. of G. has, by 10 votes to 7, rejected a proposal in favour of deferring until after the war the introduction of the E.L. in Block 3 of the institution, at a cost of £50 or £60.

Glasgow. — Fire. — According to the daily papers, damage amounting to £2,000 was caused by a fire in the electric generating building of the Victoria Infirmary recently.

Ilkeston.—The Tramways Committee has fixed the lighting rate at 4d. per unit, with reductions for quantity; for power the charge will be 2¼d. to 1½d., according to consumption, and for heating, &c., 1¾d. per unit. Electricity supplied through prepayment meters will be charged 4½d. per unit.

Ipswich.—Tale of a Destructor Loan.—The L.G.B. has refused sanction to a loan for £5,200 for duplicating the refuse destructor, apparently because the Council entered into contracts for the plant before the work had been sanctioned. It appears that the latter course was taken under pressure by Government departments, including the L.G.B. itself, and this fact is to be brought to the notice of the latter, with a view to its sanctioning the borrowing of the money.

London.—Hampstead.—The B.C. has adopted the recommendations of the Electricity Committee that the estimated deficit, £3,528, for the year ending March 31st next, on the Council's electricity undertaking, shall be met out of the reserve fund; and that the charges for electricity be increased by 10 per cent. as from the beginning of the next December quarter, and that six months' notice to this effect be given to all consumers.—*Hampstead Express.*

Fulham.—The Electricity Committee recommends an expenditure of £950 on cables and equipment to supply Townmead Engineering Works, which firm has guaranteed the Council a revenue of not less than £1,000 during a period of three years.

With reference to the linking-up of the Battersea and Fulham electricity undertakings, the Committee has received an application from the Battersea B.C. for a supply of at least 700 kw. for

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the ensuing year; it is probable that the Battersea demands may amount to some two or three million units per annum, and, under the agreement, the cost per unit payable to the Fulham Council will be materially affected by the price of coal.

The Battersea B.C. having made satisfactory arrangements for coal supply for the next 12 months, anticipates that, in view of the supply of electricity in bulk, its coal contracts may exceed its requirements, and suggests that the Fulham Council should accept the transfer of 4,000 tons of coal at 20s. 7d. per ton.

Lowestoft.—Price Increase.—The T.C. has agreed to an increase of 10 per cent. in the charges for electric lighting and heating supply.

Middlesbrough.—The Corporation Finance Committee has ordered that no profits shall be taken from the electricity and gas undertakings in relief of rates, as owing to the L.G.B. refusal to sanction capital expenditure, it will be necessary to utilise profits for extensions during the ensuing year. The electricity department last year contributed £2,000 towards the relief of rates.

Newmarket. — Street Lighting. — The Electricity Co. has refused the offer of the U.D.C. to pay £1 per lamp per annum for certain public lighting on account of restricted lighting, and has asked for £4 per lamp. The matter has been referred to a Committee.

Shaldon.—E.L. Scheme.—The Teignmouth U.D.C. has informed Dr. J. Purves, with reference to the establishment forthwith of an E.L. installation at Shaldon, that, upon the work being completed, the Council is prepared to pay for public lighting by electricity at an agreed sum, but without any minimum payment as to restricted lighting.

Sheffield.—Amongst the "considerable items" of new capital expenditure by the Corporation, recently mentioned in the "Current Topics" column of the *Sheffield Daily Telegraph*, is £307,000 for electric power extensions. The electricity department's revenue for the year now closing is estimated at £277,000, or £150,000 more than in 1914. Seven years ago the receipts were only £77,000. The writer of the column proceeds to advocate an increase in the price of electricity, apparently with a view to the department emulating the tramways "as a popular reducer of the rates," and forgetful that cheap electricity may be achieving the same result in a less ostentatious manner.

Southport. — A large electric cooking installation has been fitted at the Southport station of the L. & Y. Railway.

St. Anne's.—The electrical engineer to the D.C. reported that the sale of energy for lighting and traction purposes in January showed a decrease, but the increase in the consumption for power purposes enabled the department to show an increasing total output.

Stafford.—For the purpose of extending the Corporation's electricity works, the Council has decided to purchase the adjoining land for £1,000, subject to the approval of the L.G.B.

Swansea.—Electric Cooking.—Subject to the approval of the Board of Education, the Education Committee proposes to install electric irons and a cookery stove at the domestic subjects centre. The Electricity Committee has instructed the engineer to make arrangements with the present contractors for the supply of coal to the electricity station for the continuance of their contract for a period of one month, and recommends that, in the meantime, tenders be invited for a supply for periods of three, six, nine, and 12 months respectively.

Torquay.—Loan Sanction.—The L.G.B. has informed the T.C. that it is prepared to sanction loans of £1,578, £3,518, and £3,550 for electricity purposes, and £3,252 on account of the new electricity plant.

U.S.A.—The Northern California Power Co., of San Francisco, like several other companies, has taken advantage of the present high price of aluminium to dispose of certain of its transmission lines, for which copper lines of increased capacity have been substituted. The proceeds of the aluminium wire taken down have been sufficient to cover the cost of copper wire of greater capacity together with the labour and other costs involved.

Walsall.—Motor Hiring.—The Electricity Committee of the T.C. has made arrangements with the British Thomson-Houston Co., to supply motors on the deferred payment system. The department will install the necessary wiring where such motors are supplied to consumers. Finding it difficult to obtain suitable men to fill the vacancies, the electrical engineer is applying to the War Office for the return of a shift engineer and substation attendant, who have enlisted.

Weybridge.—The Urban Electric Supply Co., Ltd., has applied to the U.D.C. for consent to erect overhead wires to supply a local works. The request has been referred to a Committee for consideration.

Whitehaven.—New Plant. — Permission has been given for the manufacture for the Council of a 150-kw. generator; and the order is to be placed as soon as possible, and the cost met out of revenue.

Wigan.—We understand that Mr. S. L. Pearce, of Manchester, has informed the Corporation that he is unable, at the present time, to undertake the preparation of a report on the Council's electricity undertaking, as proposed by the T.C. and mentioned in these notes last week.

Wolverhampton.—Loan Sanction.—The L.G.B. has sanctioned the borrowing by the T.C. of £1,085, for laying mains to supply local firms.

The estimates for the year were recently considered by the T.C., when it was remarked that no contribution of profit from the electricity undertaking was included; Councillor Evans mentioned that a report on the subject was expected, and further intimated that the Council had a right to expect that arrangements would be made to ensure the customary dole to rate relief next year.

TRAMWAY and RAILWAY NOTES.

Accrington.—Tramway Collision.—On Saturday two cars on the Clayton-le-Moors route came into collision in Whalley Road, Altham; both cars sustained damage, and the driver of one was seriously injured.

Bristol.—Tramway Purchase.—At a meeting of the City Council last week, the Tramways Option Committee reported the result of its negotiations with the Tramways Co., as to what rent or other sum the company would be willing to pay and what concessions it would be willing to make to the Corporation if the latter agreed to refrain from exercising its option of purchasing the undertaking for seven, 14, or 21 years. The Committee states that the company is unwilling to make any payment in the nature of a wayleave, or to make such adequate concessions in the way of revision of fares or otherwise as in the Committee's opinion it would be justified in recommending the Council to accept in consideration of the Corporation refraining to exercise its option. Having regard to existing circumstances, the Committee is not prepared to make any recommendation at present on the main point, viz., the advisability of the purchase of the tramways. It, therefore, had come to the conclusion that until the time for advising the Council arrives, it should be authorised from time to time as and when necessary to apply to the Board of Trade for any further order extending the purchase period.

The City Council has decided to apply to the Board of Trade to postpone the date for the purchase of the tramways.

Bury.—Female Labour.—For the first time locally, female conductors were at work last week on the Corporation cars.

Continental.—Italy.—The Camera di Commercio, of Genoa, has approved of a scheme for the electrification of the Genoa to Ovada Railway, at present worked by steam. The electrification is rendered necessary by the congestion of traffic from the Port of Genoa.

A motion has been presented in the Consiglio Provinciale, of Florence, declaring necessary the abolition of steam traction and the substitution therefor of electricity, on the railway lines Florence-Campi-Prato, Florence-Poggio a Caiano, and Casellina-Porto di Mezzo, as soon as the Provincial Deputation shall judge the moment opportune, and in view of the circumstances connected with the war.

Spain.—The engineers entrusted with the surveys for the direct electric railway from Madrid to Valencia have completed their work with the exception of that relating to the Madrid terminus.

Dundee.—On the suggestion of the Corporation tramway manager, the Corporation electricity department, which controls the overhead equipment of the tramways, has fixed up an automatic trolley reverser at the foot of Reform Street, and should the device work successfully, it will be adopted on the other parts of the system.

Glasgow.—Female Labour.—The tramways manager has reported verbally as to the results of the experiment of training as tramcar drivers, such of the women conductors as he considered suitable, and has been instructed to maintain the tramway service by the employment, if possible, of men as drivers, but if men cannot be obtained, then by the employment of women, on the same terms and conditions as the men.

London.—B. of T. Traffic Report.—A report on London traffic in 1915, by the B. of T., has been issued, which mentions that the results of the working of the L.C.C. tramways during the first four months of 1914-15 showed some improvement, which led to unjustified hopes of continued improvement. During 1914-15 the receipts amounted to £2,399,847, and working expenses to £1,700,571, leaving a surplus on working of £699,276, which, after deducting debt charges, left a deficiency of some £33,000. For the present year, 1915-16, it would appear probable that the general reserve fund will be absorbed by the deficit on revenue account, and may possibly fail to meet the whole deficiency. The strike of May last was estimated to result in a loss of £100,000, while increased wages and other expenditure will tend to add to abnormal costs.

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The Highways Committee has considered the application of the Erith U.D.C. for a prov. order to run motor-'buses through the borough of Woolwich, and, if necessary, representations are to be made to the L.G.B. with a view to securing contributions towards road maintenance and street improvements, and an undertaking not to oppose an application by the L.C.C. for powers to run 'buses or tramways in Erith.

Mossley.—At a meeting of the T.C., on March 9th, reference was made to the increasing cost of carting coal from the railways to the gasworks—one speaker said the increase was from £700 to £1,400—and the suggestion was made that the tramways should be utilised for the conveyance of coal. It was estimated that a saving of £500 a year could be effected, and the matter had been brought to the notice of the manager of the Joint Electricity and Tramways Board, and was receiving consideration.

Newcastle.—Accident.—On the evening of the 9th inst. a collision occurred on the Scotswood tramway route; a double-decked bogie car, heavily laden, was going up the Delaval Bank towards the city, followed by a single-decked car, when the former suddenly stopped and ran backwards into the following car, causing considerable damage, but no personal injury. It was stated that the current was accidentally cut off from the first car, and the brakes failed to hold the car on the bank, owing to the greasy condition of the rails

Electric Vehicle.—The Town Improvement and Streets Committee has decided to purchase an electrically-driven van for the collection of domestic refuse.

Oldham.—At a recent meeting of the Tramways Committee, Ald. Isherwood disposed of various statements to the effect that something was wrong with the finances of the department. The borough treasurer had investigated the matter, and found all in order; in justice to the late manager, and to the Committee, and to the general public, that report should be made public.

South-Western Electrification.—On Sunday last the electrical train service over the loop line *viâ* Hounslow was commenced, and a new station opened at Barnes Bridge. The service is half-hourly, with extra steam trains at business hours.

Swansea.—Tramways Supply.—A draft agreement has been approved between the Swansea Tramways Co. and Corporation for the supply of the whole of the electrical energy for the working of the Swansea tramways. At present the Corporation supplies about one-fourth, and it is stated that the company is anxious to purchase the remainder of the current and proposed to scrap its present electricity station.

Walsall.—Year's Working.—The working of the tramways undertaking during the past 12 months has resulted in a surplus of £7,846. Working expenses during the period under review amounted to £22,955, an average of 7·530d. per car-mile, as against 7·267d. in 1914. The total income was £40,291, £39,351 of this sum being traffic revenue, or an average of 12·908d. per car-mile as compared with 11·094d. in 1914. This leaves a balance carried to net revenue account of £17,336, where interest and rent of leased lines are added, bringing the amount up to £18,615. Against this total is set interest, income-tax, sinking fund, and allowances to men serving in H.M. Forces, leaving a sum of £7,846 for appropriation. To this has been added the surplus on the motor-'bus undertaking (£928), making a total of £8,775, from which £2,000 will go in aid of the rates, £2,988 for the purchase of three additional 'buses, £899 for the purchase of a site for depôt extension, and £515 for a temporary garage. From the balance a further £2,000 is to go in aid of the rates, and £300 for a motor parcel-van. The remaining £72 will be carried forward.

TELEGRAPH and TELEPHONE NOTES.

Guernsey.—The accounts of the Guernsey States Telephone Department, for the year 1915, show that the receipts were £7,511, and the expenses (including £864 interest on capital, and £724 Post Office royalty) £4,741; sinking and reserve funds absorbed £2,230, leaving a net surplus of £540. For 1914 the profit was £769. Subscribers' lines (including extensions) numbered 2,071, an increase of 33, and the mileage of metallic circuits, overhead and underground, was 2,584 miles. Subscribers' and public calls amounted to 1,590,492. The capital expenditure on land, buildings, and works amounted to £50 358 (including £18,358 drawn from the reserve funds), of which £3,632 has been repaid.

Wireless in the R.N.A.S.—Boy mechanics are immediately required for training as wireless telegraphists in the Royal Naval Air Service; age between 17 and 17½ in March, 1916. Service is for the period of the war only. Application should be made to the Wireless Officer, R.N.A.S. Depôt, Barlby Road, North Kensington.—*The Times.*

Code Telegrams.—The Riverside Code, 5th Edition, has been added to the list of codes authorised for use in foreign telegrams. The code is not at present available for use in telegrams to the Argentine Republic, Brazil, Paraguay, Uruguay, and the Republic of Honduras.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—May 1st. Two 300-kw. turbo-alternators, condensers, switchboard, &c., for the pumping station at Ryde, for the Metropolitan Board of Water Supply and Sewerage at Sydney.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-kw. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.*

Bristol.—March 24th. Unwashed small coal or washed pea coal for the Corporation electricity works. Mr. H. F. Proctor.

Dundalk.—March 21st. U.D.C. Engine-room stores, cables, lamps, &c., for the Electricity Department. See "Official Notices" February 25th.

Dundee.—March 29th. Corporation. Electrical stores, meters, &c. Electricity Department, Dudhope Crescent Road.

Halifax.—March 23rd. Electrical fittings for six months, for the B. of G. Mr. A. T. Longbotham, Clerk, 4, Carlton Street.

London.—March 24th. H.M. Commissioners of Works. Main switches, main fuses, switch fuses and fuseboards, for one year. See "Official Notices" to-day.

Manchester.—March 22nd. Electricity Committee. 6,600-volt three-phase switchgear, for Stuart Street station. See "Official Notices" March 10th.

New Zealand.—Dunedin.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.*

Wanganui.—May 9th. Borough Council. Gas producer plant, gas engine, generator and switchgear.*

Rathmines.—March 27th. U.D.C. Cable, house-service and fuse boxes, and meters, for 12 months. See "Official Notices" to-day.

Redditch.—March 28th. U.D.C. Three and six months' supply of coal for the Electricity Department (125 tons of D.S. nuts per week). See "Official Notices" to-day.

Spain.—March 27th. The municipal authorities of San Ildefonso (Province of Segovia). Tenders for the concession for the electric lighting of the town during a period of two years.

Warrington.—March 21st. Electrical goods (not of German or Austrian origin) for six months, for the B. of G. Mr. A. Bottomley, Clerk, Bewsey Chambers.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Bradford.—The Tramways Committee has accepted the offer of the Dunlop Rubber Co. for rubber tires for railless trolley cars for two years from February, 1916, at 75d. per mile run per vehicle and that of the National Rail and Tramway Appliance Co. for brake blocks at an increase of 5 per cent. on the present contract.

Colchester.—T.C.:—

Electrical equipment of tramcars (for three months).—Mr. G. W. Allsop and P. R. Jackson & Co.
Overhead equipment (for three months).—B.I. & Helsby Cables, Ltd.
Rubber and fibre (for three months).—L. Andrews & Co.
Castings (for three months).—Stanford & Co.
Car fittings (for three months).—British Hele-Shaw Co. and Stanford & Co.
Oils and grease (for a year).—Williams & Co.

Glasgow.—The Tramway Works and Stores Committee recommends acceptance of the following tenders:—

Galvanised-steel wires.—J. Stewart & Co.
91/18 cab-tire cable.—St. Helens Cable Co.
Three-core cable.—B.I. & Helsby Cables, Ltd.

The Electricity Committee has accepted tenders for (1) air filters required in connection with the new turbo-alternators for the Port-Dundas and the St. Andrew's Cross generating stations, and (2) fans for the cooling towers at the St. Andrew's Cross station, as follows:—

Air filters.—Davidson & Co., Ltd., £562.
Fans.—Matthews & Yates, £727.

London.—Fulham.—The Electricity Committee recommends the acceptance of the tender of Messrs. Cory Bros. for the supply of 100 tons per week for six months of small Aberclyde Welsh coal, at 23s. 6d. per ton, and of the Battersea B.C. offer of 4,000 tons Pooley Hall small nuts, at 20s. 7d. per ton at Chelsea Basin, plus 1s. 2d. per ton for delivery alongside of the Council's wharf.

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HAMMERSMITH.—The Electricity Committee has received the following tenders for annual supplies :—

BOX FRAMES, COVERS, BOXES, &c.

W. Lucy & Co., Ltd.	(recommended)	£446
Johnson & Phillips		585
B.I. & Helsby Cables, Ltd.		774
Siemens Bros. & Co., Ltd.		807

INSULATING BOX FILLING COMPOUND. Per cwt.

Dussek Bitumen Co.	(recommended)	£0 17 0
L. Andrews & Co.		1 0 0
Limmer Asphalte Paving Co., Ltd.		1 0 0
Premier Bitumen & Asphalte Co., Ltd.		1 5 0
Siemens Bros. & Co., Ltd.		1 5 6
Johnson & Phillips, Ltd.		1 10 0
B.I. & Helsby Cables, Ltd.		2 6 8
Callender's Cable & Construction Co., Ltd.		2 12 6

INSULATED WIRES.

General Electric Co., Ltd.	(recommended)	£176
Pirelli, Ltd.		176
Gillespie & Beales		196
Liverpool Electric Cable Co., Ltd.		200
A. F. Goodwin & Co.		207
Henley's Telegraph Works Co., Ltd.		219
B.I. & Helsby Cables, Ltd.		221
Siemens Bros. & Co., Ltd.		222
Johnson & Phillips, Ltd.		222
Callender's Cable & Construction Co., Ltd.		222
W. T. Glover & Co., Ltd.		222

The Committee recommended the acceptance of the following tenders :—

Steam packing and jointing materials.—Middleton Bros.
Fire bricks, clay and lime.—Albion Clay Co., Ltd.
Electrical accessories.—Baxter & Caunter, Ltd.

Swansea.—Electric lighting of two new elementary day schools—Brynmill and Cwmburla. The tender of Mr. J. W. Law, the lowest in each case, was accepted by the E.C., at £168 and £410 respectively.

Whitehaven.—Council. For a year :—

Cylinder and crank-chamber oil.—Vacuum Oil Co., Ltd.
Tapes.—W. T. Henley's Telegraph Works Co., Ltd.
Bitumen.—Dussek Bitumen Co.

Wolverhampton.—The Electricity Committee recommends the acceptance of the tender of Messrs. Bruce Peebles and Co., Ltd., for a 750-KW. converter.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, March 17th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Paper on "The Composition of the Exhaust from Liquid-fuel Engines," by Second-Lieut. R. W. Fenning, R.E. (T).

Greenock Electrical Society.—Friday, March 17th. At 7.45 p.m. At the Temperance Institute, 19, West Stewart Street. Papers on "Some D.C. Diagrams of Connections," by Mr. D. Angus, and "Heating and Ventilation," by Mr. W. A. Toppin.
Friday, March 24th. At the Temperance Institute, 19, West Stewart Street. General meeting.

Electro-Harmonic Society.—Friday, March 17th. At 8 p.m. At Holborn Restaurant. Smoking concert.

Royal Institution of Great Britain.—Saturdays, March 18th and 25th. At 3 p.m. At Albemarle Street, W. Lectures (II and III) on "Radiations from Atoms and Electrons," by Prof. Sir J. J. Thomson.
Thursday, March 23rd. At 3 p.m. At Albemarle Street, W. Lecture (II) on "Organic Chemistry in War : Organic Products used as Propulsive and Explosive Agents," by Prof. H. E. Armstrong, F.R.S.

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, March 21st. At 7.30 p.m. At the Engineers' Club, 17, Albert Square. Paper on "The use of Continuous Current for Terminal and Trunk Line Electrification," by Mr. N. W. Storer.

Illuminating Engineering Society.—Tuesday, March 21st. At 5 p.m. At the Royal Society of Arts, 18, John Street, Adelphi. Discussion on "Some Aspects of the Design and Use of Glassware in relation to Natural and Artificial Illumination."

North-East Coast Institution of Engineers and Shipbuilders.—Friday, March 24th. At 7.30 p.m. At Bolbec Hall, Newcastle-on-Tyne. General meeting.

Physical Society of London.—Friday, March 24th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. General meeting.

Manchester Association of Engineers.—Saturday, March 25th. At the Grand Hotel, Aytoun Street. Report of the Tool Steel Research Committee.

NOTES.

Electro-Harmonic Society.—The last smoking concert of the present season will be held at the Holborn Restaurant (King's Hall), to-night, Friday, commencing at 8 p.m.; Mr. J. H. Rider will be in the chair. The artistes will be as follows :—Mr. Maurice D'Oisly, tenor; Mr. Edward Beaumont, baritone; Mr. Fraser Gange, bass-baritone; Mr. Joseph Bull, banjoist; Mr. Foden Williams, humorist; Mr. Allan Stainer, conjuror and ventriloquist; Mr. Thornley Dodge, entertainer; and Mr. Bernard Flanders, A.R.A.M., solo pianoforte and accompanist.

Work Wanted.—The repair staff of Taunton electricity works wants to fill in spare time with lathe, drilling machine or vice work. An announcement on the matter appears among our advertisements to-day.

Inquiries.—Makers of zinc cases for dry cells, and of insulating links for use in tumbler switches, are asked for.

Committal Order.—In the King's Bench Division, before Mr. Justice Horridge, Mr. Barton-Wright, of the Bartitsu Institute, Oxford Street, appeared to show cause why an order for committal should not be made against him for having failed to obey an order of Mr. Justice Scrutton, made in January last, directing him to pay £12 a month in liquidation of the amount of a judgment obtained against him by Mrs. Beattie, a patient.

His Lordship made an order for committal, but directed that it should not issue if Mr. Barton-Wright paid £6 in a fortnight and the balance in a month.

Institution and Lecture Notes.—Institution of Electrical Engineers.—At a largely attended general meeting of the DUBLIN LOCAL SECTION, at the Royal College of Science, Dublin, on Friday last, the following resolutions were passed :—

1. That this meeting is of opinion that the membership of this Institution of any citizen, born of alien enemy parentage, naturalised or not naturalised, shall forthwith cease, and that after the termination of the war no such citizen shall be eligible for membership; and further, that any citizen of the Empire or allied or neutral nations, being a member of any grade of the Institution, who becomes an agent for a firm owned or controlled by citizens of those enemy nations shall automatically cease to be a member.

2. That the chairman, hon. secretary and another be deputed to attend the general meeting to be held in London to support the terms of the foregoing resolution.

At the meeting of the SCOTTISH LOCAL SECTION at Glasgow, on Tuesday last, Dr. Charles Chree delivered his Kelvin lecture on "Terrestrial Magnetism."

At a meeting of the NEWCASTLE LOCAL SECTION, on Monday, Mr. J. S. Peek read an abstract of a paper by Mr. N. W. Storer, on "The Use of Continuous Current for Terminal and Trunk-Line Electrification."

Birmingham and District Electric Club.—A "ladies' night" was held on Saturday, when a lecture was delivered by the President (Mr. W. G. L. Riddle) on "Impressions of China and the Chinese." A musical programme followed.

Croydon Wireless Society.—At the meeting on March 4th, Mr. E. H. Pollett, B.Sc., gave a lecture and demonstration on electric welding.

Engineering and Scientific Association of Ireland.—"Small Electric Stations" was the subject of a lecture delivered by Mr. L. J. Lawless last Monday at a meeting of the Association. Various small electric schemes in Ireland were described, and it was shown that whether they were operated in competition with, or in substitution for, gas they proved profitable.

"Lest We Forget."—The report of Lieut.-Col. Von Donop, the Board of Trade Inspector, on the disaster near St. Bede's Junction, on the North-Eastern Railway, on December 17th, 1915, was issued last week. The Inspector says :—"This accident is one which the provision of track circuit, which is now being so largely adopted by railway companies, would undoubtedly have prevented." He adds that the evidence that the fire which consumed the wreckage originated with gas is more definite than in any previous case, and furnishes a very conclusive object lesson as to the additional danger which is caused in the case of an accident by the presence of gas on the train. After each of the Hawes Junction, Ditton, and Aisgill accidents, the Board of Trade specially communicated with all the companies on the desirability of electricity as an illuminant in preference to gas. On December 31st, out of a total number of 4,241 coaches owned or maintained by the North-Eastern Railway, 626 were lighted by electricity. But the company has not undertaken, as several other companies have done, that all their new stock shall be so fitted, nor have any steps been taken by them towards the conversion of the existing gas-lit stock.

The Inspector expresses the hope that this fire may lead the company to the adoption of a definite decision in favour of electric lighting for all new stock, and for the gradual conversion of the gas-lit stock.

Electric Cooking Development in a Small Town.—A recent issue of the *Electrical World* contained some details of the method adopted for introducing electric cooking at Glendive, Mont., which has a population of 4,000. In view of the increased revenue if electric cooking were adopted, it was considered worth while to offer ranges at cost to induce consumers to try them. It was further decided to furnish wiring free, putting in stoves on a 30 days' free trial, but with a charge of $4 in case the consumer returned the stove. The charge for energy is 4 cents per KW.-hour, with a dollar minimum charge per month, and no meter is installed until the end of the trial period, because experience shows that the first month's bill being the largest will tend to prejudice the consumer against electric cooking. It is found that the average consumption per month per range is 100 KW.-hours. In a few months 60 ranges were sold on this basis, and it is hoped to have 150 in use before 1917. It is also noted that the peak load increase has been small—not over 25 KW.

Waste Copper Recovery by Electricity in Russia.—The All-Russia Town and Communal Union is organising a factory for using waste copper. Statements have been prepared of the stocks of waste copper on the railways and in the Government works, and shortly, says a Petrograd paper, work will be begun on the recovery of such copper by the use of electricity.

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The Metric System.—The annual report of the Chief Inspector of Weights and Measures shows that last year the number of metric weights and measures verified in Whitecross Street was no less than 33,000, whereas in 1914 the total stood at only 1,741.

Waste of Coal.—Last week Prof. W. A. Bone, Professor of Chemical Technology at the Imperial College of Science, delivered an address on the subject of economy in the consumption of fuel to the members of the Society of Chemical Industry. He stated that the coal which was left behind in the pits represented about 25 per cent. of the coal raised, and the question of checking this wastage was one of supreme national importance. By the reimposition of the duty of 1s. a ton on all coal exported from this country a revenue of about £5,000,000 would be produced, which might be earmarked by the Government for investigation of the problem of coal fuel economy. The waste in the domestic consumption of coal was notorious, and it was the duty of the leaders of science in this country, in the interests of the nation, to see that the Government should not be allowed any longer to overlook a matter of such vital importance. By the elimination of wasteful processes in iron and steel works and rolling mills, a saving of about two-thirds of the fuel consumption might be effected, and the present unsatisfactory situation in the coking industry should be remedied.

Volunteer Notes.—Engineering Institutions' V.E.C.—Orders for week commencing March 20th, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, March 20th.—Sections 1 and 2, Technical; Sections 3 and 4, Lashings and Trestle Bridging, Signalling Class and Recruits.

Tuesday, March 21st.—School of Arms, 6 to 7 p.m.

Thursday, March 23rd.—Shooting for Sections 1 and 2, and Signalling Class.

Friday, March 24th.—Sections 3 and 4, Technical; Sections 1 and 2, Lashings and Trestle Bridging; Signalling Class and Recruits.

Saturday, March 25th.—Uniform Parade at 2.45 p.m.

Attendance is specially desired for all Members on Saturday, March 25th, as it is proposed to hold Battalion Drill.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, March 16th, 1916:—

Battalion Parades.—Saturday, 18th inst.—The Battalion will Parade, as strong as possible, outside Putney Bridge Station, at 3 p.m., and proceed by march route through Richmond Park, and back to Putney Bridge Station, dismissing about 5.30 p.m.

Dress.—Marching Order. Members may use their own discretion as to what they carry in their rucksacks, but the total weight of the articles carried must not be less than 20 lb. "Derby" Recruits are invited to attend.

Sunday, 19th inst.—The Battalion will parade, as strong as possible, at Liverpool Street Station (low-level entrance, G.E.R.) at 9.30 a.m., and proceed by train for Entrenching duties. Members will carry their own lunch. The Battalion will return to town about 6 p.m.

Musketry.—Acton Range will be open for shooting on Saturday, the 18th inst. Members desirous of shooting must send in their names to the Musketry Staff. Parade in uniform punctually at 2 p.m. Members are requested to bring their own ammunition, if possible.

There will also be shooting at Bisley. Members should report themselves to Sergeant Cotter, at the barrier of No. 6 Platform, at 12.45 p.m., on Saturday next, the 18th inst.

A. G. Joiner, *Major and Adjutant*, O.B.C.

Electricity at the Front.—An article in *l'Industrie Electrique*, quoting from the *Elek. Anzeiger*, states that the territory in Belgium and France which is occupied by the enemy is very rich in factories, with a great many central stations supplying electric light and power. In the villages even the poorest houses are provided with the electric light. Many manufactories have been damaged or completely destroyed by artillery fire, but, with much labour and skill, some of them have been repaired and set in operation again. The high-pressure mains, the transformer stations, and distributing networks have suffered still more than the works from the effects of the fighting, but as soon as possible after the district is occupied the mains are put in order, and the electric light is brought into use, a very important matter, in view of the scarcity and high price of oil and candles. As there were stocks of coal at the pit-heads, and the pits that were in good condition have been restarted by the Germans, energy is generated at very cheap rates. Even before the large power stations had been restored, ingenious soldiers had brought many small installations into use for lighting houses, and the electric light is almost indispensable for hospitals, operating theatres and dressing rooms, bakeries, railway stations, and offices.

With the aid of electric power the Germans have been able to thrash quickly considerable quantities of corn, to drive their workshops, and to carry on a variety of important services. As coal cannot be used at the mines in the neighbourhood of hostile artillery for fear of attracting attention by the smoke, winding engines have been driven by electric power. In the stables chaff-cutters have been driven by motors, and the dentists in rear of the front use motors to ply their art. In some cases, places which before the war were not electrically lighted have been provided with installations.

The use of electricity at the extreme front line is particularly important. In spite of the difficulty of laying mains to the firing line, electric pumps are often used to clear the trenches of water; electricity has also proved most useful in tunnelling for mines quickly and silently, a matter of great importance, besides making it possible to ventilate long and narrow underground galleries. Electric light is also used in the trenches and dug-outs. It is stated, in illustration of the wide use of electricity, that in 22 localities about 4,500 lamps have been installed, as well as 105 motors, of a total of 450 H.P.

Our French contemporary adds the amusing comment that the German journal did not mention (what it knew) that on restarting the power station at Lille, at the commencement of the German occupation, the electricians in charge took three months to find out that they were supplying free light and power to certain towns which were still in the hands of the allied armies, by way of the underground cables which connected the station with various sub-stations. Thus, for example, the British at Armentières for that period obtained their electric light from the Germans. And many other interesting matters will be revealed by *l'Industrie*—after the war.

Electric Vehicle Association of America.—A special meeting of this Association was to be held last week, with a view to members voting on the proposal that the Association should be affiliated with the National Electric Light Association, as its Electric Vehicle Section. Under this arrangement the E.V.A. annual convention would become one of the N.E.L.A. section sessions.

Trade with Spain after the War.—According to information furnished by H.M. Consul at Bilbao, local business men anticipate that after the war there will be a rush of Germans to Spain intent on doing business in, and trading with, that country. German firms will be less disliked in Spain than they are in countries with which Germany is at war, and they will, doubtless, be eager to regain and make the most of their Spanish business connections. Before the war Spain was flooded with cheap German goods, and it is reported that 75 per cent. of the machinery, tools, electrical fittings, &c., in use in Bilbao is of German manufacture. Many of these goods are highly finished, but very poor in quality; nevertheless, they are preferred by the Spanish purchaser on account of their cheapness. The present is, however, considered a good moment for introducing United Kingdom manufactures. H.M. Consul, therefore, suggests to United Kingdom firms, if they wish to preserve their position in Spain, they should consolidate their connections and clientèle, so as to be able to compete against the expected German business effort. Large numbers of Germans are now in Spain employed in obtaining information on every kind of subject.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—After a very lengthy discussion, the Blackburn Council has approved of a recommendation of the Electricity and Tramways Committee to increase the salary of Mr. P. P. Wheelwright, the electrical engineer, from £700 to £800. An amendment referring the matter back was defeated by 25 votes to 22.

The Bristol Electrical Committee reports having considered the desirability of granting Mr. Robt. Parker, foreman of the generating station, a gratuity in respect of his long service, but is unable to agree as to the making of any grant.

The Swansea Corporation Electricity Committee has decided that Mr. H. A. Davies, of the public lighting section, be placed in charge of the new publicity department, and that he be raised to Scale "B" in the salary scale.

The Dublin Corporation, by 36 votes to 9, adopted a report of the Electricity Supply Committee recommending an improvement in the scale of remuneration of the meter readers; and that Mr. Wm. Dillon, of the accountant's section of the and that Mr. Wm. Dillon, of the accountant's section of the secretarial staff, be appointed a first-class officer.

General.—On the 6th inst., at the Woolwich Works of Messrs. Siemens Bros. & Co., Ltd., was celebrated the completion of 50 years' service in the employment of the company by Mr. Robert Bertram, of the dispatching and receiving department. Mr. Alexander Siemens congratulated Mr. Bertram on having attained his jubilee of service, during which

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time he had seen the business grow from a very small beginning, when about 50 persons comprised the whole staff, to the present time, when the number of the employés is about 4,000. He had the pleasure of presenting him with an illuminated address and a cheque from his colleagues at the works, as a token of their esteem and regard, and also a cheque on behalf of the company as a recognition of his faithful service and the manner in which his duties had always been performed. Mr. Bertram, in reply, thanked the company through Mr. Siemens, and also his colleagues, most of whom were present, for their gifts and the expression of their goodwill, and referred to some of his very early experiences when the neighbourhood of the works was still rural.

Sir George Greenhill, F.R.S., and Mr. Charles Bright, F.R.S.E., M.Inst.C.E., have requested that their names be withdrawn from the executive committee of the Aeronautical Institute.

Mr. W. A. Scott, works manager of Messrs. Bruce Peebles and Co., Ltd., Edinburgh, was married on 9th inst. to Alexandrina, second daughter of Alexander Mann, Edinburgh. A few days prior to the wedding Mr. Scott was presented with a canteen of cutlery and a silver cigarette case by the workmen and staff.

The marriage took place at St. Robert's Catholic Church, Harrogate, on March 4th, of Mr. A. C. Cooper, electrical engineer, of Manchester, and Miss Muriel Margaret Seamer.

Roll of Honour.—The *Times* records that Second-Lieutenant H. A. Johnston, of the Royal Flying Corps, was killed in France on March 4th, aged 24. Before volunteering as a private he was with Messrs. Siemens Bros., and had fitted wireless installations in many parts of the world.

Obituary.—Mr. C. W. Fairweather.—We regret to record the death of Mr. C. W. Fairweather, consulting engineer, of Newcastle-on-Tyne, who was one of the founders and managers of the Northern Counties Electric Supply Co., which, after a very successful career, was absorbed by the Newcastle-upon-Tyne Electric Supply Co. Mr. Fairweather was well known in engineering and electrical circles, and in later years carried on an extensive consulting practice in connection with mining and collieries. His death will be deplored by a very wide circle of friends.

Mr. B. Short.—Mr. Bert Short, who was for six years chief clerk and cashier at the North Metropolitan Electric Supply Co.'s undertaking at St. Albans, passed away on March 4th, after an operation at St. Bartholomew's Hospital.

NEW COMPANIES REGISTERED.

New Era Signs (U.S.A.), 1916, Ltd. (142,233).—This company was registered on March 8th, with a capital of £200 in 1s. shares, to acquire and develop the patent rights in the U.S.A. of an invention for improvements in or relating to flashlight advertising devices, to carry on the business of manufacturers of and dealers in advertising apparatus for displaying electric and other advertisements, dynamos, lamps, wires, cables, insulating materials, accumulators, telephone and other apparatus, &c., and to adopt an agreement with E. C. Leachman and the Magna Charta Publishing Co., Ltd. The subscribers (with one share each) are: E. C. Leachman, 9, Oakley Street, Chelsea, S.W., advertising expert; T. C. Elliot-Lawson, 56, Cleveland Square, W., company director. Private company. The number of directors is not to be less than two or more than seven; the first are T. C. Elliott-Lawson, F. Hope-Jones, E. C. Leachman, and C. H. R. Profumo. Registered office: Albion House, 59-61, New Oxford Street, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lancashire Light Railways Co., Ltd.—A memorandum of satisfaction in full on June 9th, 1915, of a mortgage or charge dated June 29th, 1907, securing £6,000, and a mortgage or charge dated January 1st, 1908, being a transfer of the said mortgage or charge, and a further charge securing £3,000, has been filed.

Reid Brothers Engineers, Ltd.—Particulars of £3,000 debentures, created February 17th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Faringdon Electric Light and Power Co., Ltd.—Issue on May 15th, 1914, of £300 (as collateral security with bankers for loan), and on February 11th, 1916, of £1,100 debentures, parts of a series of which particulars have already been filed.

Bourton-on-the-Water Electric Light and Power Co., Ltd.—Issues on various dates from October 15th, 1913, to February 11th, 1916, of £250 debentures, parts of a series of which particulars have already been filed.

CITY NOTES.

County of London Electric Supply Co., Ltd.

Mr. H. B. Renwick presided at the annual meeting, held on Monday. He said that the gross receipts had grown by 9 per cent. to £298,269, but the costs and expenses had increased by £28,592, or 20.6 per cent., and the net revenue was £159,639, as compared with £161,043 for 1914. Increased costs due to the war occurred in the items for coal and other fuel, salaries and wages, rates and taxes, and insurance. Had it not been for war burdens, the company would have had a record year in all respects. Coal had been about 50 per cent. above the 1914 prices. Their normal supplies were sea-borne, and the cost of freightage alone was now more than the cost in pre-war times of the coal itself delivered into the bunkers. They still had difficulty in maintaining proper stocks of coal. It was time some public action was taken to deal with the matter on lines similar to the recent Act determining the maximum price of coal at the pit's mouth or by constituting a Board of Control with similar duties to those of the Railway Executive Committee which was now doing such good work in regulating the traffic of the British railways. There was a general increase in practically everything purchased during the year. The gross effect of their war burdens was to more than nullify the very excellent increase in the gross receipts. In order partially to recoup the company for these additional expenses, the charges to consumers had been advanced by 10 per cent. In the capital expenditure of the year (£59,105), £31,745 represented expenditure on mains, which included the outlay necessary to give supply in bulk to the districts of Sutton, Carshalton, Wallington, and Cheam, and in the district under the Romford Order. In regard to growth of business, the position was more than gratifying. The number of units sold increased by 2,549,309, and the consumers were 25,913, against 24,212. The continued expansion during war, in face of lighting restrictions and other adverse influences, was a striking testimony to the vitality of the company's business and to the potentialities of its areas of supply. It also spoke well for their commercial and business-getting staff, who had secured that large increase although working with a depleted staff and under adverse circumstances. They had also secured during the year two long-term contracts for supply in bulk—one with the South Metropolitan Electric Tramways & Lighting Co. in respect of their Sutton districts, and the other with a company in respect of Banstead, Chipstead, and Walton-on-the-Hill. Supply had already been commenced in the Sutton districts, but in the other cases operations would probably be deferred until after the war. These contracts had a significance and importance far beyond their revenue-producing value, seeing that they carried matters a step further in the direction of unification of supply, and they were in keeping with the company's policy of linking-up and centralisation. They adopted that policy at the commencement of operations 22 years ago, and after years of labour that policy was being vindicated more and more as time proceeded. A further result of these contracts was that there was now one generating station less in the London district, for the Sutton station was being scrapped, and the necessity was avoided of erecting a further station which would otherwise have been required for the Banstead district. They were quietly doing what they could toward solving the bigger question of the London electricity supply problem. During the year they commenced supply in Romford. They now served a total area of about 223 square miles, of which about 183 were distributing and about 40 bulk supply. After alluding to the Bournemouth and Coatbridge associated companies, Mr. Renwick said that the South London Electric Supply Co., in which they had a large share interest, had well maintained its position. The County Co. and its associated companies had 303 men on active service. In regard to the prospects, applications received to the end of February amounted to an additional 1,125 kw., which exceeded the previous year's figures; the units output was up by 10 per cent., and there were 60 per cent. more new consumers. So far as new business was concerned, therefore, they could look forward with some measure of confidence, but they must expect further increases in station costs and other burdens in the way of war taxes. The chairman concluded by referring to the special services rendered by Mr. C. P. Sparks, the engineer-in-chief, in connection with the coal and other difficulties, and by Mr. F. C. McQuown, the secretary, to whom the period had been one of unusual strain.

Pará Electric Railways & Lighting Co., Ltd.

The annual meeting was held on February 28th, Mr. Follett Holt presiding. The chairman said they had suffered from a reduction in gross receipts, resulting from the continuance of the financial crisis in Brazil; measured in sterling, with exchange at 16d., the loss in receipts amounted to £6,408, or only 2½ per cent. on the previous year's figures, the principal cause being a decrease of 957,000 in the number of tramway passengers carried. This reduction had been met by a reduction of 13 per cent., or over £17,000, in working expenses, by employing wood fuel in place of imported coal for power production, and by a very strict supervision of all items of expenditure. The fall in exchange during the past year had not only swallowed up their increased earnings of over £10,000, but a further £23,000 besides. After placing £15,000 to reserve, which now reached the substantial sum of £96,545, they were able to pay a dividend of 5 per cent. on the ordinary shares. During the year arrangements for taking over the whole of the share capital of the Pará Gas Co., Ltd., were completed. They were now engaged in developing the sale of gas for cooking and industrial heating. Their prosperity depended to a great extent upon the amount of rubber collected on the Amazon and upon its export value, and 33,500 tons of rubber were exported between July, 1914, and June, 1915, at a price 26 per cent. better than last year; they need not be disturbed at present about the future of the trade of Pará.—*Financial Times.*

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Kensington & Knightsbridge Electric Lighting Co., Ltd.

At the annual meeting, on March 2nd, Col. R. E. Crompton, who presided, said there had been still more stringent reductions in lighting, and private economies, which had resulted in a further reduction of 9 per cent. in the output. The total reduction for the two years 1914 and 1915 amounted to nearly 1,000,000 units. Against this the average price received per unit had only increased by 2 per cent. Owing to the rapid rise in the price of Welsh coal, the company's local works were closed, and the whole of the supply was taken from the Wood Lane works. A saving of about 15 per cent. had been made on repairs to plant, and the total working expenses had been cut down from £51,523 last year to £48,852 this year. The present value of the plant, not taking any credit for the increase in the value of the copper in the mains, was in excess of the value at which it stood in the books, and under the circumstances, as a temporary measure during the period of the war, the balance of the amount placed to the credit of the renewal fund had been reduced from £9,745 to £7,261. The total renewal fund credit stood at £139,021. The directors had contested the quinquennial assessment of the property by the Borough authorities of Westminster and Kensington, and had been successful in obtaining a considerable reduction. About one-quarter of the staff and workmen had joined H.M. Forces, and several others would have to join later. The total sum for rates and taxes paid during the past year had been increased by £816. The reduction of dividend had been smaller than that of other companies, although they had only increased their price by 2 per cent. to the public. The use of electricity for heating and cooking was steadily increasing. The chairman called the attention of the shareholders to the devoted work of Mr. Miller, who was not only the engineer, but performed the duties of managing director and had supreme charge of the Wood Lane works; the excellent position in which the company stood was due to him. Replying to questions, he stated that he personally had found that it was a great economy to use electric heaters instead of fires, and the Managing Director said they had had in the past year the largest increase in heating that they had ever had.

Oxford Electric Co., Ltd.

The annual meeting was held on Tuesday last week; Sir Henry Mance occupied the chair, and the Secretary read a memorandum stating that the revenue account showed a profit (including £1,055 brought forward) of £13,340. After providing £2,016 for debenture and other interest, also writing off £686 on account of hire-purchase installations, the balance available was £10,639. Renewals to the Diesel engine cost nearly £600, services to new customers £753, extensions of mains £483, meters £338. They had written off from the capital account a sum of £2,465, and had received during the year the sum of £5,000, being the first issue of 1,000 shares of the new preference capital created in 1914. The expenditure upon fuel had exceeded that of the previous year by over £800. Sales by meter showed a reduction of £1,184, and the revenue from street lighting was also less. The reserve and renewal of plant account, with the addition of the sum of £1,000 proposed to be now appropriated, would amount to £20,757. The chairman said that the expenditure on hire-purchase installations would be temporarily suspended. Of the clerical staff, four out of five were now serving with the Colours, and of the engineering staff, three members were called upon to serve at the commencement of the war, and 13 others joined shortly afterwards

City of London Electric Lighting Co., Ltd.

The capital expenditure during 1915 was £25,952. The amount written off in respect of buildings, plant, and other works dismantled during 1915 is £30,738. Enforced reduction of lighting, and increased coal and production costs have prejudiced the annual profit. The total revenue was £311,820. After deducting expenses of generation and distribution repairs and maintenance, street lighting expenses, rent, rates, taxes, &c., amounting together to £161,060, £150,760 remains, plus £23,372 brought forward. Interest on loan, consumers' deposits, debenture interest, and other charges are deducted, and £50,000 is transferred to reserve, leaving £87,770. After paying 6 per cent. on the preference shares and 8 per cent. on the ordinary, as against 9 per cent. for 1914, £18,024 remains to be carried forward. The gross revenue was (as above) £311,820, as compared with £306,084 in 1914 (increase £5,735). The net revenue was £150,759, as against £164,464, a decrease of £13,705. The average price obtained per unit was 2.27d., as against 2.26d. in 1914. The consumers connected decreased by 370 to 14,720, and the kw. connected (including power and heating) increased by 629 kw. to 46,161 kw. The reduction in number of consumers is entirely due to war conditions causing the suspension of many businesses, notably among stockbrokers and foreign importing agents. The units generated increased from 33,906,963 to 34,643,297; and the number sold from 29,182,165 to 29,479,079; the maximum supply demanded decreased from 19,739 kw. to 17,424 kw. The units sold increased by 296,914, notwithstanding that the consumption for lighting purposes was more than a million units less. Power and heating supplies continue to show a steady increase; in 1915, 12,375,577 units were sold for power and 2,844,636 for heating, together being equal to 53 per cent. of the total units sold for private supply. 168 members of the staff are serving with the Forces. Four have been killed and nine wounded. Liberal allowances have been made to all, to ensure that no financial hardship shall be suffered, and all who return will be reinstated after the war. The Marquess of Winchester, one of the directors, is now serving in France. Annual meeting: March 22nd.

Newcastle-upon-Tyne Electric Supply Co., Ltd.

The connections to the system during 1915 were increased by 26,965 h.p., making 258,390 h.p. total. The profit for the year was £204,418, as compared with £178,380, plus £5,946 brought forward. Interest and debenture stocks, loans, &c., amounted to £58,696, leaving £151,669. After paying 5 per cent. on the preference and 6 per cent. on the ordinary shares, as compared to 5½ per cent. for 1914, placing £25,000 to depreciation reserve (as compared with £20,000), and £28,000 to general reserve (as compared with £17,000), £5,191 remains to be carried forward. £93,965 has been spent out of revenue on the efficient maintenance of the plant and system generally. £110,079 spent on capital account during the year represents further cost of extensions in progress at the Carville and Dunston power stations, and to the general distribution system. The nominal value of the shares held in the County of Durham Electrical Power Distribution Co., Ltd., has been adjusted to correspond with the reduced share capital of that company. Mr. R. P. Sloan has been elected to the board, but he retains his position as manager. At Dr. J. T. Merz's wish he has relinquished the position of chairman, and Mr. J. H. Armstrong has been elected to act in his place. Dr. Merz becomes vice-chairman. Annual meeting: March 21st.

Waste Heat and Gas Electrical Generating Stations, Ltd.

Mr. R. S. Newall presided at the annual meeting on March 8th in the absence of Dr. J. B. Simpson, whose speech he read. The capital expenditure had been increased by £3,654. The expenditure incurred was almost entirely in connection with the extensions at Weardale and Grangetown power stations. The new plant was being installed at Weardale with a view to a more efficient use of the gas received from the coke ovens, and the further plant at Grangetown was being put in with a view of maintaining a greater and more continuous output. Although the manufacture of the plant and the completion of the works must necessarily be slower than in normal times, there was a good prospect that all the plant would be brought into operation during the current year. These extensions would cost about £45,000. In June, 1915, the company had been allotted £10,000 of the 4½ per cent. War Loan, and the whole had been paid up. The general reserve and depreciation account had been increased by £11,000, together with £6,573 added for redemption funds in respect of plant supplied on hire-purchase terms. He had been asked by more than one shareholder whether they made proper reserves against possible industrial developments which might tend to supersede the methods they employed in the utilisation of waste heat and gas. He thought the accounts presented to them each year, and the explanations he had given at their meetings, showed that their reserves were ample; in fact, they made such reserves as would provide for the whole cost of their installations over the period for which they had contracted to receive the supplies of waste heat. The possibility of utilising waste heat in a more efficient way also received their continual consideration, and he had already referred to the new plant which was being installed at Weardale power station with that object in view. The profits earned during the year showed an increase of about £817 over the previous year. The amount of waste heat, gas, and steam that they received during the year had been considerably less, owing to the conditions arising out of the war, the reduction representing about 10 per cent. compared with 1914, and 15 per cent. as compared with 1913. The reduced quantity of waste heat available was largely in respect of those stations where they received exhaust steam from the blowing engines at blast furnaces, owing to the furnaces having had to be worked with different and varying classes of ore. Some of the coke-oven plants, also, had not been working at full capacity, but there was an improvement in this direction. Although the revenue had in consequence fallen, so far as it was derived from the output of electrical energy from the stations, there was some satisfaction in knowing that the supplies they had been able to give to the power companies had been of even greater advantage to them than in normal times, as, without the supplies of electrical energy derived from waste heat they would have been subject to largely increased costs owing to the higher price of coal. Referring to the excess profits duty, he said from estimates prepared he did not think they would be called to pay any appreciable amount.

Bruce Peebles & Co., Ltd.

At the annual meeting at Edinburgh, on Friday last, the Chairman, Mr. F. E. Andrews, said that they had considerably re-arranged the works and added to the buildings and machinery in order to expedite and increase the output. Their export trade, to which, ever since the company was formed, they had given unremitting attention, and to which they attached the highest importance, had naturally for the time being to give place to the more pressing demands

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at home; but far from relaxing their efforts to keep closely in touch with all their foreign markets, they were increasing such efforts, and had already joined hands with several other well-known firms in forming a company to push business in Russia, so that at the conclusion of hostilities they would be in an advantageous position to deal with the large field for electrical engineering work which existed there. As regarded electrical machinery, they were constantly overhauling and improving their designs; their speciality, the Peebles-La Cour converter, continued to gain in favour; a great many had been supplied during the year, and they had a large number on order at the present moment. The profit from manufacturing and trading amounted to £13,945, compared with £11,649 for the year 1914. To this must be added interest and transfer fees £971, as against £619 last year, giving a total profit for the year of £14,916. There was a net profit of £7,096, as compared with £3,892 a year ago. This sum of £7,096 went to reduce the adverse balance against profit and loss account, which would now only amount to £10,686, and would, he hoped, be entirely eliminated in the course of another year. Their cash position had now for some time been entirely satisfactory. They had spent £4,660 during the year on maintenance out of revenue. Upwards of 34 per cent. of their workpeople had joined his Majesty's Forces, a large number of the staff were also serving, and practically all others of military age duly presented themselves for attestation under Lord Derby's scheme. They had to mourn the loss, among others, of Capt. W. Russell, a most valued member of their staff, and Capt. John Peebles, a son of the founder of the works and secretary of the company for many years. He could not speak too highly of the excellent work of the managers, Mr. Bastow and Mr. Bunting, of the staff, and of all their workpeople. Their financial position had steadily improved and might now be considered quite satisfactory. Sir John Cowan, of Edinburgh, was elected to a seat on the board of the company.

Mersey Railway Co.

Mr. J. Falconer, M.P., presiding at the annual meeting, said that having regard to the difficult times, and that they had no goods traffic, the increase of £5,860 in the receipts must be considered satisfactory. The increase in expenditure was £5,125, due partly to higher cost of coal and labour. The bulk of the increased labour cost was borne by the Government, as was also the whole of the increased cost of stores and materials. The net revenue was £52,860, as against £52,125 in 1914. Since they had been working the line electrically they had put £2,000 a year regularly to the renewal fund, and they had said that when the sum reached £20,000 they would reconsider their position. It had now reached £22,066, and they had reduced the allocation from £2,000 to £1,000. They had now begun the payment of interest on the last of the debenture stocks, and when the full interest on that was completed they would be in a position to commence paying something to the preference shareholders. In reply to questions, Mr. Falconer said that local traffic had shown satisfactory development, more than maintaining the ratio of progress of past years. There had been practically a stoppage in the development of the country around the railway because nobody was undertaking building operations when building cost 30 to 40 per cent. above the normal. He did not know who would get the best of the bargain in the financial arrangement with the Government. It now looked like being a good bargain for the Government.

South Metropolitan Electric Light and Power Co., Ltd.

Mr. H. St. J. Winkworth, presiding at the annual meeting on March 1st, said that the number of new consumers (313) was less than usual, as they had not carried out the usual extensions of small lengths of mains. The new mains laid were principally for giving bulk supply to the West Kent Electric Co. for power for factories, &c. The loss of revenue due to Government lighting restrictions was estimated at at least £8,000 to £9,000, but this was made good by new business and extensions. The total units sold increased by 37 per cent. to 9,185,742. The average price obtained was lower by reason of the bulk supply. The total sales in the show-room were £9,256, against £8,148, with £4,479 transactions, against 3,759. The total receipts were £80,576, as compared with £66,791. In regard to expenditure, coal had cost £5,700 more, owing to increased output, high freights, and inferior quality. In common with the other London companies, they increased their charges to consumers by 10 per cent. at the end of March, 1915. The total expenditure was 39 per cent. of the gross receipts, as against 36 per cent. in 1914. Owing to an ambiguity in the trust deed as to what they had to set aside to depreciation and in what circumstances, they had been in negotiation with the trustees with a view to defining the obligations under the deed. They had decided to fall in with the wishes of the trustees, and had transferred the £20,000 placed to reserve account in 1913 and 1914 to the depreciation account, and had carried to the depreciation account £16,750. A letter received from the solicitors to the trustees for the debenture stockholders indicated that they would be able to come to an agreement. The directors had under consideration the best manner of dealing with the amount due to the company by the West Kent Co. for work done, approximately £30,000. It would probably take the form later on of an issue of capital by the West Kent Co., but the precise form had not yet been decided upon. The following figures show the progress of the West Kent Co.'s business:—1914, H.P. connected, 773; consumers, 59; gross revenue, £1,596; expenditure, £1,055; net revenue, £541. 1915, H.P. connected, 3,018; consumers, 531; gross revenue, £13,320; expenditure, £10,269; net revenue, £3,051. During the year considerable extensions, both of mains and consumers, had been made, securing important power loads of a substantial and durable character. The bulk of the energy had been taken from the supply mains of the South Metropolitan Co. In regard to the outlook, it was very difficult to say what would take place in these days, but their output at present was substantially more than at the corresponding period of last year, due mainly to the increased demand of the West Kent Co. On the other hand, it was difficult to obtain regular deliveries of coal, and owing to the exceptionally high freights now ruling it was impossible to say what coal would cost, but the average price was likely to be more than that paid last year. On the whole, the outlook was satisfactory.

Metropolitan Electric Supply Co., Ltd.

At the annual meeting on March 22nd an effort is to be made to secure the appointment of a committee of shareholders to examine into and report upon the position. A circular was issued last week asking for proxies in support of this move by to-day. The circular says:—"For some considerable time we, in common with many other shareholders of the above company, have been far from satisfied with the way in which its affairs have been administered. The dividend on the ordinary shares, which in 1905 was 10 per cent., has now fallen to 3 per cent., and we learn that three of the directors (Lord Avebury, Sir James Pender, and Mr. P. D. Tuckett, the latter having recently joined the board) are all so dissatisfied with the position that they have resigned their seats on the board. We feel the time has come for the shareholders to take some action to protect their interests."

The company has issued a reply to the circular, in which the Secretary writes:—"Without explanation the circular is entirely misleading. The board has not been satisfied recently with the conduct of affairs, and in June last decided upon a complete change of management. This has been effected, and it is on this change of management that the present opposition is presumed to have arisen. . . . The chairman will give the fullest explanation of the position at the general meeting."

Chelsea Electricity Supply Co., Ltd.

Mr. W. R. Davies, presiding at the annual meeting, on March 8th, expressed regret that, owing to the class of demand in districts like theirs, the year's working necessitated a reduction in the dividend. Some of the companies in the Metropolitan area who could command a power load had done better than in 1914, but this company's business, which was for domestic and shop lighting, had again been adversely affected, not only by the increased lighting restrictions and by the desire to economise, but also by the fact that there was at present no London season with its entertainments and festivities. The units sold were 149,000 less, being 3 per cent. to 4 per cent. below those of the previous year, but low-priced power units showed an increase of 12 per cent., and the reduction in the sale of the higher priced units was nearly 10 per cent. They had been fortunate in fuel expenses, which showed a reduction of £950. This was partly due to the fact that the Diesel plant had been running for the whole year and had taken the bulk of the load, and that the cost of oil had not increased in anything like the same proportion as the cost of coal. It was also partly due to their purchasing more current from the Central Electricity Co., so that the amount generated had been proportionately less, and, to some slight extent, to their having sold fewer units. Repairs and maintenance and other costs were about the same as last year, but there were two other items on the expenditure side of the revenue account which called for special remark: one was that a special provision for income-tax of £1,500 was now necessary on account of the high income-tax; and secondly, that they had paid £1,200 away to men on military service. These two items alone more than accounted for the reduced distribution. In regard to the prospects for the current year, they must not look forward to any improvements, and they might even be faced with a further reduction of profit. This was due to the price of oil having risen very considerably, and to the reduction in the demand for current, which was still proceeding. The output for the first two months of this year showed a reduction of 6½ per cent. over the corresponding period.

British Electric Transformer Co., Ltd.—The result of working for 1915 is considered satisfactory. After paying all manufacturing costs and expenses of administration, there remains a net profit of £21,095, plus £3,478 brought forward. Out of this £7,500 is put to reserve, £1,500 to depreciation reserve, 6 per cent. is paid on the preference, and 7½ per cent. on the ordinary shares, £837 is paid as extra remuneration to directors, and £4,604 is to be carried forward. Annual meeting: To-day.

Automatic Telephone Manufacturing Co., Ltd.—The ordinary share and transfer books are closed until 25th inst. for the purpose of preparing the dividend warrants on the ordinary shares for the year.

Doulton and Co., Ltd.—Dividend of 5 per cent., less tax, on the preference shares for 1913.

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North Ormesby, South Bank, Normanby and Grangetown Railless Electric Traction Co., Ltd.—The annual meeting was held at Middlesbrough on the 9th inst. Mr. W. W. Storr, who presided, said, in moving the adoption of the balance sheet, that the share capital of the company was £40,000, of which 12s. per share had been called up, yielding £21,678. Sundry creditors amounted to £121, making a total of £21,799. On the expenditure side, the cost of the Acts, including the opposition to the Middlesbrough Corporation, had been £4,012, buildings and overhead equipment had cost £14,139, and land and sundries had involved an expenditure of £2,754, leaving a balance of £879. The contract for the cars had not yet been completed, and the system remained unopened, but they expected to obtain four cars by the end of April. When the ten cars were available they could start at once. The Board of Trade had refused to sanction double-deck cars.

South Metropolitan Electric Trams and Lighting Co., Ltd.—The total revenue for 1915 was £69,281. After adding the balance brought in, deducting all expenses, and setting aside £4,500 to renewals fund, there remains £15,486, and the directors recommend placing to reserve £4,500, payment of dividend at rate of 5 per cent. per annum on preference shares for year to December 31st, 1914, £8,478, to payment on account of preference dividend for year 1915 at rate of 1 per cent. £1,695, carrying forward £812. An agreement has been entered into with the County of London Electric Supply Co., Ltd., for the supply of current in bulk to the company's station at Sutton, which is accordingly being converted from a generating station to a sub-station. Supply from the County company was first taken on December 12th.

Stewarts and Lloyds, Ltd.—The directors, after setting aside £100,000 for depreciation, and after making provision for estimated contingencies, recommend dividends for the half-year to December 31st last at the rate of 6 per cent. per annum on the preference shares; at the rate of 10 per cent. per annum on the preferred ordinary shares; and for the year a dividend of 2s. and a bonus of 6d. per share on the deferred shares, placing £60,000 to general reserve, £20,000 to employés' benefit reserve, and carrying forward £100,000.

Listowel Electric Light and Power Co., Ltd.—At the annual meeting, held recently, the chairman said that the present position was most satisfactory, and the result of the third year's working was remarkable. The gross profits, after paying all working expenses, amounted to £322. In three years they had put to reserve £430. They recommended this year a dividend of 8½ per cent., carrying forward £32. They looked forward to a considerable expansion of business this year, when certain new works and plant required to cope with the demand had been completed.

Direct Spanish Telegraph Co., Ltd.—Dividends at the rate of 10 per cent. per annum, less income-tax, on the preference shares, and 6 per cent. per annum, less income-tax, on the ordinary shares (making 5 per cent. for the year) have been announced for the last half of 1915, and a bonus of 2 per cent. on the ordinary for the year, free of income-tax, is recommended.

Melton Mowbray Electric Light Co., Ltd.—At the annual meeting, held recently, it was reported that the revenue for the year, after adding the balance brought forward, amounted to £3,241, of which £2,286 was available for distribution. A dividend at the rate of 3 per cent. per annum was declared; £900 was placed to reserve for renewal of plant, and £786 is to be carried forward.

Reduction of Capital.—A petition for the reduction of the capital of the Compania de Electricidad de la Provincia de Buenos Aires, Ltd., and Red., from £1,350,000 to £825,000, is to be heard on March 21st.

Nairobi Electric Power and Lighting Co., Ltd.—An interim dividend at the rate of 6 per cent. per annum on the preference and ordinary shares for the last half of 1915, less income-tax, is being paid.

Scarborough Electric Supply Co., Ltd.—The profit for 1915 was £1,078, plus £2,002 brought forward. After providing for interest charges, and placing £1,000 to the depreciation fund, £1,716 is to be carried forward.

Western Telegraph Co., Ltd.—Second quarterly dividend 3s. per share, free of income-tax, for the year ending June, 1916, being at the rate of 6 per cent. per annum.

W. T. Glover and Co., Ltd.—After paying 5 per cent. on the ordinary shares, and transferring £20,000 to reserve and writing down investments, £11,700 is to be carried forward.

Launceston and District Electric Supply Co., Ltd.—The directors have declared a dividend of 3 per cent.

STOCKS AND SHARES.

Tuesday Evening.

Verdun is the cynosure of the eyes of finance as much as it is of those of the nation at large; and, hopeful views being entertained of the end of this colossal struggle, Stock Exchange markets on the whole are firm and cheery. The Budget is expected towards the end of the month, and the next War Loan early in April. City circles are discussing with animation the pros and cons of a popular loan in the shape of premium bonds; but that more money will have to be provided in some way or other before very long is obvious to everybody.

This consideration weighs but lightly upon current quotations for securities. There is a tendency to look beyond the war and to invest money in the shares of such undertakings as are now working under abnormally unfavourable conditions, such as will right themselves automatically when the war is over. The same motive which checks investment to any large extent in armament shares is at work in directing the search for issues at present depressed by the war clouds.

Such a development is one that should console the proprietors of electric lighting shares in these present darkened days. The war has bitten badly into profits, for reasons that are well known to the public, and to the investor in lighting shares particularly. But afterwards there should come such a reversal of fortune amply compensatory for the lean times through which the companies have passed; and those who are on the look-out for shares of such class might do well to include the electric supply market in their purview.

Circulars have been flying about in connection with the affairs of the Metropolitan Electric Supply Co. Three of the directors, Lord Avebury, Sir James Pender, and Mr. P. D. Tuckett, have resigned, and five shareholders are inviting support at the forthcoming general meeting, with a view to securing the appointment of a committee of shareholders to examine into, and report upon, the position. The directors, in reply, say that a complete change of management has been effected, and that the chairman will give the fullest explanation of the position at the meeting next Wednesday, March 22nd. Meanwhile, the price of the shares keeps dull at 2⅛.

Various ex-dividend markings have reduced other prices in this market to levels at which they pay handsomely, even on the basis of the reduced dividends declared in respect of 1915. There is accordingly plenty of scope for the far-seeing investor to whom reference has just been made. The City of London report is considered satisfactory, and the large increase shown by the expenses, as compared with those of the receipts, is regarded as a factor due entirely to the war. The Newcastle Electric Supply Co. has declared a dividend of 3½ per cent., making 6 per cent. for the year, which compares with 5½ per cent. paid in the previous twelve months.

Mexican matters are once more to the front, in consequence of the increased activity on the part of some of the insurgents, headed apparently by General Villa, who are making things lively on the Mexican-American frontier. Various United States citizens are said to have been killed in the Mexican raids; and once more, for the *n*th time, the expectation revives that President Wilson will take a firm stand and maintain a stiff upper lip in his demands for reform in Mexico. It is difficult to conceive that even President Wilson can be content with formularies on this occasion, because it is certain that if he cares to do so, he can command the support of his country in enforcing order into his turbulent neighbours of the Isthmus, and the sending of a few thousand American troops to Mexico really looks as though he "meant business."

Although this is regarded as something of an ultimate bull point for Mexican stocks and shares, it has not saved further falls in the railway and industrial securities. Mexico Tramway Firsts, for instance, are down 4 points, Mexican Light and Power common fell 2 to 20, and most of the bonds are more than ever difficult to realise.

Amongst other foreign descriptions, British Columbia Electric preference dropped 2 to 53, and there is noticeable weakness in Anglo-Argentine Tramways first preference, a fall of ¼ taking these to 3⅞; while the second preference weakened in sympathy to 3⅜, as will be noticed from our lists of stocks and shares this week.

The feature in the market for Home Railway stocks is the buying of the low-priced issues. Gambling counters, many people would call them; but those who are putting money into such things contend that British railway systems of importance never come to a complete end, and that recovery sooner or later is inevitable. Therefore, the strength of Metropolitans and Districts is well maintained. Underground Electrics are duller. At the meeting held last week, Sir Robert Perks suggested that fares should be raised, but the chairman, Lord George Hamilton, stated that the adoption of such a policy would encourage competition and probably cause a great outcry throughout London. It was very easy to lose traffic, he said, but traffic once lost was very difficult to recover.

British Electric Tractions have been rather wanted, in consequence of the result of the law case which has just been settled by the Court of Appeal. The Public Trustee, as executor for a deceased large holder of income certificates in the company, sought to show that he was not bound by the scheme for reducing the capital. But the judges held that the directors had acted in perfect good faith; and upon the evidence before the Court, their lordships were of opinion that the appellant, by accepting the stock and shares under the scheme, ran no risk of incurring any future liability in respect of them. The preference stock was dealt in on Monday at 72, and the 7 per cent. non-cumulative preference at 46 a week ago; while the most recent bargains in the preferred and deferred were at 16 and 10¼ respectively. No doubt the company will now press forward the completion of its scheme, and proprietors will hope to be in possession of their new securities before long.

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The Metropolitan Electric Tramways, in its report, shows a falling away of £18,000 to £513,600 in its gross revenue for last year. The company carried 3,669,000 fewer passengers, but the average fare was higher. The net revenue, however, comes out at only £3,000 less. The ordinary dividend is 1 per cent., against 2 per cent. a year ago. The price of the 4½ per cent. debenture stock is 78½, and the 5 per cent. debenture stock stands about a point lower.

Canadian lighting and power issues are creeping up again, and the American companies are sharing in the industrial activity produced throughout the States by the war conditions of Europe. The Pennsylvania Water & Power increased its profits, and announces that a new concern has been formed, called the Shawinigan Electro Products Co., the objects of the latter being to manufacture and sell electric furnace products.

Telegraphs and telephones are wholly placid. Business is quiet in this section, and there are no changes to report on the week. Telegraph Constructions are quoted ex the dividend of 36s., allowing for which they show a loss of 1¼. Babcock & Wilcox are strong, the price stiffening to 2⅞ on buying from the North. The other manufacturing issues are, on the whole, a good market. Rubber shares remain firm, business in them being more active than in anything else round the Stock Exchange. Considerable animation characterises the department devoted to base-metal shares, more particularly those of the Broken Hill group. The copper division is a little uncertain of itself, by reason of the frequent and violent fluctuations in the price of the metal.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price March 14, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	—	7	—	£7 2 10
Charing Cross Ordinary	5	5	8¼ xd	—	7 18 10
do. do. do. 4½ Pref..	4½	4½	8¾	—	6 18 6
Chelsea	5	4	8⅝ xd	—	5 14 4
City of London	9	8	11¼	—	6 14 9
do. do. 6 per cent. Pref.	6	6	10⅝	—	5 14 8
County of London	7	7	1⅝	—	6 15 0
do. 6 per cent. Pref.	6	6	10½	—	5 17 8
Kensington Ordinary	9	7	5⅞ xd	—	6 1 9
London Electric	4	3	1 xd	—	9 0 0
do. do. 6 per cent. Pref.	6	6	4⅛ xd	—	7 5 5
Metropolitan	3½	3	2⅜	—	8 4 8
do. 4½ per cent. Pref.	4½	4½	8	—	7 10 0
St. James' and Pall Mall	10	8	5⅞	—	8 18 10
South London	5	5	8 xd	— ¼	8 6 8
South Metropolitan Pref.	7	7	1¼ xd	+ ½	6 14 0
Westminster Ordinary	9	7	5¾	—	6 1 9
Telegraphs and Telephones.					
	Dividend, 1914.				
Anglo-Am. Tel. Pref.	6		100	—	6 0 0
do. Def.	33/6		21⅝	—	7 16 0
Chile Telephone	8		6⅝	—	6 5 6
Cuba Sub. Ord.	5		7⅜	—	8 9 0
Eastern Extension	7		12⅝	—	*6 5 0
Eastern Tel. Ord.	7		127	—	*6 5 6
Globe Tel. and T. Ord.	6		10⅜	—	*6 10 6
do. Pref.	6		10	—	6 0 0
Great Northern Tel.	22		34½	—	6 7 6
Indo-European	13		49½	—	6 12 6
Marconi	5		1⅜	—	5 8 1
New York Tel. 4½	4½		100¾	—	4 9 4
Oriental Telephone Ord.	10		1¼	—	5 18 6
United R. Plate Tel.	8		5¾	—	*7 19 0
West India and Pan.	1		1	—	9 10 6
Western Telegraph	7		12½	—	*6 5 0
Home Rails.					
Central London, Ord. Assented	4		67½	—	5 18 6
Metropolitan	1½		23	—	4 7 0
do. District	Nil		16	—	Nil
Underground Electric Ordinary	Nil		1⅜	— ⅛	Nil
do. do. "A"	Nil		5/8	—6d.	Nil
do. do. Income	6		81½ xd	— ½	*8 10 0
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6		4⅞	—	6 3 1
Anglo-Arg. Trams, First Pref.	5⅛		3⅝	— ⅛	7 2 0
do. 2nd Pref.	5⅛		8⅝	— ⅛	8 3 0
do. 5 Deb.	5		78	—	6 8 2
Brazil Tractions	4		50⅛	—	6 18 7
Bombay Electric Pref.	6		10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5		53	—2	9 8 8
do. do. Preferred	—		38	—	Nil
do. do. Deferred	—		34	—	Nil
do. do. Deb.	4½		64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—		35	—4	Nil
do. 6 per cent. Bonds	—		35	—	Nil
Mexican Light Common	Nil		20	—2	Nil
do. Pref.	Nil		35	—	Nil
do. 1st Bonds	—		40	—1	—
Manufacturing Companies.					
Babcock & Wilcox	14		2⅞	+ ⅛	5 1 8
British Aluminium Ord.	5		22/9	—	4 8 0
British Insulated Ord.	15		11	—	7 19 1
British Westinghouse Pref.	7½		44/6	—	6 14 6
Callenders	15		11⅛	—	6 10 5
do. 5 Pref.	5		4⅛	—	5 17 8
Castner-Kellner	20		3⅜	—	6 8 0
Edison & Swan, £3 paid	Nil		7/-	—	Nil
do. do. fully paid	Nil		1⅛	—	Nil
do. do. 5 per cent. Deb.	5		60	—	8 6 8
Electric Construction	6		14/9	—	8 1 6
Gen. Elec. Pref.	6		9⅜	—	6 4 8
Henley	20		14⅜	—	*9 10 1
do. 4½ Pref.	4½		4	—	5 12 6
India-Rubber	10		9½	—	*12 19 0
Telegraph Con.	20		34 xd	—1½	*7 19 0

* Allowance made for dividends being paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, March 15th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/4	..
a Ammoniac Sal	,,	£70	..
a Ammonia, Muriate (large crystal)	per ton	£54	..
a Bisulphide of Carbon	,,	£28	..
a Borax	,,	£28	..
a Copper Sulphate	,,	£48	..
a Potash, Chlorate	per lb.	2/1	6d. inc.
a ,, Perchlorate	,,	2/-	..
a Shellac	per cwt.	95/-	..
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	,,	£14	..
a ,, Lump	,,	£9	..
a Soda, Chlorate	per lb.	1/4½	..
a ,, Crystals	per ton	60/-	..
a Sodium Bichromate, casks	per lb.	10d.	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	1/4½ to 1/4⅝	⅛d. dec.
c ,, Tubes (solid drawn)	,,	1/5 to 1/5½	..
c ,, Wire, basis	,,	1/4⅛ to 1/4⅜	⅛d. dec.
c Copper Tubes (solid drawn)	,,	1/6½ to 1/7	..
g ,, Bars (best selected)	per ton	£148	..
g ,, Sheet	,,	£148	..
g ,, Rod	,,	£148	..
d ,, (Electrolytic) Bars	,,	£137	..
d ,, ,, Sheets	,,	£155	..
d ,, ,, Rods	,,	£144	..
d ,, ,, H.C. Wire	per lb.	1/5	..
f Ebonite Rod	,,	2/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/2	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	3/2½	½d. inc.
i Iron Pig (Cleveland warrants)	per ton	85/6	2/6 inc.
l ,, Wire, galv. No. 8, P.O. qual.	,,	£32	..
g Lead, English Pig	,,	£35 15	£2 inc.
g Mercury	per bot.	£16 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e ,, ,, ,, medium	,,	8/6 to 6/-	..
e ,, ,, ,, large	,,	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/8½	..
r Steel, Magnet, in bars	per ton	£85	..
g Tin, Block (English)	,,	£196	£4 inc.
n ,, Wire, Nos. 1 to 16	per lb.	2/9	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Field Water-Purification Plant.—A recent issue of the *Canadian Engineer* contained a description of a portable ultra-violet-ray sterilisation plant, designed and installed by Captain F. A. Dallyn, to provide a better water supply to the Ontario troops in a Canadian camp. The water is pumped from the Niagara River, which is greatly polluted, through a mechanical filter of the reverse-flow type, mounted on a four-wheeled wagon. From this it goes to the sterilising apparatus, passing through three quartz tubes, te each of which is attached an ultra-violet-ray lamp, the emanations reaching the water through the quartz. The tubes, 4 in. long by 1½ in. diam., are carried in a casting, and watertight joints are secured by means of rubber gaskets. Three windows are provided in the casting, through which the operator can watch the lamps, &c. The outfit includes a Westinghouse generator, engine, and Albany pump. Current is supplied by a 2½-KW. 220-volt direct-current dynamo; the pump is a 2½-in. water-sealed rotary type machine, with a capacity of 3,000 gallons at 250 R.P.M. These are driven by a 9-H.P. Lister vertical petrol engine, fitted with automatic pump lubrication, enabling it to run between 200 and 250 hours without refilling the oil chamber, pump-fed carburettor, &c. The plant was purchased by the Government upon the recommendation of the assistant director of medical service; it has reduced the normal count in raw water of 4,000 bacteria per c.c. to from 10 to zero. Colon bacilli were commonly present in 0·01 c.c., but after sterilisation were normally absent in 50 c.c.

Economy in Carbons.—About nine months ago the Electrical Engineering and Equipment Co., Ltd., of 109-111, New Oxford Street, W.C., offered a prize of £25 to the kinematograph operator who could show the biggest saving by the use of "Reflex" carbons during a period of six months, as compared with a similar period using any other make. We are informed that the prize has been awarded to Mr. C. J. Lord, of the Princess Picture Palace, Rawmarsh, Yorks., who reduced his energy consumption from 2,560 to 1,890 units, or 26 per cent., finding that with these carbons he could use a current of 25-30 amperes instead of 30-40 as formerly, and yet get a better and whiter light.

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THE RENAISSANCE OF THE LOW-TENSION FUSE.

By JOHN A. CRABTREE.

(*Concluded from page* 277.)

Reference has already been made to the heating up of the fuse handle. This is, of course, aggravated with longer break fuses, and is an argument against the unnecessary extension of the break. Further, such heat represents wasted energy, and therefore money.

Consider for a moment a 6-way T.P. 4/50-amp. per way 500-volt fuseboard, 6-in. break fuses, as shown in fig. 3. The length of wire will be about 10 in. for each fuse (terminal to terminal) or a total length of 15 ft. The fuses

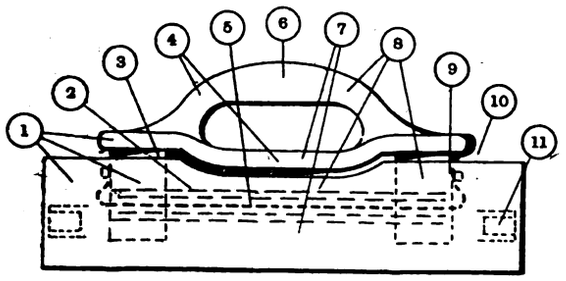

Fig. 3.

are wired with two strands 21 S.W.G. tinned copper, having a total resistance when hot under working conditions of about ·165 ω —

$$\therefore C^2R \text{ loss} = 400 \text{ watts (approx.)}.$$

The yearly cost of this, working 60 hours per week at 1d. per unit = £5.

If, therefore, the same safety could be procured with suitably designed shorter break fuses, having a fuse-wire length of 5 in. from terminal to terminal, a running cost saving has been effected of £2 10s. per annum.

Fuse Wire.—Tinned copper wire is almost universally used, is easily procured and generally handy. The question

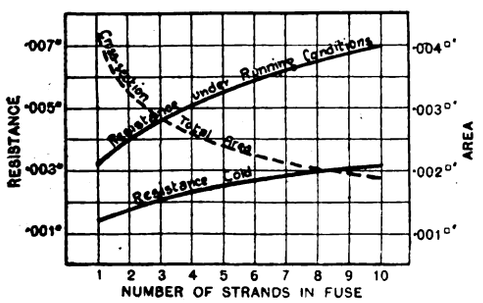

Fig. 4.

of few or many strands requires attention, and here we are between two alternatives. In the graph, fig. 4, are plotted three curves for open-type fuses, blowing at 200 amperes, one curve giving the total cross-sectional area, and the second and third curves the approximate total resistance of various stranded fuse wires (hot and cold).

It will be seen that the greater the number of strands the greater the resistance (and, therefore, the C^2R loss), and the less the total cross-sectional area. It is thus perfectly obvious that while a fuse with few strands will have a greater explosive effect on a "short," owing to the greater amount of metal volatilised, it will be distinctly cooler in working. On the other hand, the many-stranded fuse, while having a lower explosive effect, will have the disadvantage of excessive heating to contend with. Premature blowing, disintegration of the insulation, softening of the spring contact clips, handles too hot to hold, excessive waste of energy—all these are the frequent results of the many-stranded fuse.

That the waste of energy is not entirely a negligible item may be seen by considering a factory wired for 10 50-H.P. motors, 440 volts D.C., and having 20 fuses wired to carry 100 amperes normal. Having the fuses similar to fig. 3, the total C^2R loss (hot) will be :—

For single-strand wire (14 S.W.G.) = 600 watts approx.
For six-strand wire (23 S.W.G.) = 1,100 watts approx.

Allowing for 60 × 50 = 3,000 running hours per annum, we have the following result at 1d. per unit :—

Loss with single-strand wire = £7 10s. per annum.
Loss with six-strand wire = £13 15s. per annum.

Therefore, the additional loss with six strand = £6 5s. per annum, or about 12s. 6d. per annum for each 50-H.P. motor installed.

Porcelain Insulation.—Porcelain is the material almost universally adopted in this country for the insulating shields and handles. It may be said to be fairly cheap to produce, can be moulded to any reasonable requirements, and is an excellent insulator. On the debit side it is brittle, cannot be worked up after firing, cracks badly under local heat, and possesses little mechanical strength. Satisfactory fuse design must make full allowance for these weaknesses, or an unreliable fuse will be the result.

From the national point of view already referred to, one feels compelled to admit that our home Potteries have something yet to learn from the foreign, and particularly the German, competitor. Why this is so, one cannot say. Whether it is a question of the clays used, the mixing, moulding, or firing, is a matter for the Potteries to decide : but undoubtedly the future of our electrical switchgear industry is largely bound up with the enterprise and foresight of our porcelain manufacturers. The firm discovering the secret (if secret it is) of the German porcelain—its clean accuracy, excellent vitreous body, and low price—will find a fortune awaiting it after the war.

Damaged Fuses.—The distinctive forces operating upon the fuse may be classed under five headings.

I. Ordinary wear and tear.
II. The explosive force of the arc.
III. Sudden expansion stresses set up in the insulating material by heat.
IV. Damage to the metallic parts, by arcing.
V. Loosening of parts.

I. *Ordinary Wear and Tear.*—This factor requires attention in all mechanical contrivances, and needs little mention, beyond what is later covered by Sec. IV.

II. *The Explosive Force of the Arc.*—This may be considerable on any but the very smallest of fuses, and unless means are taken to counteract the danger, the fuse will be useless after the first "dead short" or heavy overload. It is, therefore, necessary to make suitable provision. Ample ventilation should be provided, where it is desired that the gases should escape ; and suitable deflectors should be fitted wherever there is any possibility of arcing across poles or to earth. Special safeguards, such as cartridge fuses, magnetic blow-outs &c., need not be here elaborated.

III. *Sudden Expansion Stresses.*—Few designers seem to pay any serious attention to the excessive local heat stresses set up in ordinary fusegear. Yet if the trouble of broken china is sifted to its root cause, it will be found that a large proportion is damaged through this cause.

Take, for example, the old tubular hand-grip fuse. The writer has noticed that a large proportion ultimately fracture, as shown in fig. 1, p. 276. An examination of the fragments shows that the initial cracks are often of long standing, and their gradual extension may be distinctly traced. The last "blow," of course, smashes the handle, already weakened by the earlier cracks, and the internal expansion stresses set up by the sudden heat. It therefore seems a reasonable conclusion that the heavy metallic ends and large cooling flanges at A rapidly absorb the heat, while the central, or hand-grip section B, can only dissipate the heat by a slow radiation. The difference in temperature, therefore, between parts A and B sets up stresses at C, and fractures the china. It has also to be recognised that the rapid heating up of the china round the core hole, also sets up stresses round the outside of the handle, frequently causing this to crack, as at D.

The old ventilated tubular fuse of Reyrolle make was, perhaps, one of the best tubular hand-grip fuses ever made, on account of the special consideration given to the question of ventilation around the fuse wire tube. This ventilation not only served to keep the handle cool for handling, but also prevented undue heat stresses cracking the porcelain.

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It is advisable to keep the hot fuse wire from contact with the porcelain, and the provision of asbestos tubes, braiding or pads, is decidedly necessary to shield the porcelain at the vital parts from the excessive heat.

IV. *Damage to the Metallic Parts by Arcing.*—It is impossible to entirely avoid this when ordinary fuse wire is used. Where fuses of any size are in question, however, it should be possible to so arrange the design that the arcing at the terminal blocks will not affect the re-wiring and contact surfaces. Some fuses burn up the fuse wire terminals, so that it is quite impossible to loosen the screws for re-wiring, and one is compelled in emergency to merely coil the fuse wire round the binding terminal. Others burn up the terminal faces, and occasionally weld fuse and base contacts in one mass. A method sometimes adopted consists in leading the fuse wire through a small hole in the insulation. This works all right if the fuse does not blow in the hole. When it does, however, the cure is as bad as the ill, and a blocked or shattered fuse is the result.

V. *Loosening of Parts.* — This principally occurs on A.C. circuits, but should, of course, be considered as a matter for standard design, and lock-nuts, spring non-return washers, and substantial screw-driver slots to all thumb-nuts and screws, should be supplied without question. Unfortunately, price only too often enters into these refinements of design, and a good fuse is spoilt by the general objection to pay the fractional additional costs entailed.

Cabinets (*Wood and Iron*).—The size and ventilation of cabinets have each a considerable effect upon the fuses enclosed. Fuses that are cool in operation in the open air will often heat up excessively in a confined space, and cause endless trouble. Softened contacts (particularly the upper ones), pitted contact surfaces, and premature fuse blowing, are all the results of this cause. Wherever possible, cases should be suitably ventilated, or have sufficient volumetric capacity and cooling surface to counteract this tendency. The sudden rise in pressure owing to a fuse blowing, has also to be taken into consideration. With conduit wiring, the gases have an opportunity of escaping up the tubes, but where armoured or other cables which present no outlet to the gases, are used, a serious rise in pressure may result. Occasions have been known where locks have been smashed, and heavy doors blown open through this cause. Apart from plain holes, the breathers shown in fig. 5 have been adopted with success.

The clearance from live metal to case requires careful attention, for while a minimum clearance of one inch may

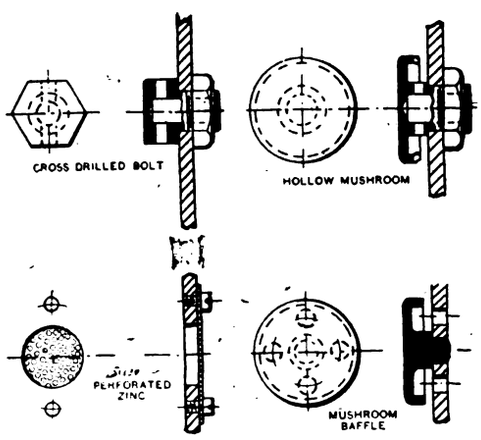

Fig. 5.

be ample under ordinary conditions, there are often circumstances where such a clearance is quite useless. Consider the case of fuses on circuits with an earthed return, where one has the full voltage between the lead in terminals, and the iron case. In the event of a blow, the arc has a strong tendency to jump to earth and burn out the whole fuse-box in a "dead short." Where, therefore, there is any possibility of a fuse blowing to earth, suitable deflector plates or shields should be fitted at the required positions, unless it is possible to combine such shields in the design of the fuse unit. Asbestos lining is often worse than useless, unless well varnished, and micanite or vitreous enamel put a board outside a competitive basis. It is much better to have a correctly designed board than to resort to makeshift safeguards.

Wiring Arrangements.—The question of wiring should be carefully considered, and it is to be regretted that designers are not compelled by law to pass through a stringent course of training, in wiring up their own boards. Boards are often delivered and found to be absolutely unwirable. Battens have to be carved and hacked away, bases packed up, cables twisted into unnatural kinks, and conduit brought all round the case to obtain a suitable entry. It is also to be regretted that buyers seldom know what they want when ordering. To make a first-class job with a board of any size, the position of entry of the cables should be considered, and settled, before the board is set out. The board should be built round the cables, not the cables round the board. For a little extra cost on the layout of the boards, pounds would be saved in the connecting up. Instead of manœuvring heavy cables into impossibly placed sockets, heavy cables should lead in direct, with little or no bending of any kind whatever. Yet how often is the manufactu er held up till the very last minute for the position of the cable entry into the case, and expected to deliver the job complete by return. The buyer arranges his cables to enter N, S, E or W, as it pleases him, and then curses the makers for supplying an unwirable board.

To sum up : We have yet to obtain the ideal fuse, but the following leading features may be considered as essential in its development (see also fig. 3).

1. Substantial, electrically and mechanically.
2. Must pass stringest short-circuit tests without damage to itself.
3. No danger of accidental contact with live parts, whether fuse is "in" or "out."
4. Safe to handle, even if inserting on a short.
5. Fuse wire as short as possible, compatible with safety, and reliability.
6. Well-ventilated handle, cool in handling.
7. Porcelain free from excessive heat stresses.
8. Should not overheat when enclosed in iron case.
9. Easily re-wired, and free from danger of burnt-up terminals.
10. No possibility of arcing to iron case.
11. Fuseboards easily connected up, with as little bending of heavy cables as possible.
12. Inexpensive.

CONTINUOUS-CURRENT RAILWAY MOTORS.

A paper on the above subject, by Mr. E. V. Pannell, was read before the Institution of Electrical Engineers and discussed on March 9th; an abstract of the paper appeared in our last issue.

Mr. F. W. Carter, who opened the discussion, said the paper was very opportune, the subject being highly specialised and the literature on it being behind development. The author was wise in limiting the subject to motors for multiple-unit trains; he thought he attached too much importance to the hourly rating, which was not in any sense a criterion of the service capacity of this type of motor, and there had been considerable discussion as to whether it should be retained for that reason. He, therefore, disagreed that the one-hour rating represented the maximum desirable current during acceleration; although this was probably true of the old tramway motors, modern commutating-pole machines often accelerated at much higher than the one-hour rated capacity. In this country we should require much larger clearances than were indicated by the author in his reference to linear dimensions. When the ventilated motor was first introduced, it was feared that it would pick up dust, snow, &c., but now from 15,000 to 20,000 of this type had been sold by one American concern alone, representing 1½ million H.P. The author was wrong in stating that the Central London motors were semi-ventilated with hollow shafts; some motors of this type for use in America had been experimentally made, but abandoned because of brake dust getting into them, and the Central London motors had solid shafts, like the District motors. Referring to the 200-kw. 1,200-volt ventilated motor shown in fig. 8, the bearings were very small, and a bad feature; they were much smaller than usual, and less than those on the new Lancashire & Yorkshire, and South-Western motors. He thought an extra 4 or 5 inches in bearing length would be required for satisfactory service. The design also showed a lip on the commutator used as an oil thrower, which was a bad feature and would, he suggested, require replacing with a proper oil thrower, and these alterations would, he considered, reduce the core length to less than the 18 in. shown. It was true that roller bearings might be considered, but

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experience with them was lacking. He very much doubted whether a 200-kw. ventilated motor of ordinary design could be got into the ordinary gauge, without recourse to large wheels or roller bearings, even with the smaller commutator due to using 1,200 volts. Artificial limitations, such as due to the one-hour rating, were undesirable.

Prof. S. P. Smith was interested to notice the author's advocacy of field control, although it was in use before the series-parallel control became the vogue; now it was coming back in combination with the latter. The unfortunate part about all such arrangements was that it was not economical to increase the types in use on existing systems, and it might involve great capital cost to convert to field control. He could not quite agree with some of the author's data regarding recently developed machines; the 600 and 1,200-volt. machines were reasonable, but he thought the 1,800-volt machine was open to criticism. For instance, 20 volts average per segment might mean a maximum of 30 volts, which, he thought, would lead to sustained sparking between segments; the segment pitch was necessarily small. It would be interesting to know whether any such voltage had been used. The segments per slot were also numerous, and the design appeared to be an effort to do the work with too small a motor.

Mr. Lydall said inside the motor there was very little room for field connections, and these should be kept to a minimum. In regard to field control, the diverter was one method, but, as mentioned in the paper, it had given trouble through flashing over, and it had been proposed to use a relay to cut out periods of the weak field, but to get a satisfactory relay was the difficulty. Part of the field winding could be cut out in various ways; it was possible to cut out the two bottom poles or alternative poles, but there might be trouble with both ways. Then there was tapping off the middle point, which was, perhaps, the best thing to do. He agreed that it was undesirable to talk about the maximum value of the average voltage, which meant nothing; the factor was the maximum voltage.

It having been suggested by one speaker that diverters might be made inductive with advantage, Mr. Highfield stated that in connection with the series wound Thury machines used by his company the diverters had been altered from non-inductive to inductive with satisfactory results. Previously, they had had trouble with the diverters such as was indicated in the paper.

Mr. Roger Smith, who in the absence of the author had read the paper, replied to one or two points on his behalf. The author, he said, had mentioned that too much importance should not be attached to the one-hour rating, and had advocated service rating. The Engineering Standards Committee had not yet legislated for railway motors in this country, and for the time being we practically used the American standards. He agreed, on behalf of the author, that the 200-kw. ventilated motor shown had serious defects from the railway operating point of view; there was too little clearance between the end of the commutator and bearing. The railway motor was a pure compromise, and the less difficulty put in the way of the designer, and the more they asked only for results, the better the results would be. Field control was one of two things making the d.c. series motor really useful; the other feature was regenerative control, and both were of singular importance in railway work.

CONTROL EQUIPMENTS FOR WINDERS AND HOISTS.

The apparatus illustrated and described in the following article has been specially developed by the British Thomson-Houston Co., of Rugby, for the control of electric motors used for winding and haulage in collieries, and furnace hoists in steel works.

Each equipment consists of a drum-type master controller, a panel on which electrically-operated air-break contactor switches are mounted, and control resistances of the air-cooled type.

The operator can start, stop, and reverse the electric motor by means of the master controller, the contactors closing automatically when the controller handle is moved. The closing of the contactors can only occur in the correct sequence, and each contactor remains open until the motor has accelerated sufficiently to permit additional resistance to be cut out of circuit without excessive current being taken from the line. Thus, even if the operator moves the control handle too quickly from the "off" position to the "full on" position, the current limit relays on the contactor panel will automatically protect the motor against damage and permit it to be started up in the shortest time compatible with safety.

These contactor equipments are particularly suitable for winders and hoists, and possess the following advantages over liquid controllers, as clearly explained in the paper by Mr. J. H. Rider, on "The Power Supply of the Central-Rand Mines Group," read before the Institution of Electrical Engineers on December 9th, 1914.

(*a*) No heavy work is imposed on the driver in operating the control lever.

(*b*) No energy is wasted in continually pumping electrolyte.

(*c*) The full speed of the motor is obtained, as, when the last rotor switch closes, the rotor is metallically short-circuited.

(*d*) No energy is wasted in the rotor resistance during the period of full-speed running, but only during the periods of acceleration and retardation.

(*e*) There is no risk of flashing over, however quickly the control lever is operated.

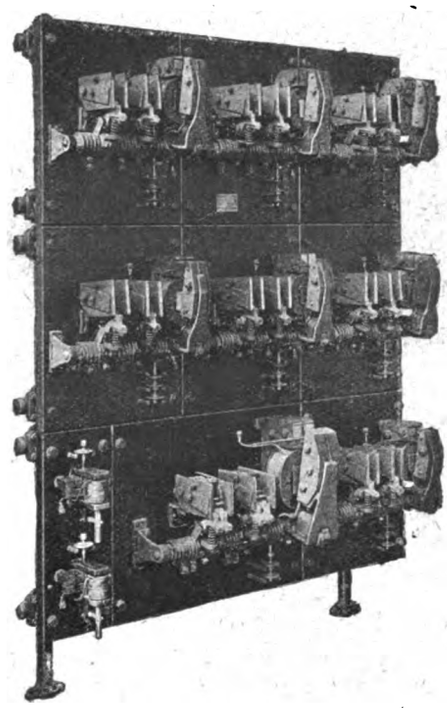

Fig. 1.—Contactor Panel for Rotor Circuit of 400-h.p. Induction Motor.

(*f*) There is no cooling pipe system to be kept clean and in order.

(*g*) The rate of accelerating the speed of the motor is automatically controlled by a relay system, so that, although the control lever may be put right over at the start, no succeeding switch closes until the current, which has increased on the closing of the preceding switch, has fallen to a predetermined and adjustable amount.

Contactor Panels.—For alternating-current slip-ring motors, one set of contactors is provided for opening and reversing

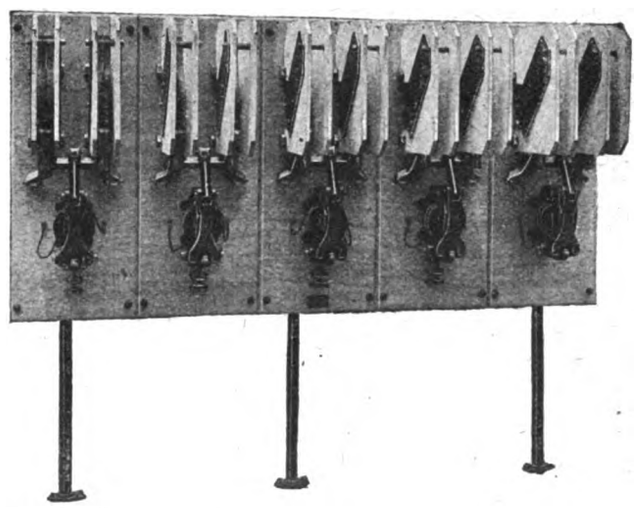

Fig. 2.—Contactor Panel for Reversing Stator Circuit of 3,300-volt Induction Motor.

the stator connections, and another set for short-circuiting the resistance divisions in the rotor circuit.

Air-break contactors are recommended for this service, even for line voltages up to 3,300, as the wear on these is less than that on contactors breaking under oil.

A typical contactor equipment for reversing stator circuits is shown in fig. 2.

The contactor panel shown in fig. 1 is a typical panel for use in the rotor circuit for cutting out the controlling resistances.

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For line voltages of 650 and less the contactors for controlling the stator circuit are mounted on the same panel as the rotor contactors, and are of the same general type as the rotor contactors. A typical panel is shown in fig. 3.

For direct-current motors the contactor panel consists of four contactors used for reversing the armature connections,

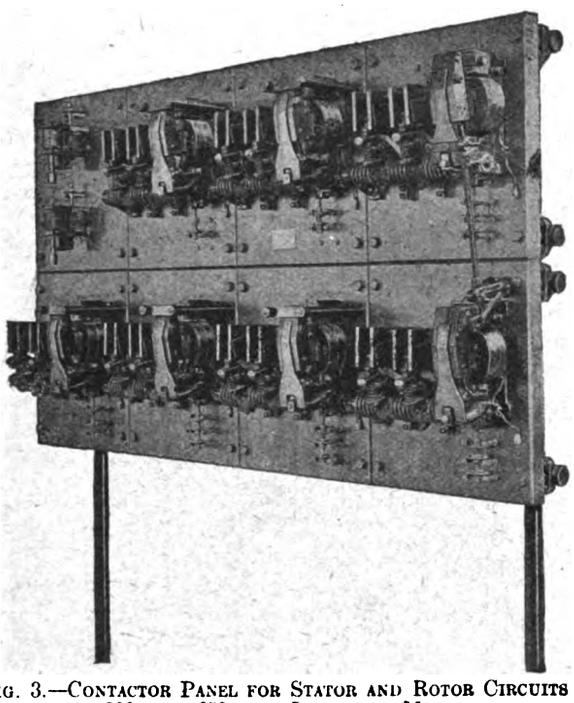

Fig. 3.—Contactor Panel for Stator and Rotor Circuits of 200-h.p., 650-volt Induction Motor.

and a number of other contactors for short-circuiting the divisions of the starting resistance. Fig. 4 shows a typical contactor panel for reversing a direct-current motor.

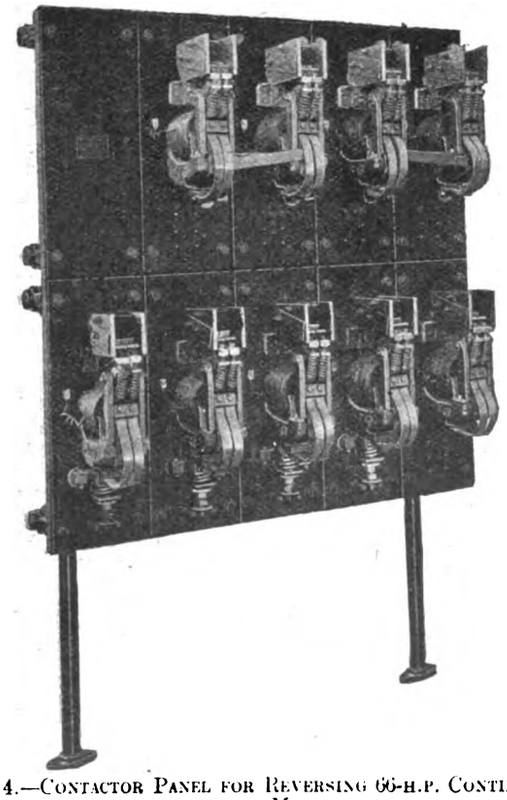

Fig. 4.—Contactor Panel for Reversing 66-h.p. Continuous-current Motor.

Resistances.—The resistances used for this service consist of iron grids mounted on mica insulated rods which are fixed to the main resistance frame. Pure mica washers are used for insulating the grids from each other and from the frame.

For small motors the resistance units are mounted as shown in fig. 5. This form of frame consists of a number of separate boxes, the end castings of each box being arranged with lugs for bolting to similar frames on the top, bottom, and sides, so that any number of boxes can be bolted together to form a complete resistance.

This form of mounting is recommended in cases where the total resistance necessitates the use of not more than six boxes.

For large motors, where more than six resistance boxes are required, the units are mounted as shown in fig. 6. In this case the end castings are dispensed with, and the rods carrying the grids are assembled in an iron pipe framework.

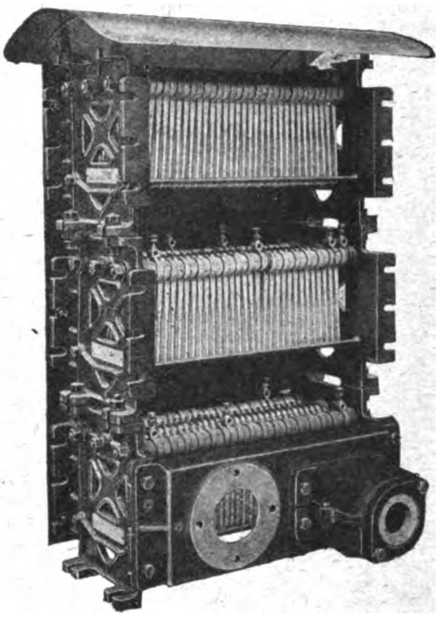

Fig. 5.—Type C G, Form G G, Resistance with Junction Box. (Side cover removed.)

Master Controller.—The motor can be started, stopped, and reversed by means of the master controller, which is of the British Thomson-Houston standard tramway type.

This controller makes or breaks the circuit of the contactor switches, which then automatically controls the current flowing to the motor independent of the operator.

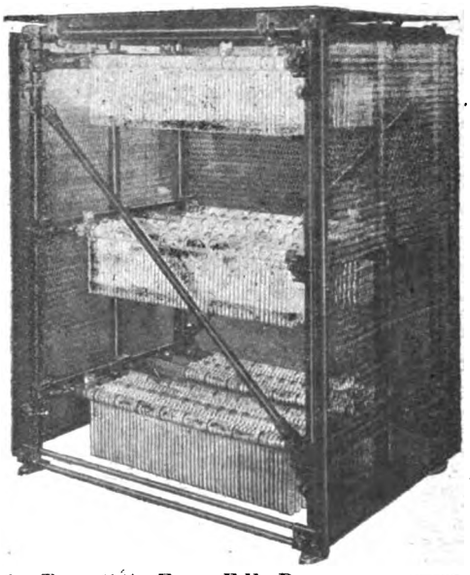

Fig. 6.—Type C G, Form E E, Resistance, fitted with Insulating Rods. (Side cover removed.)

Control equipments as described are operating satisfactorily in mines in Great Britain and other parts of the world.

TAR OILS AS FUEL FOR DIESEL ENGINES.

At the February meeting of the Diesel Engine Users' Association, Mr. W. Batho, of Messrs. Sulzer Bros., remarked that the price at which they had been accustomed to buy mineral oils had been such that there was nothing to induce manufacturers of Diesel engines to expend large sums in experiments; for years past, however, the Continental journals had contained a large amount of information on the subject. In Switzerland, about 140 Diesel engines installed by Messrs. Sulzer Bros. were nearly all running on tar oil prior to the

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outbreak of war, the sizes varying from 20 to 1,000 B.H.P. This tar oil was all imported. Messrs. Sulzer Bros. had carried out long experiments with vertical-retort tar and had designed a special method of burning it. After the outbreak of war they installed their own tar distillation plant, and the results had been very satisfactory. The reason why they installed this plant instead of using ordinary tar was that although the latter gives fairly good results, it is not such a clean and satisfactory fuel as tar oil. Further, vertical-retort tar can, as a rule, only be obtained in small quantities, and other kinds of tar require distillation to make a satisfactory fuel. It is also more economical to use tar oil, as the valuable by-products, such as benzol, toluol, ammoniacal liquors, and anthracene, would be lost if the tar were used direct in the Diesel engine.

In France, where they had installed some 50 engines, tar oil was almost universally in use. The sizes varied from 20 to 3,500 B.H.P.

The greater part of Messrs. Sulzer Bros.' engines run with tar oil without any auxiliary fuel pump, and this refers particularly to their two-stroke engines. A great deal, however, depends upon the conditions under which the engine has to work, and in some cases they have fitted their own design of auxiliary pump with a pilot jet for ignition purposes. They have found that it is not sufficient to inject a drop of oil in a solid state, so to speak, in advance of the main fuel charge, but this ignition drop requires to be properly pulverised in the same way as the main fuel supply. Unless this is done, the initial combustion is impaired, and it also considerably increases the consumption of the ignition fuel.

Light oils, such as benzol, with a low flashpoint, are not suitable for Diesel engines. The heavy tar oils are almost all suitable. It is possible that when oil has been stored, especially during cold weather, a certain amount of crystallisation takes place. These crystals usually consist of fuel of high value, which, by sufficient heating of the tar oil, as a rule become easily dissolved. In purchasing tar oils the following points should be considered :—

The specific gravity should be between 1 and 1.1.

The lowest flashpoint is about 70 deg., but for safety against fire it should be in the neighbourhood of 100 deg. to 130 deg. F.

Tar oils are as a rule dark to almost black. One drop on white paper should show no black residue, as is the case with tar. This black residue means a large percentage of free carbon or other tar ingredients.

The lower calorific value is between 15,800 and 16,500 B.TH.U.

The unburnt residue of tar oil should not exceed 1 per cent.

The amount of water should not exceed 1 per cent.

With coal tar oils the sulphur contained can be from 0.5 to 1 per cent.

If the tar oil contains a high percentage of residue which only begins to vaporise at 400 deg. C., the same results can be expected as with tar; that is to say, one must anticipate a considerable amount of dirt in the engine, and the exhaust valves will require frequent cleaning and grinding in.

With gas tar the most important point is the contents of asphalt and pitch. Tar obtained from the manufacture of gas in vertical retorts can be used without difficulty by the adoption of an auxiliary fuel pump and specially prepared lubricating oil. Tars from horizontal or inclined retorts are not suitable, and they, as well as coke-oven tars, should be distilled for the recovery of tar oil, and in this way brought into use as fuel for Diesel engines.

The specific gravity of coal tar is 1.06 to 1.12.

If the viscosity is over 20 deg. Engler at a temperature of 20 deg. C., the tar is unsuitable for good combustion.

With regard to flashpoint and water, the same remarks apply as to tar oils. It should, however, be carefully noted that when using tar as fuel, certain inconveniences will be experienced, and these will be considerably increased if the amount of water contained in the tar is high.

A thin layer of the fuel poured on to glass or paper should show the smallest possible quantity of black or crystallised deposits.

Tars with a calorific value below 15,500 B.TH.U. are of little use.

The ashes content should not exceed 0.1 per cent.

The sulphur content may be up to 2 per cent.

The impurities that remain after evaporation at 350 deg. C. should not exceed 45 per cent.

Mr. L. W. JOHNSON, of Messrs. Banks, Warner & Co., Ltd., referred to the entirely successful manner in which tar and tar oils had been used in Diesel engines in Germany. In that country the approximate total B.H.P. developed by Diesel engines was 850,000, of which about 150,000 was obtained from tar or tar oils, the corresponding figures for Great Britain being about 80,000 and 1,000 respectively. The lowest import duty on petroleum oils brought into Germany was 36s. a ton, which naturally was a great encouragement to the use of the home product.

A great saving of national wealth might be effected by the use in internal-combustion engines of fuel oil distilled from the coal produced in our own country as compared with the burning of coal in boiler furnaces; he estimated it at 30 million pounds sterling to the consumer per annum, whilst the value of the coal would be increased by fully 75 per cent.

Tar oils have so far chiefly been used for creosoting timber, and most of the available supplies are now sent to the United States; in 1913, 40 per cent. of our total production of tar was exported to America, the approximate amount being 200,000 tons, which would provide nearly a quarter of a million B.H.P. working 3,600 hours. A further large percentage was exported to Germany, and this now also goes to the United States. Lately, however, in America a number of tar distilling plants are being installed, which fact is of much importance to us.

The speaker stated that since the beginning of this year he had been in touch with most of the sources of supply of tar oils in this country, and that out of some 50 firms approached only about a dozen had been able to make any offers at all. Of these, about one-half could supply products which would be suitable for use in Diesel engines, and the total quantity would amount to about five to eight thousand tons per annum. The prices quoted ranged from 2½d. to 6d. a gallon, or, say, £2 10s. to £7 a ton at their works. It seemed probable that a further million gallons of suitable fuel oils could be supplied from other sources. The price of fuel oil suitable for Diesel engines on the Pacific coast of America was said to be 1d. per gallon, and on the Eastern coast of America 2d. per gallon. Owing to taxation of imports in Germany, tar oil had been cheaper to use than even Galician fuel; thus Diesel engines there had been developed to burn tar oils, and the exclusive use of inland fuels had tended to make Germany independent of foreign countries. The value of creating a home product lay in the fact that thereby competition was established with the foreign product, and prices were kept within reasonable limits.

A process for distilling tars obtained from gas works where vertical retorts were used had already been set to work in a neutral country, and the distilled oils were being used on Diesel engines of all sizes and of both low and high speeds with every success, and without the engines being altered for pilot ignition. In most cases, however, pilot ignition had been resorted to in one form or another, and it was only quite recently that any measure of success had attended the experiments made to use the oils without pilot ignition. The chief trouble experienced was that at lighter loads, *i.e.*, below three-quarter loads, the temperature inside the cylinder at the time of opening the fuel valve was not high enough to start and complete the combustion of the main charge.

Mr. JOHNSON referred to an engine of 150 B.H.P., which had been operating absolutely satisfactorily for about three years on ordinary gas works tar. No difficulties had been encountered, and pilot ignition was employed. Several engines had also been tested on distilled tar, and were operating successfully on this product without pilot ignition.

Of the various methods that had been tried for burning tar oils, only two were useful, namely, modifying the design of the fuel valve so as to produce the right conditions for tar oils, or using a pilot charge. The latter was at present the standard for running Diesel engines on tar oil, but the former appeared to be the correct one, as the problem of using tars and tar oils could not be considered solved until such oils could be burned as simply as residual oils. No conclusive results had as yet been obtained, and the whole principle being in its experimental stage, great secrecy was observed. The whole difference, however, appeared to be in the design and operation of the needle valve. What appeard to be required was that quite a small quantity of tar oil should enter the cylinder before, and distinct from, the main charge. This quantity was readily converted into the oil-gas formation necessary to raise the temperature in the combustion space sufficiently to permit of the smooth and complete burning of the main charge. Many experiments were carried out before conclusive evidence was obtained that the experiments were being made on the right lines and that results were possible.

It should be noted that copper, zinc, or alloys of these metals could not be employed in the manufacture of parts in contact with tar oils. Hence steel pipework must be adopted, and the parts of engines, which were generally made of gunmetal or phosphor bronze, had to be made of pure nickel or 25 per cent. nickel steel, while good joints could be made of sheet asbestos after soaking it in gold size or some like substance.

In the discussion which followed, much stress was laid on the advantage which would accrue to users of Diesel engines in this country if they were not in future to be left entirely dependent upon the use of imported petroleum fuel oils. The importance of the question from the national point of view, particularly in the more economical utilisation of the mineral resources of the country, was also referred to.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

CHILE.—Telegraphic information has been received at the Board of Trade, through the Foreign Office, to the effect that the proposed new specific Customs Tariff for Chile has been introduced in the Senate, and will, it is anticipated, be passed by that body very shortly and promulgated as law, in the form sanctioned by the Chamber of Deputies, with some few modifications. A translation of the proposed new Tariff, as approved by the Chamber of Deputies, was issued in 1914 as

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a Parliamentary Return (Cd. 7,458), obtainable from Wyman and Sons, Fetter Lane, London, E.C.

TRINIDAD AND TOBAGO.—The Board of Trade have received the copy of a Resolution which was agreed to on December 10th, 1915, by the Legislative Council of Trinidad and Tobago, amending the duties on certain articles imposed by the Customs Duties Ordinance of 1913 on their importation into the Colony. Among the amendments may be noted the following:—

The duty on machinery—including motor and other engines, steam boilers, and electric machinery *not hereunder specified* (see below), and electric dental appliances, remains the same, viz., 8 per cent. *ad. val.* under the preferential tariff, and 10 per cent. *ad val.* under the general tariff, but the italicised words are new.

The following have been transferred from the free schedule and now have to pay a uniform rate of 2½ per cent. *ad val.*, viz.:—Machinery for electric lighting and power plant on estates or mines (and parts thereof not imported for sale) if admitted as such by the Collector of Customs; machinery for railways and tramways on estates or mines, including rails and rolling stock (and parts thereof, not imported for sale), admitted as such by the Collector of Customs; also agricultural, irrigation, mining, &c., machinery, not imported for sale. Motor vehicles of all kinds, which formerly paid varying specific rates of duty, are now dutiable at the uniform rate of 8 per cent. *ad val.* under the preferential tariff and 10 per cent. *ad val.* under the general tariff.

NETHERLANDS.—The exportation from the Netherlands of rubber, gutta-percha, and articles manufactured therefrom was prohibited by a Royal Decree promulgated on January 26th.

GREECE.—In virtue of a Greek Royal Decree of October 31st last, certain tools, machinery, instruments, and utensils of agriculture and the branches of industry connected therewith, when imported into Greece by Agricultural Associations for their own use or for sale or loan to members of an Association, are to be exempted from import duty, also from municipal, communal, harbour, or any other tax. In the list of implements and machinery specified in the Decree appear the following:—Motors of agricultural machines, *i.e.*, motors worked by horse, steam, or electric power, crude petroleum and benzine (petrol) motors; means for the conveyance of motive power, *i.e.*, belts, cogged wheels, chains and wire for transmitting electric power; and pumps.

UNITED STATES OF AMERICA.—A Circular recently issued by the United States Treasury Department contains the text of revised regulations, which came into force on February 1st, regarding the procedure for the exportation of merchandise to foreign countries or shipped to or from non-contiguous territory of the United States. The full text of the Circular, which gives detailed instructions with regard to various export matters, may be consulted at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

BRITISH DOMINIONS AND COLONIES, &c.—Information relating to the rates of import duty leviable in the British Self-Governing Dominions, Colonies, Possessions, and Protectorates is contained in the Return recently published by the Board of Trade on "Colonial Import Duties, 1915." The Return is arranged with the object of bringing together the various tariff classifications and rates of duty for each principal group of articles, the information being shown for each British Possession under each group. Electrical machinery and apparatus (including wireless telegraphy) forms one of the headings into which the groups are divided. Other particulars included in the Return are details of the preferential tariff advantages accorded in certain Dominions and Colonies in favour of British goods; information respecting tariff valuations, the levying of duties on the gross or net weight of goods imported at specific rates; tare allowances; Colonial copyright laws and regulations; parcel post regulations affecting dutiable articles sent from the United Kingdom; and a detailed statement of the *export* duties leviable in the various Dominions and Colonies, &c. The Return is obtainable from Messrs. Wyman & Sons, Ltd., Fetter Lane, E.C., reference number Cd. 8,094, price 4s. 2d., post free 4s. 9d.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

2,920. "Means of control for petrol-electric cars." W. A. Stevens. February 28th.

2,924. "Means for controlling the ignition period in magneto-electric machines." H. Green. February 28th.

2,945. "Electrical contacts." M. W. F. Petmeky & A. W. Sherriff. February 28th.

2,959. "Feed-pump pressure regulators." British Thomson-Houston Co. February 28th.

2,96[illegible]. "Electrolysis of solutions of alkali chlorides." W. T. Gidden. February 28th.

2,968. "Galvanic batteries." G. Fuller, G. J. A. Fuller, & L. Fuller. February 28th.

2,976. "Variable capacity for wave-transmission systems." W. Haddon. February 28th.

2,977. "Electric heaters." E. C. R. Marks (Landers, Frary & Clark). February 28th.

2,986. "Electric cables." Callender's Cable & Construction Co. and T. O. Callender. February 28th.

3,006. "Ships' telegraphic apparatus, &c." E. A. Lambert. February 29th.

3,029. "Electric battery lamp." J. E. Hamilton. February 29th.

3,036. "Polyphase alternating electric current commutator machines." British Thomson-Houston Co. & N. Shuttleworth. February 29th.

3,052. "Electric condensers." M. O'Gorman & R. Whiddington. March 1st.

3,057. "Magneto electric machines." H. Green. March 1st.

3,059. "Cleat for carrying two separate wires or cables." J. E. Grocott. March 1st.

3,062. "Sparking plugs for internal-combustion engines." A. T. Austin. March 1st.

3,067. "Electric furnaces." H. Etchells & H. A. Greaves. March 1st.

3,076. "Electric welding or fusion-deposition of metals." A. P. Strommenger. March 1st.

3,084. "Electrolytic production of sodium perborate." Deutsche Gold-und Silber-Scheideanstalt vorm Rossler. March 1st. (Germany, March 10th, 1915.)

3,087. "Electric switches, especially for controlling electric motors." P. S. Brook & J. A. Hirst. March 1st.

3,088. "Method of reducing electrode consumption in electric steel-melting furnaces." V. Stobie. March 1st.

3,099. "Electrolytic production of sodium perborate." Deutsche Gold-und Silber-Scheideanstalt vorm Rossler. March 1st.

3,114. "Means for regulating voltage of direct-current dynamo." E. Schneider. March 1st.

3,122. "Magneto-electric machines." F. L. Hollister. March 1st.

3,161. "Battery cells." W. L. Walker. March 2nd. (U.S.A., March 17th, 1915.)

3,164. "Means for suspending and insulating electrical conductors." H. A. Ewen & Marconi's Wireless Telegraph Co. March 2nd.

3,165. "Studs or electrodes of electric dischargers." H. M. Dowsett and Marconi's Wireless Telegraph Co. March 2nd.

3,166. "Aeroplanes." Marconi's Wireless Telegraph Co. March 2nd.

3,169. "Apparatus for heating air or gases." British Thomson-Houston Co. March 2nd.

3,192. "Dynamo-electric machines." H. Chitty. March 2nd.

3,227. "Earthed concentric electric wiring systems." G. S. Boothroyd and Callender's Cable and Construction Co. March 3rd.

3,230. "Driving mechanism for machines." British Thomson-Houston Co. (General Electric Co.). March 3rd.

3,233. "Measuring instruments, relays, &c." H. A. Ewen & Marconi's Wireless Telegraph Co. March 3rd.

3,234. "Dynamometers." W. G. Walker. March 3rd.

3,254. "Electrical measuring apparatus." F. Wunsch. March 3rd. (U.S.A., March 4th, 1915.)

3,255. "Voltage regulating systems for electrical circuits." R. E. Gilmor (Sperry Gyroscope Co.). March 3rd.

3,286. "Electric cable drums, reels, &c." E. Edwards & H. G. Woods. March 4th.

3,294. "Electric incandescent arc devices." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 4th.

3,298. "Electric switches." A. H. Midgley and C. A. Vandervell & Co. March 4th.

3,299. "High-tension magnetos." A. H. Midgley and C. A. Vandervell and Co. March 4th.

PUBLISHED SPECIFICATIONS.

1914.

1,405. Continuous-current Generators. Fried. Krupp Akt. Ges. January 19th. (January 31st, 1913. Addition to 1,407/13.)

12,282. Polyphase Commutator Dynamos and Motors. A. Heyland. May 18th. (June 14th, 1913.)

23,107. Electrical Switches. F. B. Cox & Smith. November 26th. (Addition to 23,162/12.)

1915.

596. Automatic Electro-dynamic Brake System for Feed Reels and the like. H. V. James. January 14th.

1,076. Heating Unit or Resistance Element for Electric Heating Apparatus. A. Slatter & G. Wilde. January 22nd.

2,250. Convertible Electric Fire. E. A. Welch. February 12th.

2,312. Electrical Heating Apparatus. A. F. Berry. February 12th.

2,328. Electric Switches or Devices for Making or Breaking Electric Contacts. F. A. Humphreys, B. A. Quint, & E. J. Felt. February 13th.

2,532. Controllers for Electric Lifts. C. G. Major & Smith, Major and Stevens, Ltd. February 17th.

2,618. Dynamo-electric Machines. Crompton & Co. and N. Pensabene. February 18th.

2,696. Tubular Electric Pocket Lamps. E. C. R. Marks (Interstate Novelty Co.). February 19th.

2,698. Method of rendering articles made of Porcelain, Pottery, Glass, and the like, Electrically Conductive for the purpose of enabling the Deposition thereon of Metallic Coatings by Electrolysis to be effected. P. Marino. February 19th.

3,987. Printing Telegraph Receivers. Western Electric Co. (A. F. Dixon). March 13th. (March 19th, 1914.)

5,351. Electrically-heated Hot-air Syringe for Dental or Surgical use. J. M. Vaughan. April 9th.

7,704. Telephone Systems. Relay Automatic Telephone Co. & L. C. Bygrave. May 22nd.

9,279. Targets for X-ray Tubes and the like. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 24th.

11,818. Electrolytic Refining of Tin. W. J. Mellersh-Jackson (American Smelting & Refining Co.). August 16th.

12,892. Electric Lock Switches. G. W. Bowen. September 8th.

12,951. Electro-magnetically Controlled Valves for use in connection with the Electro-pneumatic Actions of Organs. H. Willis, Jun. September 9th.

13,985. Dynamo-electric Machines for the Starting and Ignition of Internal-combustion Engines. British Westinghouse Electric & Manufacturing Co. October 2nd. (October 3rd, 1914.)

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THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE ADVISORY COUNCIL.

SOME months ago we recorded the appointment by the Board of Education of the Advisory Council for industrial and scientific research, responsible to a special committee of the Privy Council, and charged with the duty of organising and promoting the investigation of scientific problems bearing on trade and industry, and the elaboration of improved processes of manufacture, with a view to rendering our industries independent of foreign, and particularly German, methods and products. Since then the Council has been engaged in laying the foundations of the organisation which must be erected in order to achieve its purposes, and has made considerable progress, not only in connection with the machinery through which its operations will be conducted, but also in setting on foot a number of researches, with a view to avoiding loss of time—for the matter is of great urgency. We have already announced that grants have been made to the Institution of Electrical Engineers towards meeting the cost of researches on the heating of buried cables, and the properties of insulating oils; similar grants have been allocated to other scientific bodies for specific purposes, and other proposals are under consideration.

The Advisory Council, as originally constituted, comprised only seven scientific members and an administrative chairman; obviously so small a body could not possibly cope with the immense task which lay before it, and the Council has wisely adopted the principal of devolution, in order that full justice may be done to every branch of industry. Strong standing committees of experts in Mining and Metallurgy have already been constituted under the chairmanship of distinguished specialists, and a similar committee will shortly be constituted for Engineering. We particularly wish to emphasise the fact that the personnel of these committees comprises only men who are in the foremost rank in their respective branches of industry and science, and that they have been chosen with the most scrupulous care and circumspection. We may confidently hope, therefore, that the work of the various sections will be directed into profitable paths and will speedily bear good fruit.

In addition to the activities briefly indicated above—which represent a considerable expenditure of time and labour—the Council has obtained particulars of the research work which is already being carried on by the scientific and professional societies, and by the universities and higher technical schools, with a view to the establishment of a register of research and the prevention of overlapping. It is even possible that in the near future steps may be taken to collect information as to the research work of manufacturing firms. We cannot afford to waste energy and money by duplication.

Another important branch of the Advisory Council's work is the training of an adequate supply of research workers, and though it is impossible during the war to make much progress in this direction, the Council is very much alive to the urgency of the matter, and has made recommendations for immediate action, in order that whatever can be done shall be done. The University of Oxford, acting independently, recently took steps to ensure that honours students in chemistry should be obliged to take up research work, and no doubt this excellent example will be followed. It may be hoped that we

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are on the eve of fundamental changes in our educational system—changes long overdue—which will inevitably include the elevation of science to the position to which it is justly entitled in the education and training of those who are destined to be the nation's leaders in art, industry, and administration.

The Voice of Australia.

For some months past we have followed with great interest the speeches that have been delivered in Australia by the Prime Minister of the Commonwealth. Quite early after the outbreak of war he recognised the strength of the bands which Germany had been winding around the resources of the British Empire, and he determined that, so far as Australia was concerned, those bands should be snapped. The policy adopted in the Empire's hour of emergency was developed as the needs of the situation became more clearly defined, and most thoroughly has such policy been applied with a view to ridding Australian industrial, economic, and public life of the last vestige of German influence wherever it was recognisable. Readers of this journal have been kept cognisant of the main features and progress of the movement. Australia needed a strong man for the emergency, and he was at hand in the person of Mr. W. M. Hughes, and when they found that their strong man was prepared to act they backed him up in practically everything that he did. He is not a man to employ half-hearted measures. Was he not first and foremost a Labour man? A Democrat of Democrats, and therefore an out-and-out Autocrat? The records of the application of his policy have shown that he and his supporters prefer to act too drastically rather than leave danger lurking beside the pathway. It was in the interests of the Empire and of the Allies, as well as of Australia, that the metal industries were freed from the Teutonic entanglements in which they had become so enmeshed, and what was done in the case of those industries led also to the strangling of many another concern in which German influence was discovered. It had been supposed that when Mr. Hughes reached the Mother Country he would have obtained another view of certain matters, but the speeches that he has delivered here during the past fortnight have all the invigorating influence and force that marked his progress as he pushed aside whatever opposition came in his way in the Commonwealth. In the main, the speeches that have been stirring the people here are similar to those delivered in Australia—we detect no relenting tendency. He wants us to know that the daughter heart of Australia beats with the heart of the Mother Country in her hour of need, and that the sword of her sons is whetted to slay those who are a menace at our threshold. He wants us to recognise that the material resources of the Empire should be so organised and controlled that that Empire shall be independent of those who aimed to dominate it. He wants us to see that what Australia has done is but the beginning of what the whole Empire should do in order to prevent future economic domination by those with whom we are at war. We welcome his speeches as much because they have come at the psychological moment as because of their invigorating spirit and strength. We learned before he came that he had some very plain truths to utter in our midst. Certainly the beds of some of our legislators must be a little draughty in these breezy days. If Mr. Hughes were to remain here we might hear less of the wait-and-see murmurings; there might be some mistakes made; the fat might be more frequently in the political fire; but we should not be told one day of Germany's head or helmet being safely under never to rise again, and on another hear the disappointing assurances that we shall arrive at and depart from the great Economic Conference at Paris entirely uncommitted to any future trade policy. Mr. Hughes sees the danger of putting things off, and on behalf of the great Commonwealth that he represents he asks us to proceed to effectively, systematically, and scientifically organise the resources of the Empire and deal *right now* with a number of after-the-war trade questions. "To wait until the end of the war is to play directly into the hands of our enemy, to help him to keep up his national spirits." "To delay the public declaration of what our trade policy is to be is to make the work of attempting to eradicate German influence in our midst infinitely more difficult and to make any radical change after the war impossible." "This is our hour, our opportunity, which being let slip, will pass for ever." Mr. Hughes holds that if we acted promptly and definitely the Allies would follow our lead, and our organised economic menace, added to our strengthened military and naval resources, would cause German credit and confidence to topple like a house of cards. We hope that when Mr. Hughes has left these shores we shall not slumber again, but shall find that among the statesmen in the Cabinet there are some who will show their colours and speak out. Has not the Minister of Munitions completed his great work?

Rubber.

Fluctuations in the price of crude rubber within the past few weeks were much more restricted than in the course of the previous month, the market having displayed a degree of stability which has helped in keeping the demand from consumers on a very satisfactory scale. In these days of precarious shipping or fears of vessels carrying rubber being interfered with by hostile cruisers or seriously delayed in reaching their destination, manufacturers are obviously more inclined to provide for their needs well ahead rather than to run the risk of being caught short of the commodity. For this reason, there is ground for believing that consumers hold a fair amount of stock as a safeguard, which is, moreover, quite in keeping with the enormous consumption going on.

Rubber continues quite a free market, and contrary to the rumours circulated recently, the Government is hardly likely to interfere with trading in this commodity as has happened in most metals, with a view to eliminating speculative transactions. In any case, the price of rubber does not appear to be unduly high, and it is chiefly determined by the progress of the legitimate demand, and not so much by the attitude of dealers. The price of fine plantation rubber fluctuated so far this year between abont 4s. 3d. and 3s. 1d. per lb., and has again improved to about 3s. 9d., though this has been followed by another setback just lately of a few pence per lb. due to a more conservative demand from consumers, and a little more pressure to sell on the part of dealers who were tempted to nurse a little stock owing to apprehension as to the delayed arrival of a big cargo, which was anxiously awaited, but has since been reported. The market is thus once again in a pretty comfortable position, and although there is no eager demand for the time being, the run of business continues moderately good, and the deliveries are making satisfactory progress. There is, at any rate, no serious accumulation of stocks, while the discharge of vessels is usually much delayed through lack of labour. The progress of consumption has been really wonderful.

War requirements have undoubtedly materially contributed to the much greater activity of the manufacturing trades in allied countries, but the huge increase which has taken place in trans-Atlantic trade requirements has been proved the most important factor in market developments within the past year, as indicated by the huge swelling of the shipments to American ports from this side and Eastern centres direct, as well as from Brazil. It is estimated that the world's production for the past year was, roughly, 150 000 tons, two-thirds of which represented plantation grades, and the other third wild rubber. The plantation output must be expected to show a further big increase this year to at least 130,000 tons, but the chances are that the surplus will be steadily absorbed by the ever-increasing outlet, provided prices are not unduly raised.

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THREE-PHASE EXTENSIONS AT BURNLEY.

Reference was recently made in our pages to the inauguration of three-phase plant in connection with the Burnley Corporation electricity undertaking, which has developed beyond the limits of economical direct-current distribution for industrial purposes.

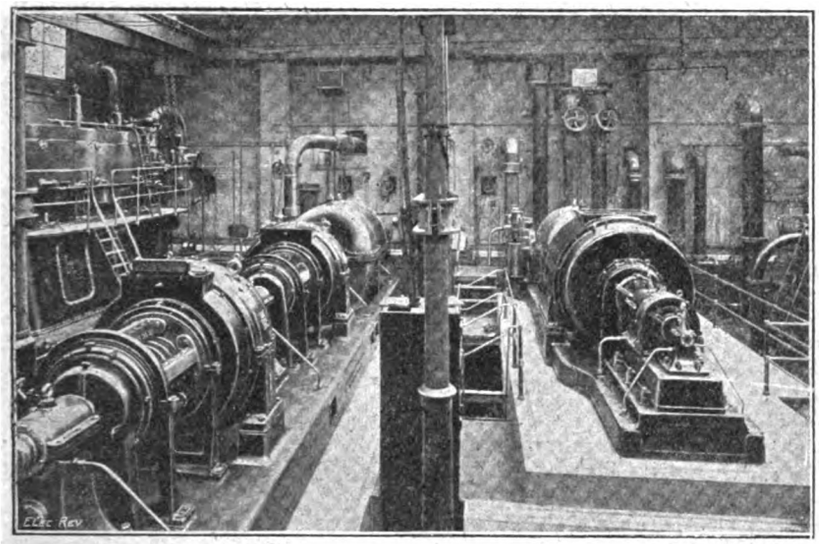

Fig. 1.—Turbine Plant at Burnley; New Plant on the right.

As previously mentioned, the new plant consists of a turbo-alternator with rotary converters and switchgear at the generating station, and rotary converter equipment at a new sub-station which has been erected at Holmby Street, in a part of the town where the load is rapidly developing. Through the courtesy of the British Westinghouse Co., the contractors for the new equipment, we are enabled to publish some views which will indicate the position of affairs.

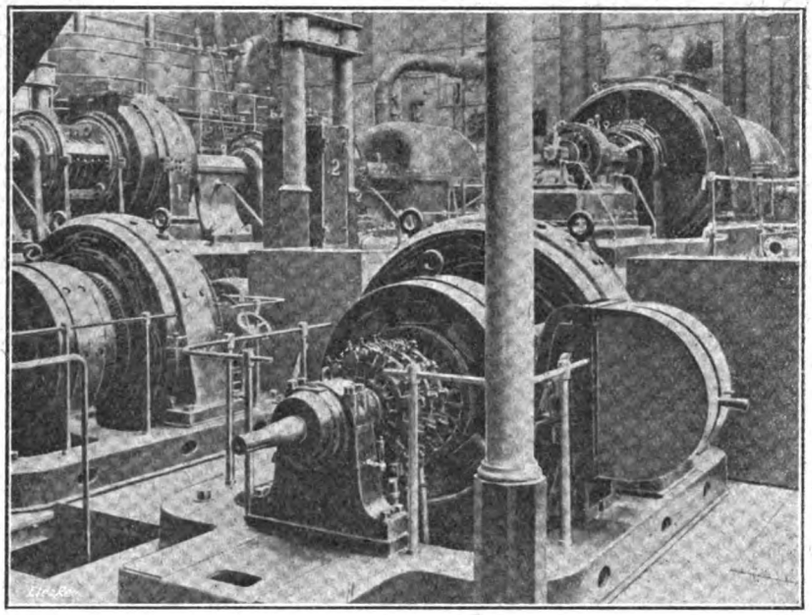

Fig. 2.—Rotary Converters at Burnley Electricity Works.

Fig. 1 shows the new turbo-alternator, which has an output of 2,000 kw. at 6,600 volts, and generates three-phase current at 50 cycles, its speed being 3,000 r.p.m.: beside it is a 1,500-kw. tandem direct-current turbine set installed in 1909, the two turbine units being sandwiched in between older high-speed reciprocating direct-current sets.

The new turbine is of the Westinghouse-Rateau impulse type, operating on steam at 160 lb. pressure, superheated 100° F., and it exhausts into a Westinghouse-Leblanc surface condenser plant, of which a feature is the turbine-driven auxiliary set, consisting of Leblanc air, extraction and circulating pumps coupled direct to a 90-b.h.p. impulse turbine running at 2,500 r.p.m. This auxiliary turbine is supplied with boiler-pressure steam and exhausts into the main turbine through a back-pressure valve.

The turbo-alternator and auxiliary plant are designed for a 25 per cent. overload for two hours.

Fig. 2 shows the rotary converter plant installed at the power station, and occupying a position under the high-tension switchboard gallery (which is not visible in the view). These machines, two in number, are each designed for an output of 600 kw., six-phase, converting from 370 volts a.c. to 460/500 volts d.c. (shunt) or 500/550 volts d.c. (compound), and can supply either the lighting or traction load in parallel with the older plant.

Each machine has an exciter and booster mounted on the shaft and a starting motor can be added later, but at present the machines are started from the d.c. side; three diverters are also provided, one across the interpole winding for traction supply, and two for use when on lighting load, one being across the reversed series winding.

The starting is done through five point switches connected to starting resistances; a throw-over switch on the machine provides for changing over the d.c. supply. The machine shafts are fitted with oscillators, and the transformers are of the oil-immersed self-cooling type, each of 700 k.v.a. capacity.

The h.t. switchgear is of the cubicle pattern, with oil switches electrically operated from controllers of the loose-handle type, mounted on the switch panels on the gallery; in addition to the turbine set and converter transformers, two outgoing 1,000-kw. feeders are controlled from this board.

In the case of the oil-switchgear, the three-phases are kept separate, and this practice is followed throughout the structure; two sets of bus-bars are also provided, with a coupling switch for use as required. Inverse time-limit overload relay

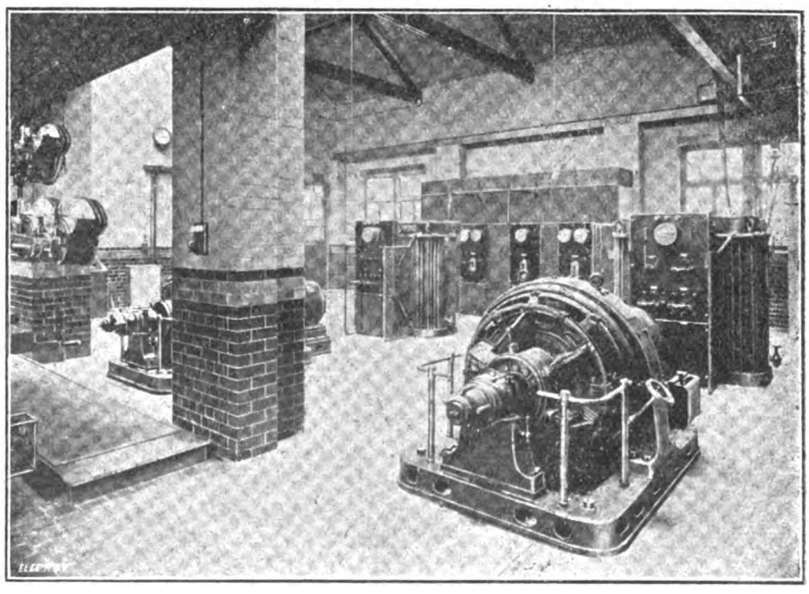

Fig. 3.—Interior of the Holmby Street Sub-station, Burnley.

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and reverse power relays are provided on the turbine and converter circuits, and overload relays on the feeders.

The same gallery contains the traction switchboard, which, in addition to the generator feeder circuits, also provides for the traction supply from the new converters.

Fig. 3 illustrates the interior of the new Holmby Street sub-station, which is equipped with two 300-KW. rotary converters and the necessary transformers; the converters are equipped with induction motors for starting, the connections employed being those of the Westinghouse self-synchronising method. The machines are arranged to supply either the lighting or traction bus-bars.

The A.C. oil switchgear is of the mechanically-operated type, the switches being mounted in cubicles behind the control panels as shown in the view, and controlled by time-limit overload relays. The direct-current switchgear for the converters, and lighting and traction supply is generally similar to that installed at the power station, but only reverse-current relays are provided in the converter circuits.

We are indebted to Mr. Starkie, the borough electrical engineer, and to the British Westinghouse Co., for the particulars here given.

THE RESISTANCE OF A CUBE.

By F. W. CARTER.

The problem of the resistance between opposite corners of a cube of sheet metal referred to in your issue of February 4th appears still open to discussion. The reason of this is, perhaps, that the problem, unlike that of the cube of wires, is an indeterminate one, not only as regards the manner in which the resistance of a side should be taken, but also as regards the resistance of the cube itself. If the resistance of a side be taken to mean that between opposite edges, then the only definite meaning that can be ascribed to the resistance of the cube between opposite corners is the theoretical one, which makes the resistance infinite. If, on the other hand, the resistance of a side be taken as that between its opposite corners, as surmised by Mr. A. J. Makower, in your issue of March 3rd, then this resistance itself is theoretically infinite and practically indefinite, so that it cannot well be given the value 1 ohm.

The problem of the flow of current between opposite corners of a square plate is familiar to mathematicians, and can be solved completely in terms of inverse elliptic functions. For the present purpose, however, it is not necessary to attempt a complete solution if the assumption be permitted that, close to the corner, the current flows in radial lines from or to the corner, so that the equipotential lines near to the corner are quadrants of circles. Let the resistance from the corner to a certain small radius x_2 (see fig. 1) be R_1 at each of the corners to which leads are attached, and let the resistance of the middle portion of the plate be R_2. The total resistance of the plate is accordingly:—

$$R = 2R_1 + R_2.$$

In this equation R_2 refers to an area containing nothing of a singular nature, and is accordingly finite. With regard to R_1, however, if t is the thickness of the plate, and ρ the specific resistance of its material, the resistance of the portion between x and $x + dx$ is:—

$$\rho\, dx / \tfrac{1}{2}\pi x t,$$

hence the total resistance between radii x_1 and x_2 is:—

$$R_1 = \frac{2\rho}{\pi t}\int_{x_1}^{x_2}\frac{dx}{x} = \frac{2\rho}{\pi t}\log\frac{x_2}{x_1}.$$

At the corner x_1 is zero, and R_1 is accordingly logarithmically infinite. In practice this is to be interpreted that the resistance of the plate, as measured between opposite corners, depends on the precise form of the corners, and on the size, shape and nature of the contact of the leads which bring the current to the plate. In other words, there is no definite value other than infinity that can be assigned to the resistance in question. For a similar reason, the only value that can be assigned to the resistance between opposite corners of the cube is a logarithmic infinity, and practical measurement would yield indefinite results.

The distinction between the present problem and that of the wire cube is that in the latter the conductors are conceived as of one dimension, and, accordingly, the leads may be supposed to enter at a point. In the present problem, however, the conductors being of two dimensions, the current should enter along a line; for example, a definite

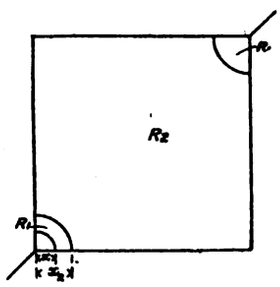

Fig. 1.

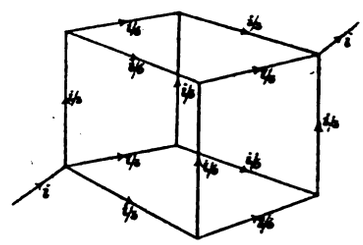

Fig. 2.

value could be assigned to the resistance between pairs of opposite edges of the cube. Similarly, in a three-dimensional problem, the current must enter over an area if the resistance is to be finite.

With regard to the problem of the cube of wire, the author, recently looking over some lecture notes, taken at Sir J. Larmor's lectures more than 20 years ago, came upon the same problem, and as the solution was conducted with a total absence of verbiage and terminated with a valuable bit of advice, it may be worth reproduction here (see fig. 2):—

"$\frac{1}{3} + \frac{1}{6} + \frac{1}{3} = \frac{5}{6}$.

Tip.—Always make the most of symmetry."

LEGAL.

Tyrell v. Smithfield Markets Electric Supply Co., Ltd.

In the City of London Court, on Monday, this case was mentioned. Plaintiff, Mrs. Tyrell, widow of Edward A. Tyrell, made a claim against the defendants for compensation under the Workmen's Compensation Act for the death of her husband, who was an assistant engine driver in the defendants' service. He met his death on February 7th while working at Smithfield Market, and was 38 years of age. He left a widow and three children. Defendants paid £300 into Court, and as that was the full sum which the plaintiff could claim, the amount was accepted. Judge Atherley-Jones, K.C., in sanctioning the settlement, apportioned the money between the widow and the children. Mrs. Tyrell said she wanted the Court to invest the money in War saving certificates, as in consequence of her husband being insured she had money in hand to last for some time, and she intended to try to earn her own living. Defendants had been paying her late husband's wages to her in full since his death. Mr. G. A. Powell attended on behalf of the defendants to explain matters on plaintiff's behalf. Judge Atherley-Jones thanked him for his kind assistance to the widow, and ordered the investment of the money as suggested.

Telephone Dispute.

The Postmaster-General sued the Arsenal Football Club, Ltd., Avenell Road, Highbury, in the City of London Court, on Tuesday, for £4 2s. 6d. telephone fees. The case for the Postmaster-General was that the Woolwich Arsenal Football Club, Ltd., signed a telephone agreement six years ago, and that the present defendants took over the telephone two years ago. They had paid the rent, and then the service was disconnected because rent was left unpaid, and the Postmaster-General now compromised his claim for six months' notice by suing for a quarter's rent in lieu of notice.

Defendants' solicitor said that the defendant company had never been asked for any agreement, nor had they ever signed any. They had had no benefit for the period sued for. The Postmaster-General could not claim under an assumed contract.

Judge Rentoul, K.C.: The company that signed the agreement is wound up. Another company has informally taken over the telephone and occupied the premises, and paid for two quarters. It was cut off through the non-payment of rent. That happens to all of us sometimes through being away or overlooking the notice of payment. It happened to me once. There is no defence here. Judgment for the plaintiff, with costs.

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CONTINUOUS CURRENT RAILWAY MOTORS.

At a meeting of the Manchester Local Section of the Institution of Electrical Engineers, on March 8th, Mr. E. V. Pannell's paper on "Continuous-current Railway Motors" was read and discussed.

The Chairman, Mr. B. Welbourn, said that some exceedingly valuable experimental work was being conducted in the United States, which would probably have considerable influence on the character of the electrification of railways to be carried out during the next few years.

Mr. T. Ferguson said that in describing a typical urban heavy railway service the author had emphasised the desirability of minimum weight. This was a most important point, and deserved much closer attention. In countries where coal was expensive, for instance, in the Argentine, the annual cost of carrying an extra ton of equipment on a city and suburban service might easily reach £10. The adoption of a motor equipment consisting of two large motors, rather than four small ones, had much to recommend it, and for an urban service it might pay to adopt an acceleration of about 1 m.p.h. per second rather than 1½ m.p.h. per second, in order to use a two-motor equipment. The saving in the cost and weight accruing from the use of the two-motor equipment was great. It was good practice to adopt the largest motor applicable to standard wheels, having due regard to preserving sufficient clearance above rail level and below the car floor, as with increase of traffic there was an invariable tendency to push up the schedule to the utmost limits of the motor capacity. He preferred separately-driven blowers to fans, as the volume of air and, consequently, the continuous rating of the motor was considerably increased. The author stated that for frequent stopping service involving rapid acceleration the non-saturated field was preferable. However, it was to be borne in mind that the non-saturated motor was heavier than the saturated motor of the same speed. With short runs it was generally better to employ the material in making a low-speed motor in order to avoid rheostatic losses during acceleration—assuming, of course, that it was not possible to make a further increase in the gear ratio. Each case required a very careful study of conditions.

Mr. J. S. Peck said that the ventilated design had not been introduced extensively into this country, but as tramway systems increased and railways were electrified it would certainly be adopted. A great trouble with the old design of motor was the unprotected ends of the armature windings, which accumulated dust. Modern designs enclosed the whole end winding in a canvas cover, also, the ducts inside the armature had been eliminated, or placed so that they could not possibly damage the insulation of the coils. In many armatures the insulation at the end of the slot had been reinforced, so that the coil was protected at its weakest point, *i.e.*, where it left the core. Large modern motors were insulated practically throughout with mica and asbestos, which ensured good insulation even when the machine was run at temperatures exceeding 100 deg. C. It had taken a long time, even after the introduction of the commutating pole, to produce a motor which would operate satisfactorily even at 1,200 volts, and the majority of railway engineers of to-day would probably hesitate to accept 1,800 volts on a four-pole motor of ordinary construction.

Mr. J. Frith sounded a note of warning against the constant temptation on the part of manufacturers to make use of the fact that commutating poles had taken away sparking, in order to force up the volts per commutator bar, and, at the same time, to take advantage of the possibility of speed regulation, in which case, with the weakened field, all the volts would be crowded on half or even less of the bars between brushes, and the flashing-over trouble would again appear. One point in favour of the self-ventilating motor as compared with the separately ventilated machine was the ease with which the air could be made to proportion itself correctly between armature and field coils.

Mr. W. C. Schacher said the one-hour rating, which was universally adopted, urgently required revision. This method was adopted originally when motors were much heavier for a given output than to-day, and when ventilation, as applied at the present time, was practically unknown. Conditions had entirely changed, and in the modern motor not the slightest relation existed between the one-hour rating and the possible continuous output. In computing the value of a modern motor from the capacity point of view, which was really the determining factor, the continuous rating in kw. at, say, half or three-quarter voltage appeared sufficient; to judge it from the service point of view it was certainly necessary to have either its characteristic at hand or at least three or four points of the curve. Considerable progress had recently been made towards increasing the diameter of motor coach wheels, and diameters of 42, or even 43½ in., were adopted. Regarding ventilation, the multiple fan or parallel system had undoubtedly many advantages over the older systems, as by this method the cool air came into contact with both field and armature. The author's diagram showed the flow of air in the direction from the pinion to the commutator, which, presumably, required a fan at the commutator end. This method had the advantage that carbon or copper dust would be ejected from the commutator without going through the machine; but, on the other hand, it had been found extremely difficult to mount a fan at the commutator end, and the speaker had never encountered a construction with the fan in this position.

Mr. H. Allcock thought the paper would serve to accelerate the more general adoption of direct-current electrification at pressures higher than 600 volts, and progress should be rapid in view of the substantial economies due to smaller currents and reduced cost of sub-station plant, which had already been established in connection with high-voltage working.

Mr. W. A. Barnes referred to the author's statement that the average conditions for urban and suburban railway service were trains of 150 tons running at a schedule speed of 15 miles per hour, with two stops per mile. The conditions were very different, however, on "surface railways," especially in the case of electrification of existing steam railways. The average distance between stops could be taken approximately at one mile with a schedule speed of 25 to 30 miles per hour, and in consequence of the heavy duty the weight of a five-car train was increased to 200 tons. Rapid acceleration and retardation, with consequent low ratio between maximum and average speed, was necessary on busy suburban lines if the required headway was to be maintained between trains, and the number of trains per hour increased to meet traffic requirements. These conditions seriously affected the design of railway motors. Four motors per motor-car were necessary in order to secure the requisite adhesion, and each motor would be of about 200 h.p. No revolutionary changes in principle, but rather refinements in design, were required for the high-voltage motor. The 200-kw., 1,200-volt motor shown in section in the paper would require considerable modification before it could be run successfully. The author had stated that the commutator on a 1,200-volt motor was only half that of a 600-volt motor of similar power; the point affecting the design was not the length of the copper bar on which the brushes rested, but the length of the commutator casting, and when the requisite leakage distances to earth were allowed, the difference in length for the two voltages was very slight. It was bad policy to bring in the ventilating air immediately over the commutator, as the brush gear necessarily formed pockets in which grit and dirt might collect. After long experience with the split-frame type of motor the Lancashire and Yorkshire Railway Co. had discarded them and introduced the solid frame. In order to improve what might be termed the space factor under the cars, the main pole-pieces had been placed horizontally and vertically instead of diagonally. This necessitated more carefully designed bearings in order to obviate the possibility of the armature dropping to the bottom pole piece. The principal details of the 1,200-volt motors in use on the Manchester-Bury line were as follows:—

Efficiency (including gear)	87.5 p.c.
Current (amps.)	140
Speed (full field)	500
Speed (short field)	600
Gear ratio	59 to 26
Diameter of car wheel	43 in.
Weight complete	7,800 lb.

Armature.

Diameter	21.75 in.
Gross core length	15.00 in.
Total conductors	708

Commutator.

Working length	4.125 in.
Diameter	20 in.
Number of segments	353

The above motor was able to give a schedule speed of 28 miles per hour, excluding stops on a section of line with very heavy gradients, and stops 1.3 miles apart.

Mr. Roger Smith, speaking from the general railway point of view, said the author's minimum acceleration figure of 1½ miles per hour per second was too high; one mile per hour per second was about the lowest that should be asked for. The author had confined his remarks to the series motor with "wheel-barrow suspension" and single-reduction gear. Such a motor was quite useful for suburban railway service, and also for goods locomotive working, provided the general speed of the motor train or goods locomotive never exceeded 60 miles per hour, but above this speed single reduction gear could not be used. The plain series motor had the great disadvantage that it was a one-speed motor for a given load. The series motor locomotive was not yet comparable with the steam locomotive at speeds at which everybody's troubles began, *i.e.*, speeds above 60 miles per hour. The output at high speeds of the series motor fell off very sharply, but for everything in view in this country in the way of railway electrification, *i.e.*, suburban and goods working, the series d.c. motor with single-reduction gear was a most satisfactory piece of apparatus now that commutating poles and field control had been established. Field control was one of the two features recently introduced which made the d.c. motor more acceptable for railway work. The other feature was regenerative control, which was being successfully applied in the United States on more than one electrified railway using d.c. series motors. If, as he believed, something less than half the energy wasted in stopping a train, due to the application of the brakes, could be returned to the supply by regenerative control, economies in suburban working which were badly wanted would become possible. Much depended

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upon the various railway companies standardising supply voltage. The Bury-Holcombe Brook line used 3,600 volts, Manchester-Bury 1,200 volts, and the North-Eastern Railway 1,500 volts. These experiments at different pressures would ultimately lead to the choice of the most suitable high D.C. voltage to suit the general average conditions of this country, and the railways would have to adopt it uniformly. The advantages of field and regenerative control could not be realised if several different supply voltages existed. It was well to emphasise the danger of comparing motors on their one-hour rating only.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Cube Problem.

I was reading in the Electrical Review of a week or two back an article respecting the resistance between the opposite points of a cube.

The conditions most simple under which to consider this matter are that the cube is balanced on one of its corners on a plane surface of an electrical conductor, and on the top corner of the cube shall rest the plane surface of another conductor.

The question is, what is the resistance between the two conductors above-mentioned, it being assumed that the resistance of such conductors is negligible? This being a pure mathematical matter, nothing but a perfect cube can be taken.

The corners of a cube are points, a point has no dimensions, hence, it is not possible for current to flow from one of the conductors to the cube or out again because the area of the cube at the point of contact is zero. Therefore, the resistance is infinity.

From a practical point of view, if an electromotive force were applied between the two conductors mentioned, a current would certainly flow, first because the corners of a manufactured cube would no longer be points, and secondly if they were nearly so the electrical pressure would cause current to jump across between the surfaces of the cube and conductors which were immediately adjacent to the points of contact, and the higher the voltage the more such surface would come into play.

It would appear, therefore, that in order to discuss this matter at all from the point of view of Mr. A. J. Makower, M.A., in yours of March 3rd, a portion of the corners of the cube would have to be cut off in order to get a start; it does not matter how little as long as the amount is defined.

David Smith.

Torquay, *March 18th*, 1916.

[It was because of the impossibility of dealing with the corner difficulty that we said, some weeks ago, that the problem was indeterminate. See Mr. F. W. Carter's article on p. 332.—Eds. Elec. Rev.]

Business Methods Which Must Go.

I think Mr. Jacobs in the above article more correctly defines the real method by which our lost trade may be recaptured.

It would seem that Britain has resolved itself into a copyist nation, waiting for someone to lead. Speaking of the electrical trade, if one follows the patent and new appliance columns of your paper he will be distressed to see that the greater percentage hail either from Germany or the United States, because of the reasons in many ways explained in the above article. It seems as though any old thing at all, so long as it hails from either Germany or the States, is assured a ready sale in Britain because the foreign article is cheaper, more profitable for the seller, better advertised, and usually more up-to-date.

Anyone who has had such dealings with American firms as Mr. Jacobs describes can vouch for their willingness to give any new method, or idea, a trial free of charge to the inventor, and they won't try to rob him.

How can any nation claim to be progressive that stifles all initiative preferring to wait till our friends, the foreigners, have got the market? All the talk of trade unions ever holding the hatchet over the manufacturer's head, is all due to the latter's fault. Piecework is the progenitor of all evils connected with trade unions, and what is piecework but robbery? The masters are for ever seeking to cut down wages instead of spending more money in going further afield for their business, and studying their market wants. Ask the British Admiralty the net result of their premium bonus system. The same had to be abandoned, not because it did not increase the output, but because the quality fell a much greater proportion than the output increased. Workmen on one hand scamp their work to make a little extra money, whilst on the other the masters seek to cut down the price; hence the distrust of one another.

It has never been satisfactorily explained why American firms can pay their workmen 100 per cent. more wages, pay more for their raw material, more taxes, yet sell an article cheaper in Britain, or any other country, than the British manufacturer. One can only conclude that it is due to better organisation, better business methods, and at all times striving to attempt something new, giving every facility for new ideas to be developed.

Canada is overwhelmed with American goods, from a generator to a lamp socket. One scarcely ever sees anything British; yet they have to pay 5 per cent. higher tariff. It costs no more to keep British travellers in Canada than in America. One can only put it down to the British manufacturers being too stingy to pay them, preferring to moan and bewail the fact that they can't compete because of the high duty. Whilst a tariff may be necessary to prevent foreigners dumping their surplus stocks, no tariff ever imposed will alter the case for the British manufacturers. Let them organise themselves and set out with a firm determination to use every means known and unknown to get their share of the world's market, treat their workmen as human, not machines, drop the throat-cutting business amongst themselves, and use every endeavour to cut the throat of German and American competition; the latter are no more our friends than the former.

It is quite refreshing to read of the new arc-incandescent lamp being the result of British research, and it is to be hoped that it will prove a success and be the forerunner of many other new developments.

W. E. L.

Canada, *February 24th*, 1916.

[Apparently "W.E.L." is referring to the article by Mr John Marks (not Jacobs), in our issue of December 24th, 1915. —Eds. Elec. Rev.]

What to do with Our Canals.

Under the above heading in your issue of the 10th inst. was an article by Mr. W. N. Stewart, proposing to convert canals into motor roads, but I venture to suggest that, without some better backing than the arguments used, the heading to his article needed the insertion of the word "not."

I admit straight away that for delivery for short and medium distances from door to door, conveyance by electric motor may be an economical and useful method of transport, but must respectfully submit that, because of that, to destroy our whole canal system would be a suicidal act, in view of what canal transport has effected in other countries. Sir William Lindley, certainly an engineer of repute, was able to report, upon making inquiries for the Royal Commission in 1909, that the cost of water transport in France had fallen 50 per cent. in the last 50 years. Has any such result followed any form of traction in England, when account is taken of the cost of the road, whether it be rail, water, macadam, or tarmac?

Next, I submit that your correspondent's argument is founded on absolutely false premises when he suggests that if our canals were drained they could be adapted as trunk motor roads at a cost of £800 per mile. If he will obtain estimates and go carefully into the matter, he will find that the cost would approach ten times the amount he named, or, say, £8,000 per mile, which coincides with the figure which the writer, with elaborate sarcasm, suggested has been recommended by the Royal Commission as the cost of installation of a system of electric haulage on canals, giving a speed of *two miles* per hour. I defy him to cite evidence from the Report of the Commission to substantiate this suggestion. They made no such recommendation.

Be that as it may, however, your correspondent has yet to square with his own dictum—that the cheaper power must be used—to prove that it requires less power to haul on a waterway than on a motor road.

Frank Impey,
Secretary, The Waterway Association.

Birmingham, *March 18th*, 1916.

The Engineer and the Commercial Manager.

One would think from the recent articles on the subject that the interests of these two classes were opposed. Is it not the question of Capital *versus* Labour in a rather different form? The commercial department represents the views of capital in that the only consideration of any account is the dividend of the company, while the engineer at heart believes that the commercial department is only little better than a necessary evil. The discrepancies in responsibility and salary seem to be generally admitted, the works manager and staff being paid less than the members of the commercial section, while hardly anyone would support the statement that the responsibilities were in the same proportion.

The works manager may not have to sell the output of the factory, but he has to buy all the material, handle the whole works staff and men, estimate the cost of all new articles to be made, and keep his works costs down by improvements in designs and methods of production, so that the firm can meet all competition in the open market. At the same time he often finds it almost impossible to persuade the board to devote new capital to the most necessary improvements or extensions. From the works manager's point of view the commercial side only have to add to the works cost a figure to represent the selling costs and profit, and find the cus-

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tomers to buy the manufactured article. The commercial department's reply is to the effect that without that department the whole business would stop. An exact parallel to the capitalist, who says: If we did not find the money there would be no work.

What the two departments have got to learn is not only that both are needed, but that any friction or misunderstanding between them is inimical to the trade of the country.

We have recently had homilies which have told us that the engineer is not a business man, and that he is not best qualified to sell his own goods or to describe them to his customers. Are these statements true? The main fact that seems to have been overlooked is that the average customer who is ready to buy the productions of an engineering firm knows more about the article he wants than the average representative sent out to interview him. Any engineer buyer in a large firm will confirm this statement, and it is probable that more engineering firms fail to make good because their commercial men are not engineers than because their engineers are not sufficiently commercial in their experience.

We have had examples of how incapable even a chief draughtsman may be in dealing with a customer. This case is probably one due to want of proper training in younger days, and the effect of having been compelled by his commercial department to draw out schemes which he knew were inefficient, because the representative who had interviewed the customer had not had sufficient engineering training to grasp the problems of the case. If this is not so, how do so-called "wild cat" schemes originate and waste the time, patience and ability of the chief draughtsman? It would be very easy to give examples of the mistakes of the commercial section apart from any individual failings.

For example, ask a purely commercial traveller if he would not be just as happy with an order for one article at £1,000 as with an order for 100 articles at £10 each. Which order would the works manager prefer? Then, one other point. The traveller who is only a traveller, and not a trained engineer, is always afraid of exposing his ignorance, and also very prone to make impossible promises. How many orders are taken on promises of delivery in less time than the works department give as the minimum possible? The works are sometimes heavily handicapped by insufficient, and possibly misleading or incorrect, particulars being obtained by the non-technical staff who interview the client, and finally, when some difficult point requires explanation, the non-technical traveller is more likely to think the client's view reasonable because it appeals to him more than the technical one, which his training is not sufficient to appreciate.

For true harmony to exist between the manufacturing and sales departments, it is therefore essential that the sales manager shall have a sufficient engineering training to avoid all these difficulties, and this fact is beginning to be more recognised. The weakness of the purely commercial man's position is practically confessed in these attempts to justify the treatment to which the engineer is frequently subjected.

H. Gee.

March 14th, 1916.

Concerning Discounts.

With reference to the comments of "Central Station Engineer" on the above in your issue of the 3rd inst., I herewith attach a portion of a discount sheet for your inspection, which goes to show that the members of this Association have been fully alive to any convenience that is to be attached to the use of equivalents and coefficients of various discounts in use.

W. C. Fisher,
Secretary, The Tungsten Lamp Association.

London, E.C., *March 15th*, 1916.

[The sheet issued to clients by the T.L.A. is admirably devised to solve the whole difficulty, by giving the discount which is equivalent to various successive discounts, and also giving the coefficient for use with the slide-rule, &c., enabling the net price to be arrived at by one operation.—Eds. Elec. Rev.]

Not being an accountant, and considering their ways "past finding out," I do not wish my name mentioned in connection with the correspondence appearing in your columns "Concerning Discounts," but sincerely trust you will spare no effort to get these apparently absurd complications of discount eliminated. We have recently been quoted prices for cables with no fewer than five sets of percentages, + and −. Personally, this does not trouble me much, as I reduce them to one percentage and use my slide rule; but it wastes endless time amongst my clerks. I quite fail to understand why contractors should not be quoted one single figure discount other than the extra 2½ or 5 per cent. cash discount, which is desirable as a stimulus to prompt settlement.

In normal times list prices could be adjusted to make this discount one of the following simple figures, 1¼, 2½, 5, 10, 20, 25, 33⅓, or 50 per cent., thus often avoiding the necessity of reference to discount tables.

When this could not be done, if manufacturers quoted single odd figures rising by 2½, such as 37½, or even rising by 1 or 1¼, it is quite certain there would soon be plenty of discount tables available to deal with such figures, and, though they would be a little more bulky, the benefit of only one reference would soon be felt, especially if the book of tables were thumb-indexed judiciously.

The preceding paragraph would under any circumstances often apply to exporters, factors, and other specially favoured dealers.

Contractor.

Track Circuits and Cab Signals.

Lieut.-Col. von Donop at last admits that the track circuit "would undoubtedly have prevented" the Jarrow wreck. But he never condemned the fact that there was *no track circuit at the place on the North-Eastern Railway*. Seeing that the track circuit ought to have been in use at Jarrow, and everywhere else 20 years ago, and that much less than half of the British railways are even now equipped with track circuit, Lieut.-Col. von Donop's report is exceedingly inaccurate. The fact is that the track circuit is being very scarcely adopted by the railway companies.

The Board of Trade inspectors well know that the railways would continue to have fatal wrecks in the absence of a proper cab signal, even if the track circuit were universal. A proper cab signal *or* the track circuit is not good enough; a cab signal and the track circuit is the least requirement.

The Board of Trade report never recommended the well-known dual necessity. The three inspectors never recommended a proper cab signal. They only went so fár as to favour the cab signal for a distant, although it has been publicly known that such a cab signal is exceedingly inadequate. The North-Eastern has only a very improper cab signal, and at the scene of the Jarrow wreck no track circuit at all. Why does Lieut.-Col. von Donop fail to denounce the railway company?

Safeguard.

What is an "Electrical Contractor"?

With reference to the letter in your issue of March 10th from "Facts," I do not think that this gentleman is an electrical contractor, otherwise he would not write in the strain he does. If he had been a wiring contractor he would have known that although the ranks of the electrical contractors may number a good many firms who from their training are only competent to carry out work in connection with the wiring of houses, yet it cannot be denied that amongst the electrical contractors of the country there are many who specialise in the erection of separate installations such as country-house installations; and there are firms amongst these who employ such a staff that they do not require any assistance whatever from the manufacturers in the fixing of the engine, dynamo, or accumulators which go to make up the complete plant, and it was in speaking for firms like this that my letter particularly mentioned the point to which he takes exception.

I may preface my remarks by saying that in my own case the works I carry out are my own design in every detail, down to the buildings themselves; they are erected throughout by my own workmen under my personal supervision, and I am not in the slightest degree dependent upon any manufacturer to supply me with any information, except such detailed drawings as every manufacturer sends out with his goods, even for his own workmen's satisfaction.

I have, therefore, cleared the ground of the imputation which he makes.

He does not appear to appreciate the point of view that the wiring contractor would take up with regard to the question of contracts. To give you an instance of what one point of view would be: suppose a wiring contractor carried out the wiring only of a country house installation, and the machinery was supplied direct by the manufacturer; assuming under these conditions that the plant portion of the work is a failure, who gets the blame? Why, the wiring contractor, of course, and afterwards the owner of the place, if asked who did his electrical installation, will say that So-and-So did it, but he cannot recommend him, as his work was faulty. I am speaking from experience, so for this reason will only carry out whole contracts.

In my opinion, one of the reasons why almost everybody knows so much about trade discounts in the electrical business is due to consulting engineers including prime cost sums, which they say must be the actual net trade prices, and, consequently, all the business in the electrical trade is made public property by everyone who ever has a specification drawn up on these lines; and when they find that the first fitting manufacturer they go to says that his discount is 50 per cent., they usually come to the conclusion that every fitting manufacturer's discount is 50 per cent., and presume that the wiring contractor gets 50 per cent. profit for doing nothing. I wonder how many of us can say that we sell fittings at this profit? I venture to say that it would be a very small proportion that could say they ever got a profit of this kind.

Another point is that in installation work customers expect a tremendous amount of attention in laying the actual wires, and no wiring contractor is adequately paid, for this very reason; whereas, as regards the purely engineering part of the concern, there are seldom any questions asked by the customer, because he is not able to ask them, as he knows nothing whatever about this part. For the sake of argument,

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a man can carry out with a minimum amount of trouble to himself an engineering detail which might cost £1,000, but he is put to endless trouble and visits for work which might cost £200, and at the finish the portion of the work to which the most attention has been paid will not be prontable at all, whereas with the purely engineering part of the installation the costs of the plant and erection can be worked out to extremely fine points with a definite certainty of making a pront out of the job.

I have recommended for years that consulting engineers should issue their specifications as a whole, as by doing this I do not think they get any worse dealt with, and, what is more to the point, they can fix the entire responsibility on to one firm. In fairness to some consulting engineers, I may say they have adopted this attitude for some time past, but there are others, particularly in London, who have not done so, and my proposal to induce them to do this is that the wiring contractor shall decline to carry out the wiring part, or what might be called the work which entails all the worry and humbug, and no profit at the end of it, as I am quite certain that the manufacturers of engines, dynamos, and accumulators will not be in a hurry to take on the wiring work after the experience some of them have had who tried this years ago.

"Facts," in his letter, states that if I possess the qualifications necessary for the carrying-out of work throughout without outside help, I should address my qualifications to consultants, so that they might be able to avail themselves of my assistance; I should be interested to know why he makes this statement, and why he should want to make out that I should be so keen to work for consulting engineers when I can design power plants myself, and—as my record in this direction shows—successfully.

Why does he also jump to the conclusion that the wireman is a man trained by someone else? Even in this war time, with less than a quarter of the staff of normal times, the only men I have have been absolutely trained by myself, and some of these have been with me up to 20 years.

I think I can assure "Facts" from what I have said that I was in a position to talk as I did. I can, further, assure him that I have carried out during the last few years at least a dozen water-power plants, without any assistance whatever from the manufacturers, neither did I want any except the drawing of the machinery; and I further add that I can find at least a dozen firms in London, at any rate, who would say the same, as there are certain large firms who make a speciality of country-house electric lighting, and who would never think of availing themselves of the services of the manufacturers in the fixing of the articles they use, and certainly the designs of the installations are their own. I need mention no names in regard to this, as anyone with a knowledge of the trade knows there are firms who stand out in this particular class of work.

I may also add to my letter that I distinctly disagree with the practice of supplying everything electrical to any Tom, Dick, or Harry who likes to apply for it, and am extremely glad to know that with the new arrangements that have been made in the Electrical Contractors' Association we shall, I hope, in a short time be such a fighting force as to be able to dictate, and will not, as at the present time, have to grovel; I sincerely trust that the new arrangements will result in the Association being made as strong as the Motor Manufacturers' Association, which, as I remarked, is such a close corporation that even an electrical engineer was not entitled to the trade discount off a dynamo to use on a motor-car.

I am quite sure that the decent manufacturers in the country do not disagree with the question of the middleman at all, as, from their point of view, they have a great many additional travellers which otherwise they would not have, and it cannot be denied by anyone in business that there are certain men who, whether they are middlemen or not, have so much weight with certain of the buying public that their opinions are valued before those of any manufacturer. This is how corporations should look on electrical wiring contractors in towns, as when they talk so much about wanting to do their own wiring they entirely forget the large number of unofficial travellers they have selling their goods, for, after all, the supply of electricity in bulk can only be considered a question of so much manufactured article; but they, like other people, think there is a certain section of the population getting well paid for doing nothing. Electrical contractors might just as well adopt the same attitude by arguing that tailors have no right to the profit on the cloth in the clothes they make; or, to carry it further still, why bother with grocers? as you might just as well buy the articles from the people who make them; and the same argument applies to every middleman in the country. The so-called huge profits made by middlemen have been the subject of discussion by wholesalers from times far back, and most trades have come to the conclusion that it is impossible to do without them, neither would they wish to do otherwise; but the electrical trade, through the curse of the so-called factor, has been placed in the position that everybody who likes to get trade discount has only to ask a factor for it and he gets it, whereas if he had to deal with the proper electrical trade he would not.

There have been various attempts at different times to define the position of a trade buyer, and one in particular has been that the firm should keep a man that does wiring work; an agreement like this would no doubt be kept by the electrical trade, but the factor calls upon everybody with works and gives them trade discounts irrespective of whether they keep a man or not, and they also do the same regarding country houses where the installation is looked after by the gardener.

It has also been stated that it is difficult to define an electrical contractor; but my definition is that, irrespective of the number of men he keeps, he must have some form of shop, like any other tradesman, and is entitled to profits on the *resale* of any goods in his particular trade. On this definition I would stop absolutely all trade discounts to everyone else.

As stated before, I am looking forward to the time when the new articles of the E.C.A. will have some driving force at the back of them, and will be able to remove some of the grossly unfair systems of trading that exist in the electrical business, as I am quite confident that if motor manufacturers and plumbers can do this there is no reason why electrical contractors should not be able to do it.

Contractor.

Cause of Flicker.

I think the cause cannot be what your correspondents suggest, saturation of interpole, or earth leakage, because Mr. Bulsara states that the flicker seems to correspond with the throw of the engine; this would also probably exclude faulty governors.

The hint of valve trouble, so lightly put aside as improbable because showing on the three sets, is neither improbable in three similar engines (presumably adjusted by the same man) nor is it a record.

Here is my experience in the first installation of electric light in Simla over 20 years ago, with three vertical compound engines, cranks at 180 deg., and belt-driven simple compound dynamos. By the time the full load was on there was a flicker worthy of an early gas engine, and belt tightening to danger point made no change. "The fault must be in the dynamo." All switches off but one lamp gave absolute steadiness. "Then what is the cause?" "If the fly-wheel during one revolution travels at a varying speed flicker is certain." "But how could that happen?" "Faulty admission of steam due to faulty valves." "Humph!"

The engine contractors had no representative there, and as there was no one within 1,000 miles who knew as much as myself (and that was very little), I was given tardy permission to investigate. Diagrams taken with an unsuitable indicator told me nothing, but measurement by wedges showed that the steam admission, instead of being nearly equal on the up and down strokes, was considerably different. I was forbidden to cut the ports, but readjustment as far as the nuts could go improved matters so that "only your professional eye could notice it," I was told, and there I had to leave it. All three engines were alike; the flicker corresponding with the beat of the engine, of course. Putting two fly-wheels on one engine made no improvement.

Mr. Bulsara's letter seems to indicate that at times there is a variation of the amount of flicker besides that due to the variation of load. An earlier experience when I was in charge of the electric light on the Atlantic liner *City of Berlin*, in 1880, may be useful. On one occasion on starting up, the small horizontal engine (for 12 arcs) behaved very erratically, giving a mad dash for one or two revolutions, stopping dead, going slow, and then dashing again. The engine-room staff professed ignorance of the cause until I pointed out that an irregular supply of steam would have such a result, and that there must be something wrong inside (that was as near as I could go in those days). The slide valve was so loose on its spindle that I suppose "while men slept an enemy had done this."

From these two experiences I suggest that not only is the valve-setting faulty, but also that there is a slight looseness of the valves, and that friction checks this in varying degrees on different occasions, and that all three engines have the same faults.

I would also suggest that Mr. Bulsara should write to Messrs. Belliss for enlightenment and guidance.

John W. Long.

Stafford, *March 20th*, 1916.

The I.E.E. and Alien Enemy Members.

The two recent meetings at the Institution on the enemy alien question must have opened the eyes of those who attended to the wide gulf that exists between the Council as a whole and the members.

One can understand a Council with a record like that of the I.E.E. getting out of touch with the aims and wishes of mere engineers, but one cannot understand the Council pretending to get the opinion of the members and calling the meeting at an hour when nine-tenths of the members would find great difficulty in being present; the fact that about 150 turned up should have shown them that the members did not mean to be trifled with. That is the kind of thing one would naturally expect from a German, but not from the Council of a great British institution.

The President stated that the Council were an average lot, neither better nor worse than the average member, but, judging from the speeches made by some of them at the second meeting, one felt that several, at any rate, showed a

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lack of ordinary judgment. Fancy suggesting at this stage of the world's history that a German should be taken at his own valuation and trusted till he proved to be false; was it any wonder that there was a disposition on the part of those present to leave the Council with no freedom of action on this matter?

If the Council desire to fulfil their duty to those who elected them, and win back some of the trust which they have rightly forfeited, they should without further delay ask the various local sections to test the feelings of the members on the same issues as the London members voted on, and then carry out the wishes of the majority in the manner that they desire.

At present they seem to represent nobody but themselves, to judge by the voting in London.

Another Station Engineer.

I think the members of the Institution of Electrical Engineers are, generally, greatly indebted to you for the assistance which they have received from your valuable paper in respect of the question of members of the Institution who are of alien enemy origin.

It is very evident, after hearing the members of the Council speak at the informal meeting held at the Institution Buildings, why the Council have done nothing, and have ignored all representations made to them in respect of this matter, and, moreover, difficult to reconcile the statement made by the President that the Council of the Institution was not pro-German. If it had not been for the assistance afforded by your paper, I am sure the correspondence alone would not have been able to raise the agitation which ultimately compelled the Council reluctantly to take some steps in the matter.

It remains to be seen whether the President of the Institution will allow (as we understand he pledged himself at the general meeting) the recommendations which have been passed by the Dublin Local Sections and the Manchester Engineers to be balloted for by the total membership, or whether he will direct the three resolutions which were passed by a meeting representing less than 2 per cent. of the total membership, to be the only ones to be decided upon by the members in general. If so, it will be very evident that it is with the sole intention that the exclusion of alien enemy members shall not be sweeping, whereas if the ballot of the total membership were taken, it is a well-known fact that the Dublin recommendation would be carried by an overwhelming majority.

The fact that a man signs a piece of paper does not justify the belief that he has changed his character or nature. I claim that it is not a case for making invidious exceptions, and I concur in every way with the statement made by Mr. Wordingham that *all members who have the taint should be excluded for the benefit of the membership in general.*

P. M. A.

[We regret that the demands on our space have compelled us to abbreviate "P.M.A.'s" long letter, omitting parts which were only remotely connected with the subject under discussion.

We fail to see why our correspondents so bitterly attack the Council, in view of the proceedings at the informal meeting, at which the resolution originally put forward by the Council, after consultation with the 17 petitioning members, was in effect endorsed by an overwhelming majority; the new resolutions retained the spirit of the first, but were couched in more precise phraseology in order to cope with the difficulty of dual nationality. One resolution was added, relating to the permanency of the ban. Lastly, the President promised that the views of every member on the several resolutions should be ascertained by post. Short of a postal ballot, what more do our correspondents want?—Eds. Elec. Rev.]

WAR ITEMS.

Exemption Applications.—The Bradford Military Service Tribunal has granted exemption to a local electrical furnace operator, whose employer stated that he was engaged in electrical smelting—a new business, and the first of its kind in England. The firm are holders of contracts with the Admiralty.

At the Newcastle-on-Tyne Tribunal, on Friday, an electrical engineer applied for exemption on conscientious grounds. He admitted being in the employ of a controlled firm, but said it was not his fault if the current he supplied was mis-applied. He was recommended for non-combatant service.

At the Whitstable Tribunal Court a man appealed on the ground that he was in a certified occupation and could not be replaced. He is a fitter-driver at the electricity works. The local military representative explained that the employer of the man failed to convince the Tribunal that he was indispensable, and the appeal was time barred. The Tribunal struck the case out.

At Haslingden Tribunal, on March 16th, an electrician to a large cotton manufacturing company claimed exemption, stating that he was the only employé who could look after the motors. He had been engaged in munition making, obtaining a certificate from the Minister of Munitions. Application was refused.

At Barrow Appeals Tribunal, on Monday, Mr. Wm. Drysdale, electrical engineer, applied for exemption for the only electrician he had left. Seventeen of his men had left from time to time to join the Forces or go into munition works. He was working on requirements for munition establishments. Mr. Drysdale said he had chances of other contracts, but he could not undertake the work if this particular man was taken. He added that he had got two men from the Labour Exchange since the application was sent in, but he could not say whether they would meet his requirements yet or not. The Chairman: We recognise how hard it falls upon you. We will extend the exemption until July 1st, and I hope that will give you plenty of time to get your other men going.

The Tudor Accumulator Co., Ltd., appealed at Dukinfield for six months' exemption, or total exemption, for their deputy chief clerk, and three months' exemption for C. W. Baxter (30), departmental cost clerk. It was stated that the firm had released as many clerks with special technical knowledge as could be spared at present—four out of eight eligible men had gone. Conditional exemption was granted in the terms of a letter which had passed between the military representatives and the firm, and it was stated that if there was no change the firm could appeal again.

At Salford, temporary exemption until May 31st was granted for a man appealed for by the head of a department in an electrical works who desired an extension of time in order that some of the contracts which the firm have in hand could be got out of the way.—At the same Tribunal, a local firm appealed for a number of men engaged in the telephone business. The men were engaged on highly specialised work, 10 per cent. being for the Post Office and the remaining 90 per cent. for other Government departments. Of the firm's employés, 138 had enlisted voluntarily, and since the war started the firm had had 50 per cent. more work and 150 fewer men to do it. It was stated that the Advisory Committee thought that forty men ought to be obtained from these works for military service, and the applicant was advised to get into touch with the Ministry of Munitions on the matter.

Three months' exemption was granted to an electrician at the Cheadle Royal Asylum who was stated to have charge of 2,000 lights.

At the Halifax Military Service Tribunal last week an application was made by Mr. John Mollett, that an electrician in his employ should be exempted until May 1st, in order that he might complete contracts upon which he was engaged. Mr. Mollett said he only asked for exemption until May 1st. The application was granted.

Russia's Electrical Industries.—At the Technical Association, Petrograd, on December 24th, Mr. I. S. Osadchi made a report on the position of the electro-technical concerns of Russia, and the immediate duties of the Association. On the question of the electrical industries of Russia previous to the war, he said there was not much information on them. But when the war broke out, and when the question arose of the supply of electro-technical goods to the Army, the producers found themselves in a very difficult position. At present, when the industry, thanks to the war, had made great progress, the necessity arose of finding out what was to be done in connection therewith at the close of the war. For this purpose, in the first place, they must fill up the blanks in their knowledge respecting that branch of industry by means of lectures, readings, etc., and also make wider circles of the community acquainted with the existing state of the industry and such success as had already attended it. The industry, after the declaration of war, took quite a different development from that observed before the war. But exact and systematic information on this point was not to be had. With this in view, the Technical Association should immediately organise a series of conferences for clearing up the conditions of the electro-technical industry for post war operations. In the discussion, it was shown that the satisfactory development of the electrical industry in Russia depended on a combination of conditions, of which the principal was the constitution of the coming Customs tariff. Down to 1905, the Customs question constituted the chief hindrance to the development of the national electro-technical industry, and a more intensive growth had begun with the change in the Customs tariff of 1905. The conditions referred to would have to be changed. The critical point of the coming development of the industry in the country would be the financing of enterprises. It would be necessary to call together an All-Russian Congress of electro-technical concerns and companies for making clear the requirements of the said concerns, and further measures for encouraging them and securing them against an increase of German competition.

Siemens Men with the Forces.—We have received a booklet of some sixty pages giving the names of the employés of Messrs. Siemens Bros. & Co., Ltd., and Siemens Bros. Dynamo Works, Ltd., who, down to last month, had joined the Forces. Altogether they number over 1,500. A Roll of Honour which accompanies it gives the names of 43 men in various departments who have fallen in the war.

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The Trade Conferences.—In view of our recent reference to the statement made by M. Gurevitch concerning German concentration on South American markets after the war, interest attaches to a question asked in the House of Commons last week by Mr. MacVeagh. He asked the Secretary of State for Foreign Affairs whether steps will be taken at the forthcoming economic congress of the Allies in Paris to preserve equally the interests of all the Allied countries in the great neutral trade markets of the world, especially in the Far East and in South America, and to make certain that no arrangements would be entered into likely to affect or weaken in any way the existing trade in these great markets. In his reply, Sir E. Grey presumes that this will be one of the aims of the proposed conference.

It is announced that Mr. Runciman will be the principal British representative at the Allied Economic Conference.

A Reuter dispatch from Paris states that, at the request of Senior Luzzatti and M. Timiriazeff, presidents of the Italian and Russian Parliamentary Trade Committees respectively, and with the approval of President Poincaré, the International Parliamentary Trade Conference has been postponed to April 24th, 25th, 26th and 27th. The conference will abstain from the discussion of Customs regulations, leaving this subject to the initiative of the various Governments.

Canadian Traders' Tour.—The Montreal correspondent of the "Daily Telegraph" states that it has been decided by the Dominion Government to take active steps during the progress of the war to win for Canada as much as possible of the trade formerly monopolised by Germans. The Department of Trade and Commerce has already selected a number of practical business men to visit France, Great Britain, and Russia. They will travel to Europe this summer, and carry on an active trade propaganda with the Allied nations along the lines recently laid down in the resolutions of numerous Canadian Boards of Trade, following suggestions from Great Britain and France. In addition to this, trade emissaries will be sent to Chile, the Argentine, and other South American Republics, where the Germans had a very large trade before the British Fleet drove them off the seas. These emissaries have been selected on account of special knowledge of the countries they will visit, and also for ability to speak their languages. It is expected in this way to attain the double object of improving Canada's trade and increasing trade amongst the Allies, at the expense of Germany and Austria.

Companies to be Wound Up.—The latest list of companies ordered to be wound up under the Trading with the Enemy Acts includes the following:—

Australian Metal Co., Ltd., 2. Metal Exchange Buildings, London, E.C. Purchasers of machinery; business practically directed by the Metallgesellschaft, Frankfort. Controller: C. H. Weatherley, 14, George Street, Mansion House, London, E.C. March 13th.

The Allolit Co. and Otto Rosentiel, 4, Charles Street, Hatton Garden, E.C. Agents for sale of aluminium foil. Controller: Harold Hartley, 9, Ironmonger Lane, E.C.

Esslerk, Ltd., 91-93, Bishopsgate, E.C., dealers in electrical carbons. Controller: W. C. Jackson, 58, Coleman Street, E.C.

Continental Tyre and Rubber Co. (Great Britain), Ltd., Thurloe Place, South Kensington. Controller: H. Bishop, 41, Coleman Street, E.C.

Electrolytic Copper in Germany.—Since the outbreak of the war German representatives of the copper producing and consuming industries have co-operated with the metal firms on the Berlin and Hamburg Exchanges in regard to the establishment of a German quotation for electrolytic copper. These negotiations have now led to the decision to fix a quotation in Berlin in future, which will first apply to Germany, and in a short time, the merchants hope, also to the world. Transactions on the Berlin Exchange are also to be extended to aluminium, antimony, lead and spelter.

Henley Men with the Forces.—The following figures give particulars of the staff and workmen of W. T. Henley's Telegraph Works Co., Ltd., who have joined H.M. Forces:—Officers, 16; non-commissioned officers, 56; privates, 479—total, 551. The casualties have numbered 49, thus:—Killed in action or died of wounds, 10; wounded, 30; missing, 2; prisoners of war, 7. Corporal W. Dagger (Duke of Cornwall's Light Infantry), since killed in action, was awarded the D.C.M. for bravery in the field (March, 1915). Driver J. Mason (R.F.A.) was awarded the D.C.M. for bravery in the field in July, 1915.

For Munition Workers.—On Thursday last week Princess Christian laid the foundation stone for a large recreation hall for munition workers at one of the Vickers works "somewhere near London." Sir Vincent Caillard, of the Vickers Co., said, in the course of his remarks, that to encourage musical activities amongst the employés a pipe organ would be installed in the hall, and Sir Frederic Bridge would open the instrument on the night when the hall was opened.

Prohibited Exports.—The exportation of the following goods to all destinations is prohibited:—Ferro-molybdenum, ferro-silicon, ferro-tungsten, radium, and tungsten. The exportation of X-ray apparatus is prohibited to all destinations abroad other than British possessions and Protectorates.

Controlled Works.—The number of controlled establishments is now 3,078.

Manufacturers and Statistics.—The feeling that has existed among many manufacturers for some time past at the extra demands that are being made upon them for statistical returns by Government departments found expression at a recent meeting of the Manufacturers' Section of the London Chamber of Commerce. It was stated, says the "Times," that these returns involve complicated calculations which apparently serve no useful purpose, when completed, commensurate with the work involved.

Trading with the Enemy.—The "London Gazette," for March 17th, contains amended and extended lists of persons and bodies of persons in Argentine Republic, Morocco, Netherlands, Persia, Portuguese East Africa, Sweden, with whom trading is prohibited.

Exporting to China.—The "London Gazette" of March 21st contains further lists of persons to whom articles exported to China and Siam may be consigned.

BUSINESS NOTES.

For Sale.—Particulars appear in our advertisement pages to-day of a sale of electrical apparatus to take place at Hammersmith on March 30th, by Messrs. P. Huddleston & Co.

Catalogues and Lists.—The British Thomson-Houston Co., Ltd., Rugby.—Folder containing nearly 30 sheets of well executed three-colour reproductions of photographs showing alternating and continuous-current switchboards which have been supplied to customers. The pictures show views of work executed for a number of well-known public electricity supply stations, an electric railway power station, collieries, mills, &c., in this country, also power stations in Calcutta and the Argentine. Only a limited number of these folders have been issued, and it is not intended to distribute them generally.

The Empire Trading Co. (Electrical Department), 69, Sisters Avenue, Clapham Junction, London, S.W.—Illustrated priced leaflet respecting "Rucella" electric radiators.

"Z" Electric Lamp Manufacturing Co., Ltd., Southfields, S.W.—Pocket price list (No. E 500) of "Z" drawn-wire lamps. They are of a size suitable for enclosure with correspondence, and traders can have quantities overprinted with their own names, &c.

Messrs. S. B. Goslin & Son, 13, Artillery Lane, London, E.—Leaflets respecting soft-iron castings for electrical and motor work, "Cyrol" alloy for aluminium soldering, &c.

Bankruptcy Proceedings.—J. W. & T. W. Tattersall, Willesden, London, electrical engineers.—April 1st is the last day for receipt of proofs for dividend. Trustee: E. S. Grey, Carey Street, W.C.

W. D. Birkett, Arnside, Windsor Avenue, Whitley Bay, Northumberland, factor of electrical goods.—The following are creditors:—

British Electrical Manufacturing Co., Newcastle-on-Tyne ..	£260
British Westinghouse Electrical and Manufacturing Co., Ltd.	10
Palmer Electrical Co.	11

The first meeting of creditors was held on March 16th at Newcastle-upon-Tyne, when the deficiency was put at £173. The failure of the debtor was due to keen competition and inability to obtain goods owing to the war. He started trading as a factor of electrical goods under the style of the Northern Wholesale Electrical Supply Co. in June, 1915, with a capital of £6. In November, his largest creditors declined to supply any more goods on credit, and in January last issued a writ for £261 which he was unable to pay. The case was a summary one, and was left with the Official Receiver.

J. R. Whitehouse, managing director of an electrical engineering company, Golder's Green.—First meeting, March 29th, at 14, Bedford Row, W.C.; public examination, April 13th, at the Town Hall, Barnet.

Book Notices.—*Notes on Screw Gauges.* From the National Physical Laboratory. Teddington: W. F. Parrott. Price 1s. 6d.—The difficulties in the way of producing screw-threads accurately to standard, and of testing their accuracy, are many and various, and have made themselves felt particularly at this time, when innumerable parts of munitions of war have to be interchangeable with other parts made in other works, and to other gauges. The staff of the N.P.L., therefore, have done a national service by compiling notes based upon their experience, with a view to facilitating the manufacture and testing of the gauges, and therefore the production of threads that will conform to the specified requirements. After emphasising the need for accuracy and the necessity of fully verifying gauges, the errors of screws and methods of measurement of the various characteristics of a screw-thread are dealt with fully. The pamphlet should prove invaluable to engineers concerned with the manufacture and use of screw gauges.

"Wireless Telegraphy and Telephony." By W. H. Eccles. London: *Electrician* Printing and Publishing Co. Price 12s. 6d. net.

Proceedings of the American Institute of Electrical Engineers, Vol. XXXV, No. 3, March, 1916. New York: The Institute.

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Dissolutions and Liquidations.—Burdon Oil Gas Furnaces, Ltd.—In voluntary liquidation, with Mr. S. C Pratt as liquidator. Meeting of creditors at 23, King Street, E.C., on March 27th.

South American Cable Co., Ltd.—A meeting is called for April 18th, at the offices, 25, Rue de Clichy, Paris, to hear an account of the winding up.

Sparkes Motor Garage, electrical and motor engineers, Dorset Mews North, St. Marylebone, London.—Messrs. G. H. Day, W. W. Symper, and W. A. Jones have dissolved partnership.

Spagnoletti, Ltd.—A meeting is called for April 27th, at 34-36, Gresham Street, E.C., to hear an account of the winding up from the liquidator, Mr. A. G. Morrish.

British Economical Lamp Co., Ltd.—A meeting is called for April 27th, at Windsor House, Kingsway, W.C., to hear an account of the winding up from the liquidator, Mr. H. E. Leigh.

Private Arrangements.—Israel Ernest Poyser (trading as the Liverpool Electrical Co.), 55, Renshaw Street, Liverpool, electrician).—The creditors interested in this matter were called together on March 16th, when the statement of affairs submitted showed liabilities amounting to £385, and net assets £117, the estate disclosing a deficiency of £268. It was reported that the debtor started trading from his home address in 1906, and in January, 1911, he opened premises at 78, Lark Lane, Liverpool, where he traded as J. E. Poyser & Co. He sold the business two months later for £160. On February 8th, 1913, he commenced at 55, Renshaw Street, Liverpool, in partnership with another and traded as the Liverpool Fittings Co., the debtor putting £200 into the business. The partner was unable, however, to find his share, and in July, 1913, the partnership was dissolved, debtor taking over the assets and liabilities, the latter being £460. Apparently the business was financially embarrassed at the time of the dissolution, but the debtor carried it on in the hope that he would be able to pull the business round. Owing to the war, labour troubles, and restricted lighting regulations, he had not been able to do this, and he attributed his present position to these causes. After fully discussing the position, it was decided that a deed of assignment should be executed to Mr. Parkin S. Booth as trustee, with a Committee of inspection, consisting of the General Electric Co., Ltd., Baxendale Bros., and Downes & Davies to supervise the realisation and distribution of the assets. The following are creditors:—

Baxendale Bros.	£21	Downes & Davies	£17
Barwell, Sons & Co., Lighting Ltd., J.	19	Falk, Stadelman & Co., Ltd. ..	69
Drake & Gorham	11	General Electric Co., Ltd. ..	52
		Jaeger Bros.	16

LIGHTING AND POWER NOTES.

Argentina.—A concession has been granted to Don Juan D. Evans for the utilisation of the waters of the Rio Percey for industrial purposes.—*Board of Trade Journal.*

A public electric lighting service has been inaugurated at Anatuya (Santiago del Estero).—*Review of the River Plate.*

Australia.—Hire-Purchase Scheme.—The Melbourne Council has adopted the "hire-purchase" proposal in connection with electrical installations within the area under its control, and has authorised the Committee to introduce a scheme for wiring premises in the city, also a scheme for the hiring-out electric motors, heating and other electrical devices to consumers, and to obtain the necessary statutory powers to enable the proposals to be carried out.—*Australian Mining Standard.*

The report of Mr. T. M. Carey, the Perth (W.A.) Corporation electrical engineer, for the past year, shows that 5,350,229 units were generated, being an increase of 4·59 per cent. over the figures for the previous year. The fuel consumed amounted to 16,395 tons, or 6·86 lb. per unit generated. The peak load reached 2,358 KW. on June 25th. The total number of consumers' connections was 7,199, an increase of 47·6 per cent. The large increase in the number of consumers is principally due to North Perth and Leederville consumers now being directly on the system, whereas previously these areas were supplied in bulk.—*Commonwealth Engineer.*

As the new Perth Government power station advances towards completion, preparations are in progress with a view to disposing of the energy which will be made available. The undertaking has powers to serve a very extended area, and the local authorities are readily arranging for supplies. The Town Council of Fremantle, the port of Perth, has signed an agreement for the supply of energy in bulk for a period of 50 years; the supply will be given over an overhead line operating at 20,000 volts, 40 cycles, three-phase, the distance to Fremantle being 12½ miles, and the Council will extend the extra-high-pressure transmission from its sub-station to the Henderson Naval Base, 7 miles from Fremantle, the total length of the 20,000-volt transmission being, therefore, over 19 miles. The maximum demand will be approximately 2,000 KW., and the energy supplied will amount to about 3½ million units per annum to commence with. The Government are also transmitting power over a distance of 10 miles to Midland Junction at 20,000 volts, to supply their railway workshops there, as well as the Midland Junction Council, the Guildford Council, and the West Guildford Road Board. At Guildford, Mr. Wm. Padbury is building a flour mill which will be driven entirely by electric power on the most up-to-date lines, and will be the first in West Australia designed solely for electric driving. The work is being carried out by the staff with direct labour, under the direction of Mr. William H. Taylor, A.M.I.E.E.

Other important consumers are the Perth City Council and the Government's own tramway system, which is now being extended. Messrs. Merz and McLellan have acted as consulting engineers for the undertaking.

The Warwick (Queensland) Council has accepted the tender of the Electric Energy Supply Co., Ltd., at £4 4s. per 180 C.P. lamp per annum for street lighting.—*Tenders.*

Barnes.—The electrical engineer reports that it will shortly be necessary to extend the works, and that the present time appears to be appropriate for considering the advisability of adopting three-phase H.T. alternating current, the prime movers being high-pressure steam turbines.

Barnsley.—Street Lighting Charges.—The Corporation has fixed the charge for public lighting for the half-year ending March 31st at £850, representing a decrease of, approximately, £400.

Bedford.—Price Increase.—The T.C. has increased the gross charges for current in all cases where the consumption is under 300,000 units per annum by 5 per cent., owing to the advances in the cost of coal and other supplies.

Bradford.—Plant Extensions.—The Electricity Committee recommends acceptance of offers for new boilers and economisers at a cost of £23,500, owing to increasing demands for power. Last year the demand on the works reached 15,000 KW., and next winter it is expected to reach 20,000 to 24,000 KW. At present the modern plant at the Valley Road works includes three 3,000-KW. turbo-generators and one 5,000-KW. unit, also four slow-speed engine units, bringing the total to 18,000 KW. or with the old plant at No. 2 works, which is only used on special occasions to 21,000-KW. capacity. As regards boilers the department is not in the same position and additional boilers are necessary. The Committee considered the Treasury would raise no objection to the borrowing.

Birmingham.—Coal Supply.—At a meeting of the City Council, Ald. Jephcott stated that at the principal station at Summer Lane coal could only be received by canal, but at the new station at Nechells arrangements had been made, which had now become operative, by which they could get both canal and rail-borne coal, which could be transferred to the canal and supplied to the stations at Summer Lane and Aston. The coal shortage was not due to the department not having ordered enough, and no difficulty was anticipated in the future.

Canada.—According to the *Canadian Electrical News*, the power question in Edmonton does not appear to be settled yet. In November last a contract with the Edmonton Power Co. was approved subject to ratification by the Provincial Legislature. Meanwhile, the Athabasca Power Co., of Winnipeg, and the Alliance Trust Co., of Calgary, are making offers of cheaper power to the city. The latter company offers to take over the present power house and sell power to the city at a rate approximately 20 per cent. lower than that called for under the present contract with the Edmonton Power Co. This offer is under consideration by the City Council at the present time.

Coniston.—E.L. Scheme.—The Ulverston Rural Council has appointed a Committee to co-operate with the Coniston Council and meet the promoters of the electric lighting scheme to discuss the terms of the final settlement.

Continental.—Italy.—La Societá Adriatica di Elettricita has applied for a concession to put down a plant to utilise the water power of the river Brenta, near Campolongo (Province of Vicenza), for the generation of electrical energy for lighting and power purposes.

Darton.—The U.D.C. has granted permission to the Yorkshire Electric Power Co. to construct overhead lines between Darton Bridge and Darton Main Colliery.

Dublin.—Cottage Lighting.—The Corporation has adopted the reports recommending the New Spitalfields, North Lotts and Newfoundland Street housing schemes, which provide for the introduction of electric lighting in workmen's dwellings.

Dundalk.—Mr. Spalding, the electrical engineer, reported to the Urban Council that the final official tests of the new electrical plant at the power station had been completed, and that further tests under full load actual working conditions were proceeding.

Halifax.—The Halifax District Nursing Association has decided to have electric light installed in its institution.

Harrogate.—Bulk Supply Proposal.—After consideration, the Corporation has decided that it cannot entertain the proposal to supply Ripon, having regard to the necessary capital expenditure and the limited electrical energy that would be required at the present time by Ripon.

Huddersfield.—Power Agreements.—The Electricity Committee has resolved that the old agreements with power users be terminated as soon as the expiry.

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India.—According to the *Madras Mail*, it has been decided to light the buildings of the Bangalore City Railway Station by electricity; negotiations have been proceeding with the Madras and Southern Mahratta Railway Co. for the extension of its supply from the Cauvery Falls plant, but these appear to have fallen through, and the railway is now arranging to put down its own plant in the Bangalore City Station grounds. It is expected that the installation will be extended to the Bangalore Cantonment Station.

Leigh.—Sewage Pumping.—In connection with the pumping of Lower Green Sewerage, the R.D.C. has made arrangements with the Pilkington Colliery Co., Ltd., for the supply of electric power. The company is also to be asked to permit its electrical engineer to prepare a scheme for the carrying out of the work, and afterwards superintend the erection of any electric plant which may be installed at Lower Green Sewerage Works.

Llanfairfechan.—E.L. Scheme.—Mr. W. R. Walton has asked the Council for some payment on account of work carried out in connection with the electric lighting scheme, which is being postponed for a time.

London.—Poplar.—The L.C.C. has sanctioned a loan of £2,000 to meet the Council's capital cost in linking-up its electricity undertaking with that of Hackney. The revenue accounts for the December quarter last show an increase of 1,321,755 units sold as compared with the corresponding period in 1914. The net income from the sale of current shows an increase of 19·75 per cent., and the working expenses an increase of 50·5 per cent. The net surplus income shows a decrease of £928, which, in view of the high prices of coal and other conditions militating against profits, is considered by the Electricity Committee to be highly satisfactory.

Electricity Charges in the City.—The Court of Common Council last week considered the Streets Committee's recommendation that, subject to the Charing Cross Electricity Co. giving an undertaking that the proposed increase in the lighting rate of ½d. per unit would not be continued beyond 12 months after the war, no objection should be offered to the application to the B. of T. After some discussion, the Court declined to adopt the recommendation.

The City of London E.L. Co. has given notice of a probable increase in all charges for electricity, not exceeding 10 per cent., as from the 31st inst.

Shoreditch.—The L.C.C. has sanctioned the borrowing by the B.C. of £1,500 for house services, and £500 for meters.

Lewisham.—Having considered an additional charge of 10 per cent. made by the South Metropolitan E.L. and P. Co., for the supply of energy for lighting purposes, the Finance Committee recommends the B.C. to enter into a fresh agreement with the company, for a period of five years, for the supply for electric lighting purposes, at 3½d. per unit, plus 10 per cent., and for power purposes at 2½d. per unit, as hitherto.

Westminster.—The contracts between the City Council and the Charing Cross Electricity Supply Co., the Metropolitan Electric Supply Co., and the St. James's and Pall Mall Electric Light Co., for the supply of energy, have been under the consideration of the Contracts Committee. The Committee formally reports the continuance of the contracts with the two latter companies, while the Charing Cross Co. has given notice of termination, stating that it will let the Council know the rates to be charged after June 30th next.

Luton.—Assessment.—The electricity undertaking assessment has been increased from £5,000 to £6,200 gross and from £2,500 to £3,100 net, having regard to the recent extensions. The Corporation has been recommended to agree to the revised figures.

Middlesbrough.—At a recent meeting of the Electricity Committee it was reported that the generating costs had been reduced from ·80d. to ·55d. per unit during the month, the total cost having been £1,065, as against £1,244 in the corresponding period of last year, and the revenue £1,508, as against £1,290. It was stated that the reduced costs were largely due to the fact that they were purchasing energy instead of generating it by steam.

Newport (Mon.).—A summarised return of the receipts and working expenses of the electricity undertaking for the December quarter last, shows an increase in revenue from the sale of current of £2,895, as compared with the corresponding period of 1914, and for the three quarters of the present financial year, an increase of £4,519. The expenditure for the quarter was heavy, no less than £2,000 being attributable to increased coal costs, which, for the nine months, was upwards of £4,000. The number of units sold totalled 3,640,940, an increase of 210,934 over the nine months of 1914. As regards the ensuing year the general manager and electrical engineer estimate that generating expenses will show an increase of £1,523 over the current year and £7,386 over the preceding 12 months. On the other hand, however, they think there is every probability that the sale of energy for power purposes will result in a gratifying increase.

New Zealand.—The Ti Kuiti B.C. (having been unable to secure the machinery for the duplication of its plant) is endeavouring to obtain an additional supply of electricity from the Hora Hora Falls of the Waihi G.M. Co., which are nearly 50 miles distant.—*Tenders.*

Rawtenstall.—Assessment.—The assessment of the electricity extension has been reduced from £850 to £640.

Rochdale.—The Electricity Committee has, it is stated, decided to call in an expert from Manchester to advise upon certain matters connected with the electricity works—the question of charges and the maximum output possible.

Shrewsbury.—Price Increase.—By resolution of the City Council, the charges for electrical energy for all purposes are to be increased 20 per cent.

South Africa.—Recently the Victoria Falls and Transvaal Power Co. offered to supply the Johannesburg T.C. in bulk at 20,000 volts, with a minimum of 4,000,000 units per annum—on condition that the supply was taken between 4 p.m. and 8 a.m. each day, and did not exceed 6,000 units in any hour—at ·75d. per unit delivered at one of the company's sub-stations. The Corporation to supply all necessary cables, transformers and switchgear. This offer was considered by Prof. Dobson, the manager of the Corporation electricity department, and, on his recommendation, was refused. The company's offer was made as an alternative to the Council's proposal to provide additional generating plant at a cost of £80,000, and it was pointed out that the load factor under the proposed presumably peak load conditions would only amount to 7½ per cent.; that the cost of the purchased power would only amount to £12,500 a year, and that the saving in running costs due to better operating conditions should more than offset the capital charges on cables, transformers, &c. Mr. Dobson, on the other hand, considers that the T.C. would have to spend £35,000 to obtain the supply, and that if the five years' contract was continued after that period, the cost per unit would amount to 1d., while if terminated at the end of five years the cost would be 1·19d. per unit, and that, in both cases, substantial savings would result by the Corporation putting in its own plant.

Surbiton.—Price Increase.—The Finance Committee recommends that Messrs. Callender's Cable and Construction Co. be permitted to increase the maximum charge for electricity for lighting purposes from 6d. to 7d. per unit, the increase to remain in operation for a period of 12 months only and to expire March 13th, 1917. The Council approved the recommendation.

Swinton and Pendlebury.—The Clerk has been instructed to settle a compensation claim lodged in respect of a girl who was burnt through her clothes coming in contact with a "fire devil" used in connection with electricity extension work, and instructions are to be issued to Corporation watchmen cautioning them about allowing children to play near their fires.

Thirsk.—Price Increase.—On April 10th the charges for electricity are to be increased by 20 per cent.

Whitstable.—The U.D.C., which has been working the plant of the local Electricity Co. at the pumping station, has passed a resolution to the effect that no further wages be paid, nor coal or any other commodity be purchased, for the purpose of generating electricity on behalf of the company. The Council has also decided to pay £40 15s. 10d. to the Receiver acting for the company, as the amount due to the company on March 12th.

TRAMWAY and RAILWAY NOTES.

Ashton-under-Lyme.—The Trades Council has decided to protest against the proposed introduction by the Stalybridge Joint Tramways Board of women tramway drivers, contending that the routes include some dangerous roads.

Bradford.—Regulations have been submitted by the Corporation to the B. of T. regarding access to tramway cars at stopping places and controlling persons resorting thereto, which provide that when six or more persons are waiting at any terminus or stopping place, they shall form up in a "line or queue," and no person shall take any place other than in proper order—the latest person taking the last place at the end of the queue.

Canada.—Harbour Terminal Electrification.—For the past three years the Montreal Harbour Commissioners have had under consideration the electrification of the harbour railway terminals, and during the past year have visited and inspected the electric freight terminals of the New York Central, Pennsylvania, and New York, New Haven, and Hartford Railways where the application of electricity had proved successful in the movement of freight. As a result of this investigation an expert electrical engineer has been engaged to study the railway conditions of the port and to report on the advisability of the scheme. Should his report confirm the conclusions of the Commissioners, steps will at once be taken to proceed with the work of electrifying the Montreal Harbour terminals.—*Canadian Electrical News.*

Continental.—France.—On the electric tramcars in Bordeaux women are employed as drivers, and they have been found very satisfactory.

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ITALY.—Application has been made for a concession for the construction and working of a narrow-gauge electric railway, about 10 miles in length, between Piacchia and S. Marcella Pistoiesi.

The Royal Commission dealing with the technical services of the State has nominated a sub-commission to study the whole problem of electrifying the State railways. This sub-commission has already begun its labours, by taking evidence from leading railway officials.

Darlington.—The General Purposes Committee has decided that for the purposes of wages computation all temporary motormen and handy men in the Light Railways department shall be classed as second-year men. This is equivalent to an increase in pay of 4½d. per day instead of ½d. per hour, as proposed.

Edinburgh.—The question of the appointment of a tramway engineer, in the interest of the Corporation, during the remainder of the Tramway Co.'s lease, the appointment of a tramway manager and the establishment of a tramway department has been remitted to a Sub-Committee of the Tramways Committee for consideration and report.

Huddersfield.—RATE RELIEF.—The Tramways Committee has decided to transfer £8,600 (equal to a 4d. rate) to the borough fund for the relief of rates.

Japan.—The Acting British Consul at Tamsui reports that, according to the local Press, a company has been formed at Tainan for the construction of an electric tramway from Tainan to the Port of Anping, a distance of about three miles. Negotiations have already been completed between the company and the military authorities for the purchase of the light railway belonging to the latter, which is the present means of communication by land between the two places. The capital of the company is said to be 400,000 yen (about £40,800).—*Board of Trade Journal.*

Leeds.—RATE RELIEF.—It is estimated there will be a net surplus of about £90,000 for the year on the Corporation's tramway undertaking (equal to a 10d. rate). The amount originally estimated was £55,000. Last year £81,000 was appropriated for the relief of the rates. At the close of the year about one million sterling in all will have been contributed by the tramways to rate relief.

Newport (Mon).—A net profit of £1,187 is estimated on the tramways undertaking for the ensuing 12 months.

Rawtenstall.—The T.C. has just adopted a suggestion for the alteration of the stages and fares between Rawtenstall and Bacup, on and after July 24th. If the project is carried into effect the journey will be divided into eight stages instead of seven at present, and the fare will be 4d. instead of 3½d.

Southend-on-Sea.—The electrical engineer reports that it is necessary to renew the overhead trolley-wire on the whole length of the Leigh section, the cost of which is estimated at £1,206. The Corporation has been recommended to authorise the engineer to purchase the necessary materials. The Tramways Committee has adjourned for six months' consideration of the offer of Loughborough Road Car Co. to dispose of an Edison electric 'bus for £1,100. The L.G.B. has approved of the Council retaining and erecting for its own purpose two of the 200-KW. sets manufactured for the Leigh sub-station.

Swansea.—TRAMWAY AGREEMENT.—The Corporation has approved of the Tramways and Lighting Committees' recommendation as to the agreement with the Swansea Tramways Co., for the supply of the whole of the electricity for the running of the company's tramways and light railways at 1½d. per unit, with reductions to ½d. per unit for all units in excess of 1,000,000 taken in one year, the price being subject to a coal clause. The company has agreed to hand over its power station to the Corporation free of ground rent, the Corporation to pay the company £400 per annum for 26 years. The cost of connecting up with the company's feeder cables is estimated at £2,000.

Swinton and Pendlebury.—At a meeting of the D.C. last week it was announced that the Salford tramways lease, which had been in hand for 10 years, had been completed. The lease runs for 21 years from 1905.

Wigan.—FEMALE LABOUR.—The Watch Committee has granted an application of the tramways manager for licences for three women car drivers and 17 women conductors.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—May 1st. Two 300-KW. turbo-alternators, condensers, switchboard, &c., for the pumping station at Ryde, for the Metropolitan Board of Water Supply and Sewerage at Sydney.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-KW. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.*

MELBOURNE.—April 11th. City Council. 533,000 arc lamp carbons. See "Official Notices" to-day.

April 18th. P.M.G. 8,500 fuses.*

April 26th. Victorian Government Railways. Car-lighting material—cables, switches, fuses, &c.*

May 10th. Victorian Government Railways. Motor-generator set and accessories for battery-charging of baggage trucks.*

TAMWORTH (N.S.W.).—May 1st. Additional generating plant, switchboard, mains, &c., in connection with the municipal electricity undertaking. Specifications from Mr. V. G. Kable, Town Clerk, Council Chambers.

Dundee.—March 29th. Corporation. Electrical stores, meters, &c. Electricity Department, Dudhope Crescent Road.

Edinburgh.—April 3rd. Midlothian and Peebles District Asylum, Rosslynlee. Stores, including electrical fittings. Forms from Clerk and Treasurer, 19, Heriot Row, Edinburgh.

April 1st. Corporation. Maintenance of telephone and electric bell installations; City Superintendent of Works. Engineers' stores, electrical material; Resident Electrical Engineer.

Leeds.—Electric light fittings for the Town Hall, Municipal Buildings, Judges' House and Offices in Great George Street. The City Engineer, Municipal Buildings, Leeds.

London.—March 24th. H.M. Commissioners of Works. Main switches, main fuses, switch fuses and fuseboards, for one year. See "Official Notices" March 17th.

Manchester.—March 30th. L. & Y. Railway. Twelve months' supply of stores (various). (30) Signal, telegraph and electric fittings; (31) signal, telegraph, and electric light wires. Mr. Waring, Stores Department, Osborne Street, Manchester.

March 29th. B. of G. Completion of the electric light installation at the Nurses' Home, Withington. Specifications (10s. 6d. returnable) from Mr. F. H Overmann, 49, King Street, Manchester.

April 1st. Electricity Committee. (*a*) Low-pressure water and exhaust steam pipes, valves and supports; (*b*) valves for circulating water pipes. Specifications from Mr. F. E. Hughes, Secretary, Electricity Department.

Rathmines.—March 27th. U.D.C. Cable, house-service and fuse boxes, and meters, for 12 months. See "Official Notices" March 17th.

Redditch.—March 28th. U.D.C. Three and six months' supply of coal for the Electricity Department (125 tons of D.S. nuts per week). See "Official Notices" March 17th.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Barnes.—The Council is recommended to enter into a contract with the Tudor Accumulator Co. for the maintenance of the storage battery for a period of ten years at an annual payment of £135.

Barnsley.—The T.C. has considered the tenders of the Westinghouse Co., Messrs. Bruce Peebles, Messrs. Bertram Thomas, the British Thomson-Houston Co., Messrs. Dick, Kerr, Messrs. Crompton, and Messrs. Reynold & Co., for the installation of new plant at the electricity works, and has accepted that of the Westinghouse Co. for £5,146.

Bingley and Ilford.—Bingley U.D.C., house-service meters for one year, and Ilford U.D.C., electricity meters for another year: Electrical Apparatus Co., Ltd.

Colwyn Bay and Hornsey.—Messrs. Chamberlain and Hookham, Ltd, have received a contract from Colwyn Bay for meters for the coming year, and also a renewal contract for a further 12 months from Hornsey.

Government Contracts.—List of new contracts for February, 1916:—

WAR OFFICE.

Electric cable and wire.—S. S. Abelson & Co.; B.I. & Helsby Cables, Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Hooper's Telegraph and I.R. Works Co., Ltd.; I.R., G.P. & Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; St. Helens Cable & Rubber Co., Ltd.; Siemens Bros. & Co., Ltd.

Ebonite.—Peel-Conner Telephone Works Co., Ltd.; Siemens Bros. and Co., Ltd.

Generating sets.—Austin Motor Co. (1914), Ltd.

Lamps (electric).—Brimsdown Lamp Works, Ltd.; Brit. Thomson-Houston Co., Ltd.; Foster Engineering Co., Ltd.; Pope's Electric Lamp Co., Ltd.; "Z" Electric Lamp Mfg. Co., Ltd.

Switchboards.—Automatic Telephone Mfg. Co., Ltd.

Works services.—Electric lighting at Officers' Mess, Dover: V. G. Middleton. Electric lighting at Portland: G. E. Taylor & Co. Power house, Thetford: Mann, Egerton & Co.

POST OFFICE.

Telephone apparatus.—Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.

Testing apparatus.—W. G. Pye & Co.; I.R., G.P. & Telegraph Works Co. Ltd.; Park Royal Engineering Works Co., Ltd.

Telephone cable.—B.I. & Helsby Cables, Ltd.

Insulators.—Taylor, Tunnicliff & Co., Ltd.

Galvanised wire.—Rylands Bros., Ltd.

Laying earthenware ducts and cast-iron pipes in Old Street, Great Eastern Street, E.C.—A. J. Ewart, Ltd.

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Glasgow.—The T.C. Committee on Cleansing—a deputation of which has visited Dover, Sheffield, Nottingham, &c.—has agreed to recommend the purchase of two 2-ton Edison electric vehicles for the collection of refuse.

Johannesburg.—The Tramway and Lighting Committee recommends the acceptance of the following tenders :—

Two 3,000-kw. turbo-alternating sets, with Parsons condensing plant, switchgear, &c., £26,895 ; spare motor, £798 —Sykes & Co.
Wet-air filtration plant, £690.—Griffin Engineering Co.

London.—Bermondsey.—The Electricity Committee has purchased out of contract eight wagons and 146 tons of coal, at prices varying from 21s. 8d. to 37s. a ton. For the annual tenders for coal no replies were received ; the present contractors state that they are willing to quote from time to time for current supplies, and would endeavour to maintain deliveries at the rate of about 100 tons weekly. The price of Shipley peas now being supplied is 24s. 8d. per ton. The engineer has been instructed to purchase on this quotation as much as possible, and to supplement this by purchases at lower prices if possible. The Committee recommends the acceptance of the tender of Messrs. Chamberlain and Hookham for meters at an increase of about 7½ per cent. on the existing prices ; also the offer of Venner Time Switches, Ltd., for Type B time switches. The Committee has accepted the tender of Messrs. Babcock & Wilcox, Ltd., for various fittings.

Southend-on-Sea.—The Tramways Committee has accepted the tender of Messrs. John Brown & Co. for 64 steel tires, at £37 10s. per ton, to be supplied as required.

Walthamstow.—The electrical engineer has arranged with Messrs. Myers, Rose & Co. to increase the amount of coal to be supplied during the ensuing 12 months to 60 tons of Warwickshire peas and 75 tons of Warwickshire double-screened nuts per week, and to supply as from November 1st next to April 1st, 1917, a further 50 tons per week of D.S. nuts and 50 tons per week of Derbyshire small nuts. The Council is recommended to accept the offers of the following firms to renew their contracts for annual supplies :—

Electricity Department.—Joint-box compound, Dussek Bitumen Co. ; meters, Chamberlain & Hookham ; carbon-filament lamps, General Electric Co., Crypselco, Ltd., and Electrical Mfg. & Supplies Co. ; rubber insertion, G. Angus & Co. ; cylinder oil, crank-chamber oil, and D.T.E. turbine oil, Vacuum Oil Co., Ltd. With regard to the remainder of the items, the electrical engineer has been directed to obtain quotations from time to time as required.

Tramways Department.—Lamps, General Electric Co. ; rubber packing, G. Angus & Co. ; trolley heads, W. Wood & Co. ; trolley wheels, Anti-Attrition Metal Co. ; paints and varnishes, Dooker Bros., R. Kearsley and Co., and L. Berger & Co. As regards controller fingers, pinions, gear wheels, armature coils, oils and grease, castings, green paint, and car accessories, the tramways engineer is to obtain quotations for these as and when required.

OVERHEAD WIRES AND CABLES.

The case of the Postmaster-General *v.* Hutchings, which was decided recently by the Railway and Canal Commissioners, serves to remind us that as regards the right to suspend telephone and telegraph wires over various kinds of property, the Postmaster-General is in a favoured position. If a private owner objects to wires being put over his park or garden, he may make a claim for compensation, which is settled, in the last resort, by the Railway and Canal Commissioners. In the case under notice, it was pointed out that where roads are public roads not taken over by the local authority, the person entitled to consent is the adjoining landowner ; but he has no right to demand, as the price of his consent, that a certain annual sum shall be paid in the nature of rent. The Railway and Canal Commissioners said that a payment of the annual sum of £5 would have no relation to the actual damage done, but would be in the nature of a charge for use and occupation, which was not allowable. Wholly different considerations apply to the suspension of cables over private roads or places by persons who, unlike the Postmaster-General, exercise no statutory power or authority. That there is doubt prevailing on this matter appears from the letter of a correspondent in which he asks :—(1) In a scheme in which overhead cables are employed, where it is found necessary to take the cables over private property belonging to another party, provided the property is not entered during the process of erection, can the owner of the property legally object to such cables? If so, is it necessary to prove damage?

(2) What is the position in a similar case to the above, in which the property crossed is a road owned by the Council?

It is understood in both cases that no provisional order has been obtained by the company. With reference to these questions, the mere fact that the person suspending the cables does not enter the land is immaterial. It is a trespass to suspend anything over a man's land even at a great height above it. No damage need be proved ; and an injunction would be granted, in a proper case, to compel removal of the wires. With regard to roads owned by a local authority, the matter stands on a different footing. Attempts have been made from time to time on the part of local authorities to veto the right of putting up overhead wires, by resort to the various statutes by which the streets are vested in them. It is now well settled, however, that the vesting of the street or road vests in the highway authority such property, and such property only, as is necessary for the control, protection, and maintenance of the street as a highway for public use. And such property does not entitle the local authority to interfere with overhead wires which are put up in such a way as not to be dangerous to the public. By agreement, therefore, with adjoining owners, who may grant leave to put the necessary poles on their lands, it is possible to make arrangements for a non-statutory company to carry on its business. Note, however, that in this case the person suspending wires supplying electricity must comply with the regulations which have been made by the Board of Trade under Sec. 4 of the Electric Lighting Act, 1888.

THE SELLING SIDE OF ELECTRICITY.—V.

It may be opportune at the present time, when so many of the regular showroom representatives are called away on service in a greater field than electricity supply, to offer a few remarks to those who are "carrying on."

Perhaps the most trying moments in dealing with a captious public arise when a consumer calls to lodge a complaint. Even the best managed undertakings have complaints, and one of the most important functions of the sales department is to deal with them satisfactorily. It is obviously as valuable work to keep consumers as it is to get them. Indeed, more so, for a lost consumer means a dead service, and the capital spent thereon becoming unproductive.

American writers frequently take occasion to emphasise the necessity of courtesy, and remark that politeness costs nothing. This point is so self-evident that nothing more need be said upon that head. Tact is the next thing, and though it has been stated that this is a quality some people may never acquire, there is nothing to prevent anyone being sympathetic, and that is nearly the same thing. Bear in mind that many of your visitors who come to complain, are less keen in securing redress than in having their say. Listen with sympathetic interest, and don't short-circuit them before they have got it off their chests. They have probably thought out what they are going to tell you, and if they go off without having said it, the fact will rankle. Therefore, although the answer to their grievance may spring to your lips long before their tale is told, let them go through with it first.

There are usually a certain number of irreconcilables who turn up every quarter, their accounts, according to themselves, always being far in excess of what they could possibly have used, and so on. These constitute a problem in themselves, causing as they do an amount of work far in excess of what their business warrants. But it must be remembered that each of these has his circle of friends, and can do an incalculable amount of harm, so although he may be recognised as a chronic, he must receive his full share of attention.

Most stations find that some of their best friends have been discovered from complaints. Faulty wiring, uneconomical lamps, over-shading, badly-placed lights, &c., are frequently at the bottom of heavy account complaints. Nothing like full advantage is taken of two and three-point switching, and, one way or another, it is very rarely some remedy cannot be found. The ultimate result is increased business, for once the customer is satisfied that the supply authority is studying his interests as well as its own, he is ready to listen to other propositions which may be placed

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before him. Heating, cooking, and other uses follow so many of these complaints in due season, that an experienced salesman welcomes a complaint, giving him, as it does, the personal interviews that are often so difficult to obtain.

Where a complaint necessitates telephoning another department, it is permissible, if a thorough understanding exists between departments, to display a little heat over the treatment the consumer has received, which will be allayed on learning the facts, which can be given to the consumer.

The importance of increasing the station's load through existing services cannot be too frequently insisted upon, for it means not only increased output, but also a better load factor. A good plan is to have an iron, or something of the kind, on your table, to which you can direct the conversation at a convenient opportunity, in case the consumer is disinclined to make a general inspection of the showrooms. Never miss a chance. Above all, see that the right thing is sold for the purpose in view; an iron of too small a weight, or a radiator of insufficient capacity, may lead to more harm than good.

DIRECT-CURRENT TRACTION AT 5,000 VOLTS.

In a recent issue of the *Electric Railway Journal*, Mr. N. W. Storer described the experimental 5,000-volt direct-current equipment of the Michigan United Traction Co., on the branch line from Jackson, Mich., to Grass Lake and Wolf Lake, a distance of 12 miles.

Five thousand volts was selected as the initial limit, as this is high enough to make easily possible the collection of current for the largest locomotive from an overhead wire. It is also high enough to lessen the amount of line copper and the number of sub-stations, and to secure a good load factor and efficiency with reasonable cost.

The initial experiments involved the design and construction of two 2,400-volt motors and the necessary control equipment, which were mounted on a car and tested on the interworks railway at East Pittsburgh in the spring of 1914. The equipment was first arranged for series-parallel control with voltages of from 2,400 to 3,000 on the trolley. Then the two motors were connected permanently in series and the equipment was operated at a trolley voltage of 4,000, which was gradually increased until the equipment was finally tested with 7,000 volts on the trolley.

The line extends to within two miles of the centre of Jackson, and the car has therefore to operate over a 600-volt line in the city limits.

The trolley line was reinsulated and a mercury arc rectifier sub-station provided at Grass Lake. A complete car equipment, consisting of four 100-h.p. motors with control and

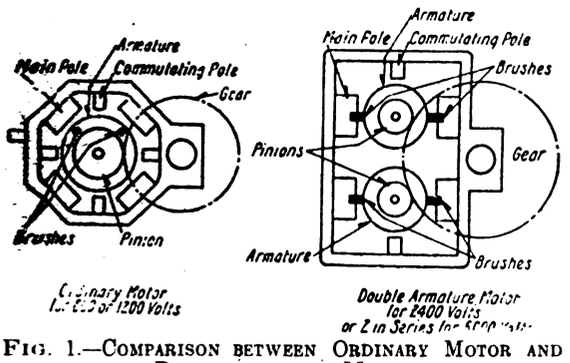

Fig. 1.—Comparison between Ordinary Motor and Double-armature Motor.

auxiliaries, was installed on one of the Michigan United cars, which weighs complete about 40 tons.

The motor is known as the twin-armature bi-polar type, and it has many advantageous features for high voltage work. A bi-polar design permits the use of double the voltage on a given commutator that is possible with a four-pole motor. The twin armatures make the weight but little more than that of a corresponding four-pole motor. Fewer field coils are required than are used with the four-pole motor, and the two armatures, being geared to the same axle, act as one unit and cut the pressure on the gear teeth in half. The two armatures are connected in series, and consequently, the voltage on each is reduced to lower limits. The form of motor lends itself readily to a very effective type of insulation, and the mechanical construction is simple and rugged.

One characteristic that will assist in the maintenance of the insulation is the fact that the current is small, being only 30 amp. for each 100-h.p. motor, and that only a few small brushes are required. Thus with the excellent commutation, there is very little wear either on brushes or commutators, and consequently the amount of carbon and copper dust originating in the motor is small. It is fully recognised that upon the permanence of the insulation depends the success or failure of the experiment, and this is something that time alone can determine.

Next to the motors, the control is the most important feature of the equipment, since the switches must close and open the high-voltage circuits properly and must be insulated to stand continuously the maximum voltage to ground in all kinds of weather.

In order to secure a relatively large number of breaks in series without increasing the number of switches unduly, each switch is made with two breaks in series.

The high-voltage switches are very similar to the standard Westinghouse electro-pneumatic switches, but have some special features due to the small current and high voltage. One of the novel features in the switch is the use of an "arc splitter," consisting of a piece of soapstone placed in front of the switch jaws in the path of the arc. The effect of the magnetic field is to blow the arc against this along its entire length until the arc is broken. This greatly increases the length and at the same time chills the arc, and the result is highly satisfactory. The operation of the switch groups has been fully as reliable as that of the motors.

Practically the only other part of the control equipment that is subject to the line voltage is the starting rheostat. This is composed of cast alloy grids in a number of frames, which are insulated from ground by triple insulation and from each other by double or quadruple insulation.

Inasmuch as the equipment is required to operate through the city of Jackson on 600 volts, a change-over switch is provided which connects the four sets of armatures in parallel. This apparatus consists of two triple-pole, double-throw disconnecting switches with the contacts mounted on porcelain insulators immersed in oil. They are connected together so that they are operated by a single lever, which also operates a small drum that changes a few of the contactor magnet connections.

One group of switches is provided to effect the necessary changes on the ground side of the equipment and the auxiliaries. This is a standard group which is used ordinarily for small 600-volt car equipments.

A standard type of electro-pneumatically operated two-motor reverser is used to reverse the connections of the motor fields, the fields being always connected on the ground side of the armatures so that no extra insulation is required.

Not of least importance is the apparatus needed for furnishing current for control, lights and the air-compressor motor. It is well known that the small high-voltage machine known as the dynamotor which is used for this purpose on 1,200-volt and 1,500-volt equipments is the least reliable part of the equipment, and it was felt necessary to eliminate the dynamotor from higher voltage equipments. For this reason the entire auxiliary equipment of the 5,000-volt car is operated at 150 volts.

A 150-volt storage battery, to which all of the auxiliaries are connected, is placed in the main motor circuit between the motors and ground. All of the main motor current, therefore, either goes through the battery and charges it, or

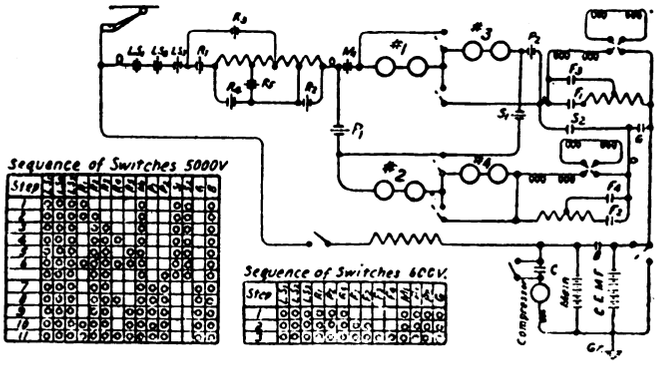

Fig. 2.—Wiring Diagram of 5,000-volt Equipment.

through the auxiliary circuits which may be connected to the battery at the time the motors are working. By the application of a simple device, the air compressor does practically all of its work when the main motors are operating, and thus simply diverts a part or all of the main motor current as required, so that the battery is relieved from furnishing the current to the compressor motor and at the same time does not receive the high charging currents that would otherwise be imposed on it during acceleration. The battery has thus a very light duty to perform and can be made up of small cells. A set of counter-e.m.f. cells parallels the battery during charging periods to prevent overcharging and excessive charging rates.

The voltage of the battery for such an equipment is determined by the amount of power required for the auxiliaries. The average current required by the auxiliaries should, in order to leave a satisfactory margin, be not more than 80 per cent. of the average current taken by the main motors. The use of 150 volts for the battery in this case indicates that the auxiliaries are expected to use less than 3 per cent. of the total power taken by the car.

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The main schematic wiring diagram is shown in fig. 2, in which the double-break switches are indicated by three parallel lines across the circuit and the single-break switches by two lines. It will be seen that twelve of the former and ten of the latter are required for this equipment. Considering the fact that these switches control not only the main motor circuits for both 5,000-volt and 600-volt operation, but all of the auxiliaries as well, the equipment is very simple. Very satisfactory operation on 600 volts is secured by shunting the fields of the motors.

As before stated, power for operating this car is obtained from three mercury-arc rectifiers, which receive power from a 60-cycle, three-phase system and are operated in series. Connecting the three phases of the system in series not only gives a smooth current wave, but balances the load on the three phases of the transmission system. This is believed to be the first time mercury-arc rectifiers have been used in this way to furnish so much power for high-voltage work.

FORTHCOMING EVENTS.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, March 24th. At 7.30 p.m. At Bolbec Hall, Newcastle-on-Tyne. General meeting.

Physical Society of London.—Friday, March 24th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. General meeting.

Manchester Association of Engineers.—Saturday, March 25th. At the Grand Hotel, Aytoun Street. Report of the Tool Steel Research Committee.

Electrical Trades Benevolent Institution.—Monday, March 27th. At 2.30 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Annual general meeting.

Post Office Telephone and Telegraph Society of London.—Monday, March 27th. At 6.30 p.m. At the I.E.E., Victoria Embankment, W.C. Paper on "Telegraph and Telephone Work in a Provincial Depôt," by Mr. J. M. Rusk.

Institution of Electrical Engineers (Students' Section).—Wednesday, March 29th. At 7.45 p.m. At the I.E.E., Victoria Embankment, W.C. Annual general meeting.

Leeds Association of Engineers.—Thursday, March 30th. At 7.30 p.m. At 5, Park Lane. Paper on "Hardness and its Determination," by Prof. G. F. Charnock.

Royal Institution of Great Britain.—Saturdays, April 1st and 8th. At 3 p.m. At Albemarle Street, W. Lectures (IV and V) on "Radiations from Atoms and Electrons," by Prof. Sir J. J. Thomson.

NOTES.

The Water Power of the Main.—A Bill has been brought into the Prussian Diet to authorise the Government to expend £310,000 on the establishment of hydro-electric works at the weirs which are being constructed at Mainkur, Kesselstadt and Gross-Krotzenburg in connection with the general scheme for the canalisation of the Main from Offenbach to Aschaffenburg. The result of a technical examination shows that if four turbo-generators are provided at each place, it will be possible to obtain an average of 30 000 000 KW.-hours per annum, or 25,000,000 KW.-hours after deducting losses in lines and transformers. It is proposed to erect a transmission line between these works and the Government hydro-electric works on the upper part of the Weser, so that an interchange of supply may be effected when necessary. It has been found that when the water power of the Main fails, or almost fails, that of the Weser works is abundant, and *vice versâ*. When the works have been completed, the supply from State generating stations will be in operation over an area extending from Bremen to the Main.

Italian Water Powers and Manufacturing.—The proceedings in connection with the eighth Congress of the Società Italiana pel Progresso delle Science, which was opened at Rome on the 1st inst., included the presentation by Prof. Ascoli of a paper on the electrotechnical industry in Italy. Dealing first with the production of electrical energy, the author stated that the situation of the country was very favourable for the purpose, in consequence of the utilisation of hydraulic power to a large extent. The Lombardy network comprised seven provinces, and afforded a very fine example of an initiative in the direction of national organisation of the water power of the kingdom. In 1913 the water power in service exceeded 1,000,000 H.P., which was divided among the three principal groups represented by the Piedmont Alps, the Lombardy Alps, and the Central Apennines to the extent of nine-tenths, and in the proportion of about 300,000 H.P. in each case. It was also possible to reckon on the establishment of mountain reservoirs by the embankment of streams, particularly in the Southern Provinces, and a law already contemplated the formation of artificial lakes in connection with the Tirso, in Sardinia, and the Sila, in Calabria. With similar schemes there would be available several further hundreds of thousands of horse-power for industrial purposes, after having satisfied the requirements of agriculture. But the task of utilising the hydraulic energy would take a long time to carry out, and it would also be impossible to determine the total amount of power which could be derived therefrom. It was better for the present, the Professor continued, to examine another side of the problem which was very important, namely, the manner in which the energy already rendered available could be fully utilised. It was found, for instance, that while the hydraulic power now at their disposal could yield 8,000,000,000 H.P.-hours, in reality the various industries only used 2.000,000,000 H.P.-hours per annum, the different works only being in operation for a certain number of hours daily. In other words, the energy at present used was equivalent to about 2,500,000 tons of coal, whilst if full advantage were taken of it, it would represent 10,000,000 tons of coal, or a saving of £12,000,000 in normal peace times, and of about £40,000 000 in the present exceptional times. It was, therefore, of special importance to co-ordinate the different industries, so that the consumption of electrical energy might be equally distributed throughout the day and the year, and every hydro-generating station should be provided with reservoirs, so as to yield extra power in the hours and months of greatest demand. According to the further report of the proceedings at the Congress, the Professor dealt at some length with the problems of manufacturing in Italy, but apparently no reference was made to foreign competition. Indeed, the author stated that for the greater part the alternators, switchboards, distributing conductors, &c., were produced in Italy, so that from this point of view "the national industry is in a satisfactory condition." This assertion scarcely coincides with the opinions expressed recently at meetings of the Italian Association of Electrical Engineers, as previously reported in this journal. Nevertheless, the Professor concluded by predicting the formation of a central organisation, which will be in permanent contact with makers, and which will cause all individual efforts to converge towards a single object.

Electrochemical Industries for South Africa.—In the *South African Mining Journal* of February 19th the publication of a report on the possibility of establishing on a commercial basis certain electrochemical industries was commenced. The report has been prepared by a Committee of the South African Institute of Electrical Engineers (known as the Development of Resources Committee), and has for its purpose to call the attention of the Government and others to the possibilities of manufacturing locally, by the aid of electric power, several articles of very great commercial importance which are now either being imported, or of which there is little or no importation owing to the cost of transport from overseas. It deals with materials produced by synthetic chemistry, and especially the manufacture of various valuable compounds which can only be formed at the high temperature available in electric furnaces; it is stated that there is produced in the world annually, by means of the electric furnace, about a million tons of manufactured product, of which the value is probably in excess of £20,000,000. The report is confined to the consideration of materials which are most necessary for agriculture and mining; these industries, taken together, require annually more than two million pounds' worth of chemicals, all of which are imported in the form of fertilisers, cyanide and nitrates. The essential elements for the successful manufacture of these compounds are cheap electricity, abundant coal, limestone, and the necessary labour, all of which exist in South Africa; and, furthermore, the local market is to a considerable extent protected from competition by the necessarily high costs of transport chargeable on imported articles, as well as by Customs duties. Imports of calcium carbide in 1913 amounted to about 2,600 tons, valued at £60,000; the estimated factory cost for local production is £35,850. The cost of cyanamide at South African Coast ports was, prior to the war, £13 per short ton (2,000 lb.); the estimated factory cost of local production is £9 per ton. The pre-war cost of sulphate of ammonia (an equivalent fertiliser) was £15 per ton. In addition to its utility as a fertiliser, cyanamide is valuable because of the readiness with which it can be induced to part with its nitrogen molecule to form many of the compounds used in the manufacture of modern explosives. South Africa, during the year 1914, consumed 10,518,000 lb. of sodium cyanide, having a total value of £454,743. In the opinion of the Committee, the various products dealt with can be profitably manufactured in South Africa, provided the necessary raw materials are obtainable at about the costs which have been assumed. An early investigation with regard to the location, quality and cost of production of these raw materials is a matter of the greatest possible importance, and it is hoped that the Government Munitions and Industries Committee, or some other suitably constituted body, will take the matter in hand forthwith.

Shortage of Electricians in Australia.—According to a Sydney newspaper a special general meeting of the Electrical Employers' Association of N.S.W. was held in February, to consider the situation which has arisen owing to the present shortage of labour in the industry, a considerable number of men having enlisted for active service, and a number also being employed by the Commonwealth authorities in connection with local defence. A resolution was carried "that the public be notified that owing to a large number of employés in the electrical industry having enlisted for active service, and a further number being employed by the Commonwealth Government for defence purposes, it is exceedingly difficult for employers in the electrical industry to carry out their contracts for electrical installations and to execute extensions and repairs within what would otherwise be reasonable time."

Orwell Electric Vehicles.—The Midland Railway Co. have lately acquired an "Orwell" 30-cwt. electric tilt van from Messrs. Mossay & Co., Ltd., for use in connection with their parcels delivery service. A 2-ton electric lorry has also been supplied by the same firm to the Ipswich Industrial Co-operative Society, Ltd. It may be remembered that the vehicles are built by Messrs. Ransomes, Sims, & Jefferies, Ltd., of Ipswich.

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Fatalities.—Deptford.—An engineer was killed at an electricity works at Deptford, last week, by a shock at 6 200 volts. He was found at the switchboard with his clothes in flames.

Coventry.—At an inquest held at Binley Colliery concerning the death of Thomas Pritchard, aged 48, who met his death while operating an electric coal-cutter in the mine on March 10th, Guiseppe Goggrene, an Italian by birth, said deceased was a stall man. About 3.50 a.m. on Friday deceased was cutting coal with a machine. Witness was there, and saw that the deceased had his left hand on the ratchet wheel and his right hand on the controller; he pulled the coal-cutter towards the face of the coal, with his stomach on the machine. He was not able to get off the machine, and shouted "Take me off." Witness touched his boot, and received a shock himself; he then ran to a switchbox 35 yards away and turned off the current. Deceased was thus released from the machine and fell to the ground. When witness touched him again the man was dead.

Ernest Runciman, the electrician of the colliery, was unable to state definitely how the deceased came to receive the shock which killed him. The Coroner questioned him as to the value of rubber gloves, boot soles, or mats as a protection against shock. Witness said that the sense of security afforded by these had often proved in itself a trap, by making men less careful than they otherwise would be. Such articles were liable to lose their efficacy, whilst leaving the user under the impression that he was safe.

Asked how he accounted for the accident, witness said it was very hard to account for. Subsequent tests had shown that it was an exceptionally safe machine. Investigation showed that an intermittent earth took place on the trailing cable, which was about 70 yards long, and was provided with a special earth wire; it appeared that this wire had broken, the effect of which would be that in the event of the machine becoming alive the provision made for earthing the current would be non-existent so far as this wire was concerned. There was, however, intermittent earthing through this wire due to the fact that when the cable was in some positions the two ends of the severed wire butted together, whereas at other times they parted. The machine itself was lying solidly on earth, and if it became alive there was every possibility that a large proportion of the current would be dissipated to earth directly from the machine. It was possible, however, that the man had been standing on earth which was a better conductor than the earth on which the machine rested, which was very dry clay. If he had had rubber gloves on he would not have been killed; but the Home Office did not call for—and he was sure they did not want—anything in the nature of rubber gloves. At the Binley Colliery everything possible had been done to reduce the danger from shock to the minimum.

The medical evidence showed that deceased died from paralysis of the nerve centres produced by shock. Proper attempts at artificial respiration were made, but were quite valueless, as the man must have died instantaneously. The jury returned a verdict of accidental death.

French Electrical Industry.—A survey of the condition of the French electrical industry is afforded by the recent report of the Société d'Applications Industrielles, a concern which embraces a number of important operative undertakings in the northern, middle and eastern portions of France. "Although," this report says, "the chief sources of income have been adversely affected by the war and the greater number of the undertakings have deemed it wise to withhold any dividend, results have nevertheless turned out more favourable than could have been expected. The undertakings are of two kinds—those producing current by means of coal and those utilising water power. The former have greatly suffered from the enhanced coal prices, leading to a rise in the cost of production, only partly compensated by the increased charge to the consumer allowed by the coal clause. On the other hand, the difficulties attending the purchase of fuel have thrown into relief the considerable value of France's water sources. All the undertakings producing energy by means of waterfalls have found themselves in a much more favourable situation. Numerous industries have been created to supply the growing requirements for national defence, and these have found in the power from the waterfalls a support such as, translated into figures, certainly stands for a very notable economy for the country. The available power in the hydro-electric networks has been rapidly utilised to its utmost capacity, and several waterfalls which were the objects of schemes before the war, are now about being harnessed to supply the energy which we are lacking. Everybody recognises it is to the general interest to aid the extension of the hydro-electric industry, and it is probable that, after the war, a rational and intensive utilisation of this source of wealth to the country will be witnessed, which will compensate in great part for the expenditure arising from the higher price of coal. All the producing and distributing undertakings have, moreover, found themselves in a very favourable situation from the point of view of the future, for they will be the first to benefit from the resumption and growth of economic life in our country, of which they are one of the most indispensable factors."—*Revue Electrique.*

Water Power Legislation in Italy.—A Bill has been prepared by the Italian Government to deal with the use of water powers, and in substitution for the antiquated law of 1884. The Commission appointed by the Ministry to bring the matter to a speedy conclusion first decided to obtain the views of the Italian Electrotechnical Association, this being the only occasion when the wishes of the Association have been sought by the Government since its formation. A special meeting has been held to formulate opinions, upon which a report will be forwarded to the Commission.

Appointments Vacant.—Clerk for the Batley Corporation electricity works. See advertisement pages to-day.

Institution and Lecture Notes.—Institution of Electrical Engineers (Western Local Section).—The annual meeting of this Section will be held at Bristol, on April 3rd, at 5 p.m. A paper on "The Hire and Maintenance of Direct-Current Motors" will be read by Mr. H. Joseph. A morning dress dinner will follow, at 7 p.m., at the St. Stephen's Restaurant.

Mining Engineers.—At a joint meeting of the Mining Institute of Scotland, the National Association of Colliery Managers, and the Association of Mining Electrical Engineers at Glasgow last Saturday, a paper on "Electric Winding", was read by Mr. F. Anslow.

Volunteer Notes.—Engineering Institutions' V.E.C.—Orders for week commencing March 27th, 1916.—By Lieut.-Col. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, March 27th.—Sections 1 and 2, Technical; Sections 3 and 4, Squad and Platoon, Signalling Class and Recruits.

Tuesday, March 28th.—School of Arms, 6 to 7 p.m.

Thursday, March 30th.—Shooting for Sections 3 and 4.

Friday, March 31st.—Sections 3 and 4, Technical; Sections 1 and 2, Squad and Platoon, Signalling Class and Recruits.

Saturday, April 1st.—Adjutant's Instruction Class at 2.30 p.m.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, March 23rd, 1916:—

Battalion Parades.—Sunday, 26th inst.—The Battalion will parade at Liverpool Street Station (low-level entrance, G.E.R.) at 9.30 a.m., and proceed by train for Entrenching duties.

Sergeant-Major's Class—The Adjutant will hold an examination of members of the above Class, at Wembley Camp, on Sunday next, the 26th inst., commencing at 11 a.m. Members of the Class desirous of presenting themselves for this examination must send in their names to the Orderly Room before 12 noon on Saturday, the 25th inst.

Musketry.—The Acton Range will be open on Saturday next, the 25th inst. Members desirous of shooting must send in their names to the Musketry Staff.

The Miniature Range at Wembley Camp will be re-opened for shooting on Sunday next, the 26th inst.

A. G. Joiner, *Major and Adjutant*, O.B.C.

Argentine Naval Electrical Specifications.—The Ministry of Marine has recently approved some new regulations formulated by the Electrical Section of the Ministry's "Direccion General de Material" to unify types of electrical materials employed in the navy and to ensure a careful technical selection of same. The regulations referred to are subdivided into a number of sections relating respectively to: incandescent lamps, lamp fittings, conductors, fuses, interceptors and commutators, switches, cells and accumulators, ventilators and arc lamps.—*Review of the River Plate.*

Russian Mica.—The Central Military Industrial Committee through its electrical section has inquired into a number of questions affecting the immediate supply of the electrical requirements of the country, particularly for army use. In its report on raw material found in the country, it observes in respect to mica, that previously to the war all mica required in the Russian electrical factories was obtained from Canada and India. The best sort in sheets about 1 millimetre thick and 6 in. × 8 in. was valued at 90 roubles per pood. Last summer, however, in consequence of the disorganisation of the transport system in and out of the country, there were moments when the price of mica rose to fabulous heights, and it was bought by the factories at 25 roubles per funt (1 funt being a 40th part of a pood). Meanwhile, Russia controls immense reserves of the best quality of mica, and there was a time previously to the great development of the glass business, when Russia was the only furnisher of mica to the world's markets, in consequence of which this mica obtained the name by which it was scientifically known—Muscovite. Thus, in 1681, there was exported from Russia 2,580 poods of mica to Holland, 2,400 poods to England, and 500 poods to North America. Then there existed a special class of people called mica workers, who, by special Imperial Letters, were protected from the arrogance of the local authorities. With the development of the glass business, the mica industry gradually declined, and, finally, in Russia not only was the production of mica stopped, but all traces of those places were lost where, in the old days, the production was most actively carried on. They were only re-discovered in 1912 by the engineer Zikso. This occurred in the Mamsky virgin forest, but so far the exploitation of mica in Russia has not developed to more than 30 to 40 poods per month, whilst 5,000 poods are required in the course of the year by the electrical factories alone.

Besides the Mamsky virgin forest, there are deposits of mica in the Archangel Government, in the Urals, and in Eastern Siberia, in most cases consisting of mica of the best quality. It is remarkable at the same time, that Russian electrical factories, in consequence of the difficulties in the supply of foreign mica, paid at one time—true, not for long—25 roubles per funt, whilst the cost of production and delivery of one pood of the best mica from the Mamsky deposits amounted to only 30 roubles.

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Engineering Trade after the War.—The Board of Trade has appointed a Committee to consider the position of the iron, steel and engineering industries after the war, especially in relation to international competition, and to report what measures, if any, are necessary or desirable, in order to safeguard that position. The following are members of the Committee:—Sir Clarendon Hyde (chairman), Mr. A. Balfour, Sir Hugh Bell, Bart., Mr. A. J. Hobson, Sir Hallewell Rogers, and Mr. Douglas Vickers.

At a meeting held at Manchester on Tuesday afternoon, the following resolution was passed:—"That in view of the greatly enhanced capacity of the British engineering industry, now engaged on munition work, and of the severe competition to be expected after the war, this meeting of Manchester engineers is of opinion that the organisation of the industry from within should immediately be undertaken." It was also resolved "that this meeting urges the Government to create a Ministry of Commerce, after consultation with representative commercial interests."

Inquiries.—Makers of an ampere gauge that can be attached to cables (without cutting them) are asked for. Also makers of "John Bull" dry cells and pocket flash-lamp cases, and of augers for making holes for setting telegraph poles.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—Mr. V. J. Allan, engineer-in-charge, electricity works, Southampton, has resigned, to take up the position of electrical station superintendent at Kilmarnock electricity works.

The Sydney (N.S.W.) Electric Light Committee recommends the appointment of Mr. F. T. Davies, manager of the power sales department of the Montreal Light, Heat, Power Co., as deputy general manager of the City Council's electricity supply department. Inquiries made by the Town Clerk by cable showed that Mr. Davies had had English technical training.

Stoke Newington B.C. is recommended to increase the salary of Mr. H. Large, chief assistant in the electric lighting department, by the addition of £20 per annum to his salary of £140, and to grant £25 as an honorarium for his services in acting as borough electrical engineer during Mr. Hann's absence. Several sub-station assistants also have received advances.

Tynemouth Electricity Committee has recommended that the salaries of Mr. Dowson, shift engineer, Mr. J. Waller, station superintendent, and Mr. H. T. Wilkens, chief clerk, be increased.

The Hackney B.C. is recommended to promote Mr. J. F. Heathman, chief clerk in the electricity department, to Class 2 (a), and increase his salary to £185.

Mr. D. Macfarlane Macleod, who has for the past six years held the position of resident engineer to the Clyde Valley Electrical Power Co., has been appointed chief engineer.

General.—Mr. H. V. Kilvert, of the Lancashire Dynamo and Motor Co., Ltd., Trafford Park, was last week elected on the newly-constituted board of directors of the Manchester Chamber of Commerce.

The Highways Committee of the L.C.C. recommends that Mr. G. H. Hume be appointed chairman and Captain T. Prestige vice-chairman.

From the *London Gazette*:—Territorial Force: Royal Engineers, London Electrical Engineers:—Chief Petty Officer H. J. Waller, from the R.N.A.S., Anti-Aircraft Corps, to be Second-Lieutenant (on probation). Corporal A. J. Anido to be Second-Lieutenant (on probation). Sapper F. G. Hort to be Second-Lieutenant (on probation). Territorial Force: Royal Engineers. Tyne Electrical Engineers:—Second-Lieutenant T. T. Tucker to be temporary lieutenant, October 18th, 1915.

Roll of Honour.—The D.S.O. has been awarded to Lieut.-Commr. E. L. Colley Grattan, R.N., who was in charge of wireless telegraphy at Cape Helles since May 1st. Admiral de Robeck reports that the work carried out by this officer has been of inestimable service; also to Commr. J. F. Somerville, R.N., Fleet wireless officer, who performed duties of exceptional difficulty most efficiently.

The D.S. Cross has been given to Acting Warrant Telegraphist John A. Britten, R.N., who displayed great ability and resource in erecting a wireless station at Cape Helles under fire.

The *Gazette* last week announced the award of the D.C.M. to Private F. Mottershead, of the 1/7th Lancashire Fusiliers (T.F.), for conspicuous gallantry in volunteering to destroy the entrance to one of the enemy's mine shafts. Prior to the war he was employed by the British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park. He has been twice wounded, and is now in hospital at Alexandria.

Private Thomas Morton Healey, of the 9th Battalion West Riding Regiment, who was killed in France on March 1st, was prior to enlistment, engaged as an electrical engineer

The D.C.M. has been awarded to Corporal J. W. Smith, late of the Nelson Corporation tramway staff, and of the East Yorkshire Regiment, for volunteering, at Ypres, to cut barbed wire entanglements under heavy fire, thus allowing his section to advance. Corpl. Smith has also received the Russian Order of St. George for another courageous deed

Sergeant Jas. Huntly, of the Northumberland Fusiliers, formerly at Berwick-upon-Tweed on the staff of the Urban Electric Supply Co., is reported killed in action in France. He had been posted as missing since April last.

Obituary.—Lady Kelvin.—We deeply regret to record the death of Lady Kelvin, which occurred on March 16th at Netherall, Largs, Ayrshire. Lady Kelvin became the second wife of Lord Kelvin (then Sir William Thomson) in 1874, and the great scientist frequently referred to the splendid assistance that he received in many of his activities from his wife.

Mr. Ivan Levinstein.—We regret to record the death, at the age of 70 years, of Mr. Ivan Levinstein, chemical manufacturer, one of the founders of the Manchester School of Technology, and an expert in regard to patent law matters. His patent principles requiring foreigners to work their patents in this country were adopted by Mr. Lloyd George in the Patents Act of 1907.

Mr. J. Gordon and Mr. Geo. Castles.—The deaths are announced of Mr. J. Gordon, manager of the electric station, Carrick-on-Shannon, and Mr. Geo. Castles, director of the Dromore (Co. Down) Electric Lighting & Power Co., Ltd.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Baughan and Co., Ltd.—Particulars of £4,000 debentures, created March 7th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

British Battery Co., Ltd. (137,905).—Capital, £1,000 in £1 shares (800 pref.). Return dated December 14th, 1915. 800 pref. and 199 ord. shares taken up; £999 paid. Mortgages and charges: £1,000.

Adelaide Electric Supply Co., Ltd.—Capital, £750,000 in £5 shares (50,000 pref., 50,000 ord., and 50,000 unclassified). Return dated January 4th, 1916. 50,000 pref. and 50,000 ord. shares taken up; £5 per share called up on 24,000 ord. and 50,000 pref.; £370,000 paid; £130,000 considered as paid on 26,000 ord. shares. Mortgages and charges: £118,852 5 per cent. deb. stocks.

David Bridge and Co., Ltd.—Capital, £25,000 in £1 shares (16,000 pref.). Return dated February 1st, 1916. 15,830 pref. and 4,170 ord. shares taken up; £20,000 considered as paid. Mortgages and charges: £8,800.

CITY NOTES.

German Electrical Companies.

The A.G. Mix und Genest, of Berlin-Schoneberg, after setting aside £40,000 for depreciation, as compared with £18,000 in 1914, reports net profits of £132,000 for 1915, as against £60,000 in the previous year. It is intended to place £50,000 to a reserve fund for the tax on war profits, £20,000 to the special reserve fund, and £15,000 to the provident fund, and to pay a dividend of 18 per cent., as contrasted with 12 per cent. in 1914.

The Strasseneisenbahn Gesellschaft, of Hamburg, states in the annual report for 1915, that as the vital vein of the city lay in the oversea trade, which was completely at a standstill, the traffic suffered more from the effects of the war than was the case with many other towns. The net profits amounted to £26,000, as compared with £121,000 in 1914, and the directors recommend a dividend of 1 per cent., as against 8 per cent. in the preceding year.

The recent meeting of the *Elektrometallurgische Werke, A.G., of Horrem*, which company was formed in 1913 with a share capital of £50,000, held entirely by the Metal Bank and Metallurgical Co., of Frankfort-on-Main, and the Griesheim-Elektron Chemical Works Co., decided to increase the capital to £175,000 for the purpose of extending the plant and undertaking new branches of manufacture. The two companies in question have also taken over the new shares.

The Bergmann Elektrizitats Unternehmungen, A.G., of Berlin (the financial company of the Bergmann Electricity Works Co.), after having already disposed of the Nordharz Wolfenbuttel, and Bodenbach works, is now only interested in the Magdeburg Suburban tramways, the parent company having decided two or three years ago that the subsidiary should not embark upon any further business. The accounts for 1914-15 show net profits of £440, as compared with £9,500 in the previous year, and the debit balance remains at £26,000 on a paid-up share capital of £300,000.

The Fabrik Isolierter Drähte (late Vogel), of Berlin, reports that the decline in the turnover in the first quarter of 1914-15

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as compared with the corresponding period in the previous year, was fully equalised in the remainder of the year through working being adjusted to meet the Army requirements. After setting aside £7,800 for depreciation, as against £6,300 in 1913-14, the net profits are returned at £48,000, as contrasted with £32,000. The sum of £14,000 has been placed to reserve on account of the tax on war profits, and a dividend of 15 per cent. is proposed, as against 13 per cent. in 1913-14.

The Elektrotechnische Fabrik Rheydt Max Schorch & Co., of Rheydt, reports for 1914-15 that all parts of the undertaking were fully employed, and night shifts had frequently to be worked. New plant was installed for the production of war materials, and the turnover was about five times greater than in the preceding year, the profits being correspondingly larger at £179,000, as compared with £19,000 in 1913-14. After making provision for depreciation, the tax on war profits, and the reserve funds, it is proposed to pay a dividend of 20 per cent., as against 12 per cent., on capital of £87,500, and to devote £43,750 to increasing the share capital by allocating the new shares in the proportion of one free share to two existing shares.

The directors of the *Grosse Berliner Strassenbahn* report that a gradual increase in the traffic occurred in 1915 with the further withdrawal of omnibus and motor-cab services from the streets of Berlin, although great difficulty was experienced in coping with the augmentation owing to the calling up of 2,000 men, in addition to the 5,000 whom the Army authorities requisitioned in 1914. By the re-employment, however, of old drivers, the greater use of trailers, and the working of overtime and partial suspension of holidays, it was possible to maintain the mileage run at only 10 per cent. less than in the peace year of 1913, and 5 per cent. less than in 1914. As the number of conductors capable of being employed as drivers was now exhausted, and a further call of drivers for Army service was to be expected, women conductors had been trained as drivers, and 70 were placed on cars serving lines having light traffic conditions at the end of February, 1916. Women had also been increasingly employed in the offices and depôts, the total now numbering 4,000. The company had applied for permission to increase the 10 pfennigs (1½d.) fare, but the request had not been sanctioned, although it was intended to make fresh proposals at a convenient time. The accounts show the following figures:—

	1915.	1914.
Total receipts	£2,173,000	£2,118,000
Working expenses	1,310,000	1,300,000
Net profits and balance forward	327,000	328,000
Dividend percentage	6	6

The length of line in operation was 372 miles, and the number of car miles run was 56,878,800, as compared with 60,071,800 in 1914, the passengers carried having amounted to 437,000,000, as against 426,420,000 in the previous year. The number of employés declined from 11,407 in 1914 to 9,637 last year, despite the employment of the 4,000 women already mentioned, whilst the amount which had to be paid for electrical power increased owing to the uneconomical working of the new drivers.

British Electric Transformer Co., Ltd.

Mr. A. F. Berry presided at the annual meeting held on 17th inst. He said that their sundry creditors item showed an increase of about £13,000 as a result of the larger business done. In the circumstances, they were not excessive. It was not necessary to increase the amount put to depreciation reserve this year, but it might be necessary to place a larger sum to that reserve next year in view of the extensions to the works. The reserve fund would be increased by £7,500 to £31,823. That account had been built up entirely out of profits. Originally it had been created principally to meet losses which might arise on investments, but the ascertained losses in that direction had been met, and the whole figure could, if necessary, be set against patents and goodwill, which stood at £65,158. A conservative policy was being adopted in recommending the distribution by way of dividend of only about one-half of the profits. Their resources should be husbanded for the benefit of the business. They would not be justified in paying more than at the corresponding time last year, but he hoped that when the war was over, and business had settled down, they might be able to resume what they regarded as their regular 10 per cent. ordinary dividend. The past year had been the most extraordinary in the history of the company. Prices of all materials had risen to unprecedented figures, while they had been under contract to supply machines at prices fixed before the outbreak of war. All difficulties had, however, been satisfactorily overcome. Great difficulties had been experienced in getting deliveries of raw materials, and also in getting finished goods delivered, but those troubles had been considerably lessened. Practically the whole of the eligible members of their staff and workmen had enlisted or attested under Lord Derby's scheme. Much had been heard of late of the high prices at which war contracts had been taken. It was only fair to say that they had charged no more for transformers, used so largely for war purposes, than they had charged for their products in ordinary times. As to their prospects, they had commenced the year 1916 with a little less in orders than at the beginning of 1915, when a lot of work was held over at the end of 1914, consequent on the war. Up to date this year their orders were about the same in extent as for the same period in 1915. At the moment "Tricity" cookers were looked upon by some as an economy, while others regarded them as luxuries. They were, however, improving designs and getting out fresh articles for which they believed there was a good demand. A great deal had lately been heard of the lack of interest taken by bankers in British industries, but they had always found their bankers willing to support them. On the outbreak of war, for instance, they had been assured by their bankers of their willingness to advance such moneys as they might require, and, while they owed little or nothing to their bankers at the moment, he felt justified in saying that should they in the next two or three years again require assistance, all they needed would be afforded on the best possible terms. Bankers had scarcely been given credit for the very great assistance they had always given to industry. There was no doubt that when peace came they would find their great efforts in war work would be of considerable value to them. War experience had proved that the most convenient and economical way of driving machinery was by means of electrical power; war, by compelling the installation of electricity in so many factories, had put forward the clock of electrical development some five years, and they should reap the benefit from the fact that works, having had an opportunity of appreciating the value of electricity, would apply it still further.

British L. M. Ericsson Manufacturing Co., Ltd.

Mr. W. M. Crowe presided at the annual meeting on March 15th. He said that the net profits had been increased by £2,000, and, in view of all the circumstances, that was a very good result. The year was not an easy one for manufacturers, and the difficulties of the previous year were increased four-fold with regard to the supply of raw materials and the shortness of labour. Their difficulties would have been greater but for the fact that they had a plentiful supply of female labour. The profit on trading increased by £6,775. The share capital remained unaltered. There was a loan from the bank of £24,000, secured by the deposit of £25,000 War Loan. The loan from the bank was necessary for the purchase of raw material for heavy orders received from the Government, and also for the purchase of additional machinery. Last year they showed in the accounts a large amount standing at interest at the bank, but that cash was now being used in the business and was earning better profits. The stocks on hand and work in progress at London and Beeston had increased enormously since last year, and the transfer of cash from the bank to the factory accounted for the difference in the cash balance. The amount of stocks, &c., at the end of 1914 was £113,904, and by the end of 1915 that item had increased to £180,849, or an increase of £66,945. Practically all these stocks and work in progress were put in hand against firm orders from Government departments. Therefore, they were as good as cash. The position of the company was improving each year. The percentage of profit on the whole capital of the company worked out at over 11 per cent., and deducting the preference shares, on which 6 per cent. was paid, the profit earned in respect of the ordinary shares was 16½ per cent. Of this profit they were paying to the ordinary shareholders less than one-half, namely, 8 per cent., which was good policy. The prospects of 1916 were very bright. The factory was full of work. The Post Office telephone department had practically shut down all installation work, and consequently manufacturers were suffering. They were, however, looking forward to the time when the accumulated work of years would have to be done by the Post Office, and then they hoped to benefit. He mentioned last year that they were going into the question of making magnetos for motor-cars and motor-cycles in order to meet the demand here, formerly supplied from Germany, but they were unable to carry out their good intentions in this direction owing to their having become a controlled establishment. They bought a quantity of machinery for the purpose of manufacturing these magnetos, and that machinery exactly suited the special work allotted to them. As soon as the war was over they intended going fully into this question again, and in the meantime they were acting as agents for Ericssons, of Buffalo, the original makers of the magneto they were taking up.

Newcastle-on-Tyne Electric Supply Co., Ltd.

Presiding at the annual meeting, on March 21st, Mr. J. H. Armstrong, after summarising the financial results for several years, said that their profits had been adversely affected during the year by the reduction of lighting hours, and in the tramways supply, to the amount of 2,000,000 units. Other factors which had affected them were increased cost of labour, material, and coal, but, on the other hand, there had been compensating benefits from general consumers. They had spent £93,965 in maintaining the plant and system in an efficient state, as compared with £74,571 in the previous year. The cause for this increase was that they had taken out two motors and two old turbines of 3,000 H.P. and had replaced them by two modern ones of 6,000 H.P. each. The new plant was much more economical, and enabled them to gain 5,000 KW. capacity. The dividend was half per cent. more than in the previous year. £38,299 had been received on consolidated first mortgage debenture stock. The expenditure on capital account had been £110,078 for the year, in accordance with the scheme of development laid down in 1914. On the laying of new mains £18,825 had

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been expended, but only four new mains had been laid, as against 20 in the preceding year, but there were contracts which were running in 1914 which came in for payment in the succeeding year. The chairman referred to the scheme for fusion with the Durham Electric Supply Co., under which the Newcastle Co. took over the shares of the Durham Co., and he said that the trouble of the Durham Co. was want of capital, but now that the whole of the Durham area practically became their own (the Newcastle Co.'s) there was no necessity for money advanced for developments to go under the head of debts. Speaking of depreciation and reserves, the chairman pointed out that the Newcastle Co. had received in cash, representing profits and premiums, £502,668, and the whole of that sum had been spent on improvements and developments of the business. Speaking as to kindred companies with which they were associated, he said the Durham Co. had made £27,645 profit last year, as against £23,946 in the preceding year, when 4 per cent. was paid on the preference shares at their original value, while this year 3 per cent. was paid on the whole of the capital, and £6,000 was set aside for depreciation, as against nothing in the previous year. The Houghton Co., which was part of the interests they acquired in the Durham collieries, had a capital of £23,550, and had paid a dividend of 10 per cent. this year and had carried £1,000 to reserve, the total of the latter being now £5,000. The Hon. R. H. Brand seconded, and after congratulating shareholders on the sound position of the company, he said that they had, as always, pursued a conservative policy as regarded the disposition of the extra profits made. That policy was especially necessary for two reasons; one was that they did not know what the general financial position was going to be during the war and after it. He would be a very wise man who could look forward and say what was going to happen. Capital would be much scarcer after the war, and that would mean that there would be an extra charge on industrial undertakings. These would have to pay more for their capital, and would find it very difficult to get. Thus, it was wise of the directors to pursue a conservative policy and strengthen the company's position. A company like that could get capital on terms if it was prosperous, but it all depended on what they were prepared to pay for their capital.

London and Suburban Traction Co., Ltd.

The Rt. Hon. C. B. Stuart-Wortley presided at the annual meeting, held on March 15th. After going through the accounts, he referred to the effect of the war upon their fortunes. Theirs was not an operating enterprise, but a holding company. Their fortunes and prosperity depended on those of the operating companies whose stocks they existed to hold. There had been a great all-round increase in prices of materials and cost of labour. Coal by rail had advanced by 13 per cent., and sea-borne by 34 per cent. Timber had gone up by 50 per cent., glass 90 per cent., copper 50 per cent., wood blocks 31 per cent., and steel tires by 20 per cent. All their subsidiary companies were interested in some of those commodities, and some were interested in all. In some cases prices were still rising. The chairman proceeded to refer to the increased cost of labour, to the enlistment of men for war service (1,466 from the different companies, or 35 per cent. of the whole). The number of women conductors employed by their three companies was 281, and it would undoubtedly be increased. There was an all-round improvement of the reserves of the various companies. In the second year of war their position was a good deal better than it might have been.

Llanelly and District Electric Lighting and Traction Co., Ltd.

Mr. A. R. Holland, presiding at the annual meeting, held last week in London, said that the year had been an extremely difficult one. Cost of fuel and materials had greatly increased. The increase in turnover was more than offset by the increase in expenses. Labour had been difficult to obtain, and repair, maintenance, and installation work were difficult to carry out. Under all the circumstances they were to be congratulated on the result, although the net profit was reduced. In the ordinary course they would have been asked to approve of an increase in the capital to provide for past expenditure and future development, but that matter must be postponed. Lighting and power rates were increased in the latter part of 1915, and further increases might have to be made in the near future. A fair amount of new power business had been secured, and further additions were under consideration.

Madras Electric Tramways (1904), Ltd.

The gross profit for 1915 was £22,498. After debiting interest and London office expenses, providing for debenture sinking fund, putting £6,000 to depreciation and renewals, £11,031 remains, plus £3,258 brought forward. Dividends of 6 per cent. are paid on the preference and ordinary shares, £581 is written off the balance of the cost of issue of new preference shares, and £4,272 is carried forward subject to excess profits duty. Traffic receipts increased by 6.4 per cent., the whole of the increase occurring in the latter part of the year. The special renewals of the permanent way having been practically completed, the reduced sum of £6,000 has been credited to depreciation and renewal fund. The reserve arising from the debenture stock sinking fund is now £7,178. Mr. T. E. Ivens, a director, has died, and Mr. J. G. B. Stone has been elected to the board.

Automatic Telephone Manufacturing Co., Ltd.

The profit for 1915 was £41,868, plus £5,256 brought forward. Directors' fees require £2,450, depreciation on patents, goodwill, buildings, plant and machinery £6,000; there is written off underwriting commission on shares £3,500; written off preliminary expenses, £2,000; preference dividend, £12,000. A dividend of 4 per cent. (less income-tax) for the year on the ordinary shares requires £14,400, and £6,774 is to be carried forward. During 1915 several automatic exchanges have been completed, and are working satisfactorily; others are steadily approaching completion, but owing to the war no new exchanges have been ordered, and the company's normal business is suffering accordingly.

Launceston and District Electric Supply Co., Ltd.

The growth of business during 1915 was satisfactory. There are now 205 consumers with 5,631 lamps. The total revenue receipts were £1,232, and the working expenses £516, leaving a gross profit of £717. After deducting bank charges and preference dividend, the net profit is £589, which, plus £41 brought forward, after paying income-tax, makes a total of £630. A dividend of 3 per cent. is to be paid on the ordinary shares, to depreciation £250 is put, £50 is written off preliminary expenses, £50 to reserve, and £58 is carried forward. The units distributed were 51,253. The annual meeting was held on March 10th.

Northern General Transport Co., Ltd.

The directors state that the difficulties during 1915 were exceptional owing to the high cost of material and the scarcity of labour. The omnibus services had to be curtailed, and a number of vehicles were sold. The company holds shares in the Gateshead and District Tramways Co., the Tynemouth and District Electric Traction Co., Ltd., and the Jarrow and District Electric Traction Co., Ltd., which stand in the books at £392,134 cost, and the dividends for 1915 amounted to £24,215. For the year these three companies put to reserves and renewals £27,955. The result is a revenue for this company of £38,744, plus £4,230 brought forward. After deducting administration and general expenses, and interest, £4,806, and putting £6,536 to renewals, £1,372 is applied to sinking fund for redemption of debenture stock, 6 per cent. is paid on the preference and 6 per cent. on the ordinary shares, and £5,777 is to be carried forward. Meeting: Kingsway, March 27th.

Scarborough Electric Supply Co., Ltd.

During 1915 there were connected 871 new lamps, making the total 131,777. The units supplied were 637,219. The profit was £1,078. After paying bank interest and making various allowances, and putting £1,000 to depreciation, the credit balance of £1,716 is to be carried forward. Mr. G. Alderson-Smith, presiding at the annual meeting on March 16th, said that they were in for hard times. Their receipts for current last year were £7,500, against £11,000 in the year before. There was a loss under this head of £4,000, and the rental of meters was down another £200. On the other hand, they had saved on coal. All their charges had been carefully looked into, and they were all down. The shareholders could not expect much more from the directors than that. Of course, they had had very bad times. The bombardment frightened away 200 of their customers, who shut up their houses, and their meters could not be read. After a great deal of trouble that, however, had been done. It had been a desperately hard time for them. They knew the state of Scarborough at present, and the trouble they had about the lights. Thirteen of their men had joined the Army, and three of them had been killed. Mr. Campbell Swinton, in seconding, remarked that the company was to be congratulated that it had not made a loss on the year's working, with £4,000 falling off in the revenue. It had only been by paying great attention to savings that they had done as well as they had.

British Aluminium Co., Ltd.—A financial contemporary states that the accounts for 1915 show a profit, including the sum brought in, after making provision for excess profit duty, &c., and after charging interest on prior lien and debenture stocks, of £204,808. £50,000 has been set aside for depreciation, and £70,000 added to reserve. After providing for preference dividend the directors recommend a dividend of 7 per cent. on the ordinary shares, carrying forward £24,791.

Compania de Electricidad de la Province de Buenos Aires, Ltd.—Mr. Justice Neville on Tuesday, in the Chancery Division, sanctioned a reduction of the capital of this company in accordance with special resolutions that had been duly passed. Counsel informed the Court that he believed the necessity for reduction was due to over-capitalisation, too many shares having been issued as fully-paid.

Brompton and Kensington Electricity Supply Co., Ltd.—After transferring £3,000 from the reserve fund to net revenue and putting £9,656 to depreciation and sundry reserve accounts, a final dividend of 11 per cent. is announced, making 10 per cent. for the year, and £6,011 is to be carried forward.

P. R. Jackson and Co., Ltd.—The gross profit for 1915 is £18,050. Of the available balance of £12,561, after paying 7½ per cent. on the ordinary shares, £3,000 is to be written off goodwill and £3,750 carried forward.

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Bournemouth and Poole Electricity Supply Co., Ltd.

Mr. A. H. Sanderson presided at the annual meeting on 16th inst. He said that the effects of the war were reduced receipts, reduced profits, and increased running costs. The gross revenue was down by £1,305. Cost of coal and oil increased by £1,912, but there were decreases under other heads. They carried to net revenue £38,684, as against £41,680 in 1914. £8,000 was placed to depreciation, against £7,000, and the dividend was 6 per cent., as against 7 per cent. for 1914. Having regard to the exceptional conditions, the results were satisfactory. They depended chiefly upon lighting revenue, so that the lighting restrictions had been responsible for the drop in receipts. They had increased the charges to consumers by 10 per cent. as from the commencement of this year. Of the company's staff, 75 had left for war service, and 35 attested ones were liable to be called within the next few months. The new second preference shares were offered to their share and debenture holders only, and the issue was considerably over-subscribed. From the new generating plant at the Bourne Valley lighting station they had derived considerable advantage, making a total saving of 25 per cent. on the capital cost of the plant. The lighting units showed a drop of 4½ per cent., but the total output increased by 4 per cent.

Windsor Electrical Installation Co., Ltd.

The capital expended during 1915 amounted to £1,027, and it was chiefly incurred for the installation of supplementary machinery for H.T. supply. The profit for the year, including £468 brought forward, was £6,515. Of this, £633 has been devoted to debenture and other interest, £1,020 to 5 per cent. preference dividend, £2,000 is put to depreciation, renewal and reserve fund, directors' fees account for £350, 4 per cent. is to be paid on the ordinary shares, and £779 carried forward. The directors consider the result satisfactory, in view of the lighting restrictions and the high cost of fuel and other materials. During the year 3,736 new lamps were connected, making the total 60,339.

Slough and Datchet Electric Supply Co., Ltd.

During 1915, £325 new capital was expended, and 1,263 new lamps were connected, bringing up the total to 30,120. The units sold increased from 831,803 to 1,070,927, and the revenue from £8,956 to £9,625. The revenue increase of £669 is due to cheap power supply. Lighting receipts decreased considerably owing to the restrictions over the whole area. Fuel oil for the Diesel engines had increased from £3 to over £6 per ton, and the rise in coal, wages, &c., coupled with the drop in the more remunerative lighting revenue resulted in a serious reduction in net profit. £1,250 has been put to depreciation and reserve, 4 per cent. dividend is to be paid, less income-tax, and £219 is being carried forward.

British Insulated and Helsby Cables, Ltd.

The profit for 1915 was £295,132, plus £119,380 brought forward. The total is dealt with as follows:—Directors' and debenture trustees' fees, and remuneration to works' committee, £5,915; interest on first debenture stock, £22,500; interest on second debenture stock, £10,000, depreciation on buildings, plant, machinery, &c., £25,000; special depreciation on plant and machinery, £10,000; transfer to reserve account, £50,000; transfer to special reserve account, £8,500; transfer to first mortgage debenture stock redemption account, £5,000; dividend on preference shares, £30,000; dividend for the year on the ordinary shares, 15 per cent., plus a bonus of 2½ per cent., carrying forward to next account, subject to excess profits duties, £160,096. The company is a controlled establishment. The volume of trade during the year was well maintained, resulting in an increase of £17,703 in profit. Annual meeting: Liverpool, March 27th.

W. T. Henley's Telegraph Works Co., Ltd.

The directors' report for 1915 shows the following results—we have indicated the figures for 1914 in parentheses:—Profit, £161,109 (£119,246); less directors' and auditors' fees, debenture interest, income-tax, and amount written off for depreciation on buildings and machinery, £56,585 (£21,121). Adding £69,420 (£59,065) brought forward, the total is £173,944 (£149,191). From this are deducted:—£4,680 transferred to reserve in respect of depreciation of war loan and other trustee securities; reserve account £25,000 (£10,000); preference dividend £9,000 (£9,000); interim dividend on ordinary shares £10,000 (£10,000). The available balance is £125,264 (£99,420). From this there is to be put to the establishment of a staff pension and benefit fund £30,000, after being voted by shareholders; the final dividend on the ordinary shares, making the total 15 per cent. for the year, plus a bonus of 10s. per share less income-tax, will require £40,000 (£30,000), leaving £55,264 (£69,420) to be carried forward. A reserve has been made in the accounts in respect of the liability of the company for the years 1914 and 1915 for special taxation. The sum written off for depreciation on machinery has had to be considerably increased, as much of the plant has been run night and day on special work, and new machinery for special work, some of which will be useless after the war, has been purchased at inflated prices. Particulars of the employés, &c., who have joined the Forces appear in our "War Items." Allowances have been made to dependents where necessary. The company is a controlled establishment. Annual meeting: March 29th.

Direct Spanish Telegraph Co., Ltd.

For 1915 the directors report that after providing for the preference dividend £46,941 remains. A dividend of 5 per cent. on the ordinary shares absorbs £3,233; a bonus of 2 per cent. on the same shares requires £1,293; £5,231 is applied to depreciation of Stock Exchange securities; £5,000 is put to reserve, and £32,185 is to be carried forward. This sum is subject to a special taxation of profits for 1914 and 1915, the amount being at present unascertained. Both the dividend and bonus on the ordinary shares are free of income-tax. £10,000, balance of a loan of £30,000 from the Eastern Telegraph Co., has been paid off since the last report. The cables and land lines have continued in good working order throughout the year.

Dublin and Lucan Electric Railway Co., Ltd.—At the annual meeting Mr. J. W. Hill, who presided, said that to meet heavy charges due to the war they had had to increase passenger and goods rates, but these were still lower than they were legally entitled to charge. Though passenger traffic was down, goods carried brought £164 more than in the previous year, and the total receipts, £7,511, were higher by £144, and constituted a record. They had secured the services on the board of Mr. Gerald Murphy, son of Mr. Wm. M. Murphy, chairman of the Dublin United (Electric) Tramways Co., and he was sure his experience of tramway and electricity work would greatly assist them.

Metropolitan Electric Tramways, Ltd.—At the recent annual meeting, Mr. Garcke explained that they had reduced their services of cars owing to shortage of men and the 13 days' strike in May. But for these two factors they would have shown a large increase in traffic receipts. They were now employing 150 women conductors. Notwithstanding a reduction of 15 per cent. in the car mileage, the receipts in the latter half of 1915 were very good. The total expenses were £14,500 less than in 1914, against a total fall of £18,000 in receipts.

North Metropolitan Electric Power Supply Co.—Mr. Garcke, at the annual meeting on March 13th, said that the nature of their output had changed owing to the war. More was used for power and less for tramways and lighting; the units sold increased by 2,500,000, or 7 per cent. New power business had been secured, and they hoped to be able to permanently retain much of it, as factory owners were appreciating the benefits of electric power more than ever. If the war continued and coal prices did not fall they might have to charge higher prices for electricity.

London United Tramways, Ltd.—Mr. W. M. Ackworth, at the annual meeting on 13th inst., said that owing to the increased labour employed in their districts the traffic receipts advanced by £1,503. Satisfactory results were attending the employment of the 120 women conductors. Their number would be considerably increased. The increase in passengers was 1,711,000, and the car mileage fell by 1¼ million miles. Owing to higher cost of materials and other causes, the expenses only fell by £7,800.

Minehead Electric Supply Co., Ltd.—At the annual meeting recently, Mr. H. D. Leather, who presided, said that all things considered the year had been satisfactory. The profit was £1,753, as against £1,967 in 1914. As compared with other electrical companies of similar size in the United Kingdom, none surpassed theirs in lowness of working costs and amount put to depreciation and reserve. £400 had been invested in War Loan.

Clyde Valley Electrical Power Co.—The report for the last half of 1915 shows as follows:—Profit £47,466, brought in £12,430, transfer £25,000 to contingency fund for depreciation, &c. (making £150,000). It is recommended to transfer to special reserve £5,259, writing off balance of costs of Acts, 1901, 1904, and 1912, £8,353, dividend on preference shares to April 30th, 1916, £9,000, and carry forward £12,613.—*Financial Times.*

Victoria Falls and Transvaal Power Co.—The net earnings of this company, including those of the Rand Mines Power Supply Co., for quarter ended December 31st amounted to £190,295.

Hastings and District Electric Tramways Co., Ltd.—After paying 6 per cent. on the preference shares, £1,000 is put to depreciation, £1,500 to suspense account, and £766 is to be carried forward.

British Westinghouse Electric & Manufacturing Co., Ltd.—A dividend on the preference shares for the year ending December 31st, 1915, at the rate of 7½ per cent. is announced.

International Light and Power Co.—According to the *Financial Times*, the directors have decided to defer payment of quarterly dividends at present.

Globe Telegraph and Trust Co., Ltd.—A quarterly interim dividend of 2s. per share is announced.

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Ramsgate and District Electric Supply Co., Ltd.—The report for 1915 shows that the gross profit, including £1,524 brought forward, is £4,614, and after allowing for interest at the rate of 5 per cent. per annum on outstanding accounts due to the contractors, and writing off expenses of creating debenture stock, the balance is £3,346. A dividend of 5 per cent. is recommended, £1,200 is to be placed to reserve, and £1,146 is to be carried forward. The annual meeting was held on March 13th, at Westminster.

Metropolitan Electric Supply Co., Ltd.—The annual meeting was held on Wednesday, Mr. W. Harrison Cripps presiding. After the report was adopted, a resolution was passed appointing a committee to report upon the company's affairs. We shall give a report of the meeting next week.

Hadfields, Ltd.—In the report for 1915, the directors say that in view of adjustments which may be necessary to meet the provisions of the Munitions and Finance Acts, £60,000 is to be added to reserve and renewal account, and £152,173 carried forward. In addition to the interim dividend of 1s. per share already paid on the ordinary shares, a further dividend of 2s. per share and a bonus of 2s. per share, all free of income-tax, are to be paid. Mr. J. T. Middleham, for many years secretary and chief accountant, has been elected a director.

STOCKS AND SHARES.

Tuesday Evening.

Markets are firm, in the confidence that the events of the war are going steadily in favour of the Allies. Without indulging undue optimism, the Stock Exchange is of opinion that the enemy loses ground as daily the Allies secure it. It is not so much in the actual fighting itself that the expectations of victory are placed; it is more in the indirect influences which begin to assert themselves, particularly in the neutral countries. There is no talk of early peace; but of ultimate victory—perhaps before many expect—there is held to be hope as reasonable as it is logical.

Therefore prices are nearly all better in the investment markets. Strength has returned to the Home Railway stocks. Industrials are holding their ground with a tenacity that would be surprising were it not based upon the confidence alluded to above. There is business, too, and that not only in the rubber market, but amongst investment stocks and shares—business that the near approach of the Budget has not sufficed to quench, as was the case ten months ago, when the 4½ per cent. War Loan was on its way.

The electric lighting tale of results is now complete for the year 1915. With most of the reports we have dealt in detail as they have appeared. The Brompton dividend came last, and, being at 11 per cent., making 10 per cent. for the year, formed a satisfactory wind-up to the list, because it, too, was expected to be less than its predecessor, in the same way that lowered dividends were declared by the St. James', Westminster, London, Chelsea, City, and Metropolitan companies. There is not much stock on offer in the market. A little inquiry would lead to the prospective buyer finding how comparatively few shares there are of which he could buy several hundreds without materially affecting prices.

The preference list offers good returns and security. Seven per cent. is to be obtained from the preference shares of the London Electric Supply and 6 per cent. from those of the North Metropolitan Power companies. A line of South Metropolitan Electric second preference might be picked up at about 19s. 3d., the return thereon being 6¼ per cent. Charing Cross preference returns 6¾; Chelsea preference, over 6½; Kensington second preference, 5½ per cent. Counties are better on the meeting, the speech of Mr. H. B. Renwick, the managing director, affording considerable satisfaction in market circles. The preference, however, are ½ lower at 10½. Kensingtons have fallen 10s. to 5½. The remainder of the list is steady.

General Electric preference at 9¾ are ¼ up. British Aluminium ordinary shares are strong, the dividend hopes causing steady buying. British Insulated ordinary remain at 11. The report says that the trade showed an increase in the profits of £17,703. The carry-forward is £160,000, subject to excess profits tax.

The City of London Electric Lighting Co. has given notice that it reserves to itself the right to increase charges for electricity, in consequence of the increased cost of production; but this will not become operative until confirmed by a further notice, to be issued not later than April 30th.

Underground Electric incomes continue to droop. It seems as though there is some fairly large block of stock requiring to be realised, because the rest of the railway market is firm to good. Districts are better at 16¼, and Metropolitans, after dipping to 22½, recovered to 23¼. Our tables show comparatively little change in the electric section, though, of course, improvement in the steam stocks is bound to be reflected in those of the tube companies in due course.

Telegraphs and telephones are placid. Eastern ordinary gained a point, but Anglo-American preferred is easier to the same extent. The New York Stock Exchange has put down prices during the last day or two, and some of the shares in the Canadian munition companies declined, owing, it is said, to expectations on the other side of the water that the war would not last much longer. Recovery in Canadian Marconis is something of a feature, the shares rising to 8s.; while American Marconis are a little better at 15s. 9d., though the parent shares have not moved.

What news there is respecting Mexico is not so bad; but while it has the effect of strengthening prices in Mexican Railway issues, so far as the utility concerns go the tendency is heavy and depressed. Mexican Light & Power first mortgage bonds at 38 are 2 lower. The feature in the foreign section is a recovery of 2 in Brazil Tractions, this taking the price to 52½. Anglo-Argentine Tramways first preference have again eased off; the yield on the money at the present price, it will be noticed, comes to £7 6s. 8d. per cent. Bombay Electric preference at 10½ are the fraction to the good, and other issues in this department keep steady.

Activity prevails in copper shares, by reason of the jump that took place early this week in the price of the metal, which crossed the £100 line on Monday. Copper is fluctuating widely on either side of what the Stock Exchange calls par; and those qualified to express an opinion seem to think that it will move for some time to come round about 100. The price of rubber keeps in the neighbourhood of 3s. 6d. per lb. to a little over. Most of the reports and dividends now appearing are in respect of a period during which the price of rubber averaged about half-a-crown per lb.; so that a further rise of 1s. per lb. will not be reflected in profits for another six months or so, save in exceptional cases. There is much business being done in rubber shares, and the market in them in the Stock Exchange is rapidly becoming the largest in the House.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1914.	Dividend 1915.	Price March 21, 1916.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	7	—	£7 2 10
Charing Cross Ordinary	5	5	8¾	—	7 18 10
do. do. do. 4½ Pref.	4½	4½	8¾	—	6 18 6
Chelsea	5	4	8½	—	5 14 4
City of London	9	8	11¾	—	6 14 9
do. do. 6 per cent. Pref.	6	6	10½	—	5 14 3
County of London	7	7	10½	+ ¼	6 13 4
do. 6 per cent. Pref.	6	6	10¾	— ¼	5 18 3
Kensington Ordinary	9	7	5¾	— ½	6 13 4
London Electric	4	3	1	—	9 0 0
do. do. 6 per cent. Pref.	6	6	4½	—	7 5 5
Metropolitan	8½	8	9¾	—	8 4 8
do. 4½ per cent. Pref.	4½	4½	8	—	7 10 0
St. James' and Pall Mall	10	8	5¾	—	8 13 10
South London	5	5	8	—	8 6 8
South Metropolitan Pref.	7	7	1 1/16	—	6 14 0
Westminster Ordinary	9	7	5¾	—	6 1 8

Telegraphs and Telephones.

	Dividend 1914.		Rise or fall this week.	Yield p.c.
Anglo-Am. Tel. Pref.	6	99	—1	6 1 0
do. Def.	38/6	21⅝	—	7 16 0
Chile Telephone	8	6⅝	—	6 5 6
Cuba Sub. Ord.	5	7⅝	—	6 9 0
Eastern Extension	7	12¾	—	*6 5 0
Eastern Tel. Ord.	7	128	+1	*6 4 6
Globe Tel. and T. Ord.	6	10⅜	—	*6 10 6
do. Pref.	6	10	—	6 0 0
Great Northern Tel.	22	84½	—	6 7 6
Indo-European	13	49½	—	6 12 6
Marconi	5	1⅛	—	5 8 1
New York Tel. 4½	4½	100¾	—	4 9 4
Oriental Telephone Ord.	10	1 1/16	—	5 18 6
United R. Plate Tel.	8	5¼	—	*7 19 0
West India and Pan.	1	1 1/16	—	9 10 6
Western Telegraph	7	12¾	—	*6 5 0

Home Rails.

Central London, Ord. Assented	4	67½	—	5 18 6
Metropolitan	1½	23½	+ ¼	4 6 0
do. District	Nil	16¼	—	Nil
Underground Electric Ordinary	Nil	11⅛	— ⅛	Nil
do. do. "A"	Nil	5/6	—6d.	Nil
do. do. Income	6	80 xd	—1½	*8 11 8

Foreign Trams, &c.

Adelaide Sup. 6 per cent. Pref.	6	4⅞	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½	8½	— ½	7 6 8
do. 2nd Pref.	5½	8⅝	— ⅛	8 3 0
do. 5 Deb.	5	78	—	6 8 2
Brazil Tractions	4	52½	+2	6 13 4
Bombay Electric Pref.	6	10½	+ ½	5 17 8
British Columbia Elec. Rly. Pfce.	5	53	—	9 8 8
do. do. Preferred	—	38	—	Nil
do. do. Deferred	—	34	—	Nil
do. do. Deb.	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	35	—	Nil
do. 6 per cent. Bonds	—	35	—	Nil
Mexican Light Common	Nil	20	—	Nil
do. Pref.	Nil	35	—	Nil
do. 1st Bonds	—	38	—2	—

Manufacturing Companies.

Babcock & Wilcox	14	2⅞	—	5 1 8
British Aluminium Ord.	5	28/6	+9d.	4 5 0
British Insulated Ord.	15	11	—	7 19 1
British Westinghouse Pref.	7½	44/6	—	6 14 6
Callenders	15	11⅛	—	6 10 5
do. 5 Pref.	5	4⅝	—	5 17 8
Castner-Kellner	20	8½	—	6 8 0
Edison & Swan, £3 paid	Nil	7/-	—	Nil
do. do. fully paid	Nil	1½	—	Nil
do. do. 5 per cent. Deb.	5	60	—	8 6 8
Electric Construction	6	14/9	—	8 1 6
Gen. Elec. Pref.	6	9⅞	+ ⅛	6 8 1
Henley	20	14⅝	—	*9 10 1
do. 4½ Pref.	4½	4	—	5 12 6
India-Rubber	10	9½	—	*12 19 0
Telegraph Con.	20	34	—	*7 19 0

* Allowance made for dividends being paid free of income-tax.

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EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING FEBRUARY, 1916.

It will be noted with interest that the February returns of electrical exports from this country show a continuation of the steady improvement which has been taking place since December last.

The total value of the exports recorded for the month was £396 483, as compared with £381,599 in January, and £349,409 in December.

The electrical imports have been moving in the opposite direction, and the February total of £182,222, as compared with £216,407 in January, represents a bigger falling-off in value than in the previous month.

The re-exports valued at £15,614, show a marked advance in value, as compared with the £10,612 recorded for January.

The increased value of the exports was due almost entirely to improved business in the machinery, cable and telegraphic sections; cable exports in particular rose to a high value In other directions i.e., telephonic material, batteries, lamps, instruments, &c., the totals show a reduction as compared with January.

The import sections show a general falling-off, cable imports, however, being an exception, while machinery imports remained almost stationary in value.

Australia continues to be probably the best all-round market for British electrical goods; Indian purchases fell off considerably as compared with January, but, nearer home France and North-Eastern Europe accounted for a respectable trade.

It will be noted that American import figures, though still large, show a tendency to fall off, otherwise the importers remain much as in previous months.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports	Electrical goods and appliances.	Wires and cables rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	4,172	5,066	216	1,154	1,104	1,460	10,110	195	115	34	2,730	9,166	35,522
German West Africa	...	...	...	...	...	...	...	...	11	...	...	...	11
Netherlands, Java and Dutch Indies ...	480	10 283	603	39	...	62	3,992	333	87	28	56	413	16,420
Belgium	...	...	...	...	...	...	...	...	...	...	...	...	...
Belgian Congo	106	...	...	28	...	...	40	...	...	...	...	...	174
France	1,748	402	632	951	292	352	10,709	434	705	141	6,219	1,366	23,951
Portugal	5	297	67	83	...	11	29	27	52	2	400	...	973
Spain, Canary Isles and Spanish N. Africa...	305	...	6	29	...	1,030	2,721	68	69	13	361	1,616	6,218
Switzerland, Italy and Austria-Hungary ...	548	...	50	...	...	415	5,832	910	959	...	154	730	9,598
Greece, Roumania, Turkey and Bulgaria ...	...	...	...	...	...	...	...	...	...	...	...	...	...
Channel Isles, Gibraltar, Malta and Cyprus...	159	...	21	92	...	31	79	18	...	18	965	2 634	4,017
U.S.A., Philippines and Cuba	1,521	2,272	169	27	...	92	560	...	...	...	...	...	4 641
Canada and Newfoundland	1,458	81	110	179	96	595	1,431	25	43	...	...	214	4 562
British West Indies and British Guiana ...	802	...	41	101	...	...	312	...	...	...	...	...	1,286
Mexico and Central America	311	141	...	29	19	...	348	7	...	16	...	...	871
Peru and Uruguay	...	...	...	282	...	35	...	...	...	...	132	88	537
Chile	299	308	53	436	...	56	1 482	11	...	...	536	103	3,284
Brasil	185	393	2	214	...	552	1,234	67	314	192	27	1,229	4,409
Argentina	888	15,889	148	729	11	1,564	11,500	4 806	1 201	164	1,130	373	38,403
Colombia, Venezuela, Ecuador and Bolivia...	199	...	6	39	...	...	76	...	...	...	14	244	578
Egypt, Tunis and Morocco	188	478	70	421	...	56	785	...	1 365	50	2,583	1,539	7,535
British West Africa	39	171	54	63	...	...	130	...	154	...	...	333	944
Rhodesia, O.R.C. and Transvaal	880	4 494	397	194	19	200	1,698	...	470	19	240	105	8,716
Cape of Good Hope	523	3,706	216	337	...	...	713	72	2,061	28	433	1,684	9.773
Natal	260	4,105	156	320	...	3	1,195	...	18	24	4	386	6,471
Zanzibar, Brit. E. Africa, Mauritius & Aden	10	21	...	66	...	...	50	...	29	...	60	71	307
Azores, Madeira and Portuguese Africa ...	31	...	11	71	...	78	50	...	...	...	16	432	688
French African Colonies and Madagascar...	...	119	...	10	...	...	167	535	...	...	...	...	831
China and Siam	336	873	211	80	60	27	8 045	312	345	2	21	201	10,513
Japan and Korea	...	...	...	21	...	53	3 910	35	432	24	...	...	4 505
India	4,154	12,995	1.218	1,698	130	3,139	13,174	2,738	2,613	52	2,180	366	44,458
Ceylon	185	219	127	71	...	107	91	10	175	...	32	36	1,053
Hong Kong	97	1,778	10	...	...	212	1,146	...	483	55	508	14	4.303
Federated Malay States	1,042	1,295	270	942	...	38	2,988	304	77	16	6,941	238	14,151
West Australia	...	1,351	50	453	...	1,061	4,725	828	58	...	2,649	114	11,289
South Australia	81	464	101	177	...	779	45	...	564	1,087	2,221	...	5,519
Victoria	2,281	22.131	728	786	12	1,406	11,799	462	541	...	2.043	3 125	45,304
New South Wales	335	13 649	2,384	1,082	224	1,685	6,689	4,945	1,039	257	5,876	1,694	39 859
Queensland	1,146	2,251	32	189	...	464	492	...	281	...	149	...	5,004
Tasmania	12	...	33	...	28	...	123	...	...	...	...	...	196
New Zealand and Fiji Islands	1,305	3,769	394	...	...	...	2,550	345	933	...	9,315	997	19.608
Total, £	25 991	109.002	8,586	11,393	1,995	15,563	111,080	17,537	15,614	2,222	47,989	29,511	396,483

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	7	4	16	32	1,936	...	4,152	1,714	1,958	...	3,183	13 002
Germany	...	...	...	...	...	...	...	...	...	...	...	...
Holland...	...	1,832	...	2.483	...	...	190	...	1,167	...	1,075	16,747
Belgium	...	...	...	...	...	...	...	...	...	...	...	...
France	310	3,000	105	184	131	119	...	...	7,840	1,216	46	12 951
Switzerland	729	...	136	92	...	1,288	69	57	460	976	235	4,042
Italy	102	8.853	...	...	...	...	671	33	...	...	...	9,957
Austria-Hungary	...	...	...	...	...	...	...	...	...	...	...	...
United States	8,586	2 011	373	2,154	2,611	247	9 073	69 751	7,292	10,441	11.979	124,518
Total, £	9,734	15,700	635	14 945	4,678	1,654	4,155	71,853	18 717	12,633	16,518	181,217

Additional imports.—Spain, carbons, £264; Japan, goods, £105; fittings, £120; glow lamps, £6; Brazil, machinery, £500; Canada, machinery, £10.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above... ...	1,116	3,265	...	2.223	101	830	2,748	...	966	396	3,939	15,614

TOTAL EXPORTS: £396,483 TOTAL RE-EXPORTS: £15,614 TOTAL IMPORTS: £182,222

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

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NOTES ON THE MAINTENANCE OF ROLLING STOCK ON THE LONDON UNDERGROUND RAILWAYS.

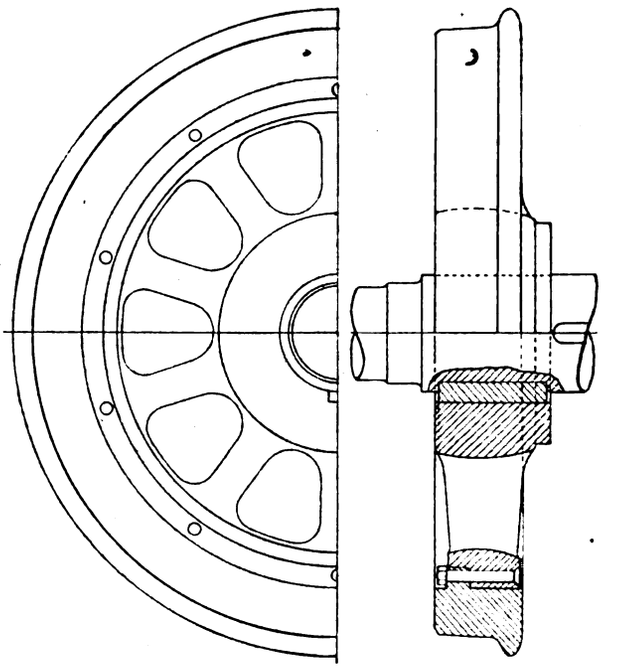
We recently enjoyed the privilege of a tour through some of the repair shops of the Metropolitan District Railway and the Golders Green depôt of the London Electric Railway under the genial guidance of Mr. A. R. McCallum, the chief assistant mechanical engineer to the Underground group of electric railways. The extent of the shops and the variety of work carried on therein were somewhat surprising, and many of the processes employed were extremely interesting. One of the novel features resulting from the war conditions was, of course, the employment of women in the shops, on all kinds of work, due to the scarcity of male labour, which constantly tends to become more difficult to cope with, owing to the calling-up of "groups and classes," and to voluntary enlistment in the Army and Navy. Subject to their obvious limitations, the work of the women appears to be satisfactory on the whole. They were first employed on the cleaning of cars, with satisfactory results, although the output of cleaned cars with the female labour has been found to be considerably lower than was obtained from male labour. They are now, however, also employed in the workshops not only on light work, such as taping and remaking armature coils and the making up of contactor fingers, but also in the heavy machine shops on drilling machines, metal saws, etc., mainly on repetition work.

The repair shops of the District Railway are situated at Ealing Common; considerable additions to the equipment of the shops have been made since the electrification of the railway was accomplished, in order to deal with the increase of traffic, and this has necessitated the purchase of additional cars from time to time, in which improvements have been embodied suggested by the experience obtained on previous rolling stock. The car bodies of the original stock were built of wood which had been rendered fire-resisting. The trucks were of somewhat light construction, and of comparatively short wheel base. The latest cars are of an entire steel construction with floors of fire-proof composition laid on steel plates. The new trucks are of pressed steel with a longer wheel base and are of very strong construction.

An interesting example of development is presented by the motor-car wheels. Troubles were experienced with the earlier type of wheel which have led, through stages, to the adoption of the wheel shown in the drawing herewith. This new wheel has a very massive centre of cast-steel with heavy spokes. The usual method of fastening the tire to the wheel centre by means of shrinkage and the use of a tire-retaining ring has been modified. The tire, which is of the section shown, is shrunk on to the centre, and holes are drilled through both tire and centre in an axial direction, one hole being drilled at the end of each spoke. The countersunk bolts which pass through tire and centre are a driving fit in the holes, and after the nut has been tightened the end of the bolt is riveted over in a recess in the head of the nut, thus effectually securing it from slackening back. A considerable number of these wheels are now running with most satisfactory results.

The original trucks are gradually being replaced by pressed steel trucks similar to those employed on the newer stock. The work of making these trucks is proceeding in the Ealing shops, where some additional machines—notably a heavy pneumatic hammer for the big forging work—have been installed. The side frames and transoms are purchased, as no facilities exist in the shops for pressing these, but the work of assemblage and the making of the forgings for the brake rigging, etc., is carried out. Owing to the fact that the new trucks are of a longer wheel base than the old, alterations are required to the foundation brake rigging on the car body and to the electrical equipment (contactors, circuit breaker, etc.) which is hung under the car body and has to be re-arranged. This entails a very considerable amount of work, but justifies itself in the increased comfort of the passenger and in savings on the cost of truck maintenance.

The large majority of the traction motors on the District and London Electric Railways are of the G.E. 69 type supplied by the British Thomson-Houston Co., Ltd. These are of a plain four-pole character. Recent additions, however, have been of the G.E. 212 type, which are provided with interpoles, and they are giving very satisfactory service. It has not been found possible on the District to adopt ventilated covers on these motors owing to the conditions of working, but on the London Electric, where the great proportion of the running is done in tunnel, the new G.E. 212 motors all have inspection covers made of a frame holding wide mesh expanded metal. The result of the ventilation so obtained has been very marked in the reduction



Elevations and Part Section of Forged Steel Wheels.

of motor temperatures, and it is hoped that an appreciable increase in the life of the insulation will result.

Owing to the fact that the Underground group of railways is under one control, it has been found possible to concentrate work of various classes in one or the other of the workshops. This is specially so in the case of armature repairs and coil-winding work, which have been largely concentrated in the Golders Green shops of the London Electric Railway. Here provision has been made for the manufacture and repair of all armature coils for the District, London Electric, and Central London Railways. Since war broke out a special room has been built for women and girl labour, and it is intended that this class of labour shall continue to be used for this work.

At the moment there is a considerable amount of work in hand in the repair of traction armatures. After the number of years that the railways have been in electrical operation, some trouble is being experienced through loosening of the armature core disks on the shaft and on the back cone. All defective armatures, accordingly, go through a rigorous examination for loose cores, and in those cases where this is evident the armature is entirely stripped and rebuilt on a new forged steel shaft. All the core plates are tested on a mandrel for inside

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diameter and fit on the key, and only those which pass this test are used in the rebuilding—those which fail to pass being scrapped. The plates at each end of the armature are being replaced by plates $\frac{1}{8}$ in. thick, and the corners of the teeth at the end of the slots are being very well rounded off. Every care is taken that a newly built-up core is a sound mechanical job, so that the armature winder has a solid foundation on which to build.

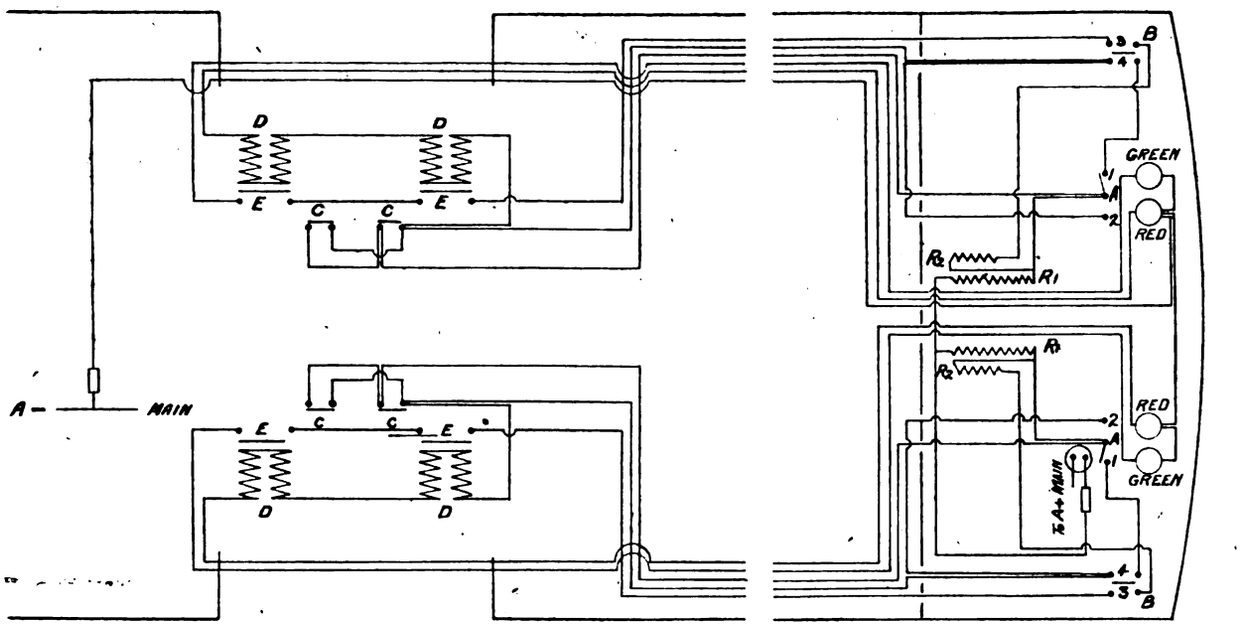
The armatures are bar wound, the end connections being riveted and soldered. The copper bars are bent to shape on formers, and the coil is completed by being jointed at the back end in position in the slots. The insulation consists entirely of pure mica and micanite, the only fabric employed being one layer of cotton tape round the outside of the coil to give mechanical strength to the bar. Each bare copper strip (there are five conductors per bar) is insulated with a peculiar kind of tape, uniformly coated with thin layers of sheet mica. After the bars are so insulated they are placed together in batches of five, heated in an electric heater, and pressed in a water-cooled press. The bars are then laid in a micanite trough, the lid of the trough is laid on, and the whole is mica taped, after which it is again heated and pressed up and finally bound with one layer of Egyptian superfine cotton tape. The bar is then painted with insulating paint. The bar so formed is a very sound job with very high insulating properties.

It is interesting to note that the soldering of the armature bars to the commutator is being done in one operation, the whole commutator being soldered up in twenty minutes. The armature, ready for soldering, is stood on end, commutator downwards, and a ring of gas jets play upon the commutator risers. Resin is used as a flux and solder (62 per cent. of tin) is run in, and it runs in very well. An arrangement of this sort is possible with the "all mica" insulation. The time taken to solder up a commutator bar by bar with a soldering iron and gas jet is about three hours, so that there is a very considerable saving in time in this process. The covers for the front connections are made from horsehair cloth, as it has been found that this material does not perish so quickly under high temperatures as the cotton duck which was formerly used. The commutator end rings and adjacent parts inside the motor are painted with Pinchin-Johnson's heat-resisting enamel. This dries with a highly polished porcelain-like surface, to which carbon dust does not adhere. An improvement has been noticed as a result in the number of flash-overs occurring.

At present all armatures, after winding, are painted with insulating varnish and baked in an electrically heated oven, but a vacuum impregnating plant is in course of erection which should have good results. The mica of the commutators is under-cut to a depth of 1/32 in. and Battersea electro-graphite brushes are used.

In addition to the traction armatures, a great deal of other work is done in the Golders Green armature room—the range of motors dealt with extending through various kinds of lift motors, fan motors for the tunnel ventilating plant, air compressor motors, and tunnel drainage motors, down to the tiny Gramme ring wound motors used in the control gear of the Sprague lifts on the Central London Railway.

Mention of the cars which have recently been put into service on the Bakerloo Railway in connection with the opening of the extension of this line to Queen's Park and Willesden must not be omitted from these references to improvements on the Underground. A special feature is the provision of a middle door half-way along the car, which facilitates the loading and unloading to a marked degree. Unlike the sliding doors on the District Railway, these middle doors are hinged and swing inwards to open. The door is operated by the passenger, who, when the door is unlocked, pushes it open to enter or pulls it open to alight, the door closing automatically by means of a Bardsley door check placed under the car floor. Although the doors are operated by the passenger, it is only while the car is stationary at a platform that the doors are unlocked. Electric locks are provided, which are under the control of the gateman; when the gates are opened at the ends of the car, the electric locks of the middle doors are released, and passengers can then push the door open to enter. When the gateman shuts his gates, if the middle door is closed the electric lock shoots, and he receives an indication of the fact on his signal lamps; if the middle door is not locked, the "danger" signal lamp remains alight until the door is closed and the bolt shoots into place, when a green light appears, and the gateman then signals that the train may be started.



Switch A.—Normally closed on position 1.
Switch B.—Two-way switch operated by end gates. Middle door locked with switch in position 3, and unlocked with switch in position 4.
Switch C.—Switch operated by centre door. Closed when door is open. This switch is in parallel with Switch B in position 4.
Switch E.—Switch closed when bolt of electric lock is shot home. Coils D, coils of electric lock; R_1, resistance; R_2, resistance equivalent to that of coils of middle-door lock.
Switch A in position 2 unlocks middle door irrespective of position of two-way Switch B.

Wiring Diagram for Door Locks and Lamp Signals.

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THE USE OF CONTINUOUS CURRENT FOR TERMINAL AND TRUNK-LINE ELECTRIFICATION.

By N. W. STORER.

(*Abstract of paper read before* The Institution of Electrical Engineers, *March 16th*, 1916.)

This paper deals chiefly with the characteristics and possibilities of the continuous-current motor for handling trains in the most economical and satisfactory manner, not only on one line, but for interchanging equipments on lines where different conditions prevail.

The Series Motor.—The series motor has been so successful and has shown itself to be so superior to all other types of railway motors, that it is now used almost universally for traction. In addition to giving the most efficient performance, the steep speed curve makes the series motor more reliable and cheaper to maintain than any other continuous-current type, enabling it to withstand the severe service of rapidly accelerating heavy trains and developing overload torques that would be impossible in any other type of motor. It also gives the best commutation, and is least subject to injury resulting from the fluctuating line voltages that are common to all electric railways. Voltages of more than three times the normal have been reached on heavy-capacity third-rail lines due to surges following the opening of heavy loads or short-circuits.

The series motor as generally used has not the most efficient characteristics. As a rule the field becomes saturated at a current corresponding to about the one-hour rating. After the series-parallel control was introduced, the control of the field was abandoned, partly because of the grave troubles from commutation and overload which were introduced by running on the weak field. Thanks to the great progress that has been made in motor design, notably in the development of the commutating pole, field control is once more being employed. While giving the greatest economy in accelerating, its introduction has again called attention to the advantages of the motor with the steep speed curve and the unsaturated field.

For frequent stopping service the unsaturated motor will operate more efficiently, since it accelerates with so much less current. The difference is still more pronounced on overloads. The root-mean-square current will be very materially decreased in the unsaturated motor for a given service and, consequently, an unsaturated motor of a given rating will have a greater service capacity. There will also be a saving in rheostatic losses.

Field Control.—The use of field control still further improves the efficiency of acceleration, and offers, where desirable, additional operating speeds. This was first applied in recent years to the A.C.-D.C. locomotives installed on the New

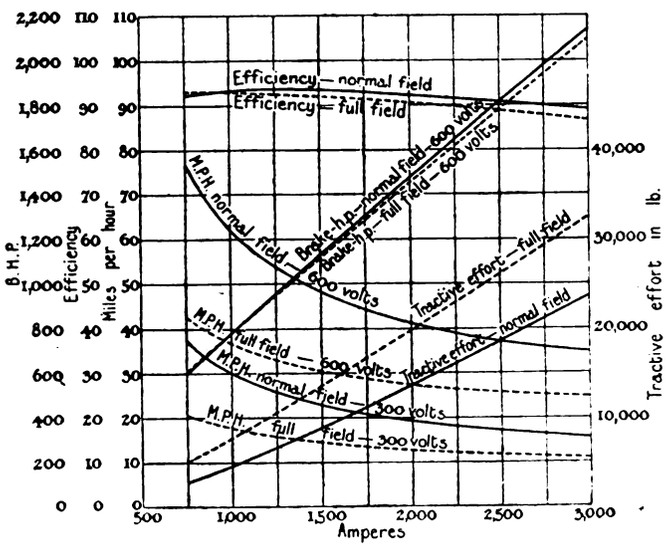

Fig. 1.—Comparison of Characteristic Curves of Saturated and Unsaturated Field Motors, 200 h.p., 600 volts.

York, New Haven, and Hartford Railroad to provide some speed control on the continuous-current zone of operation. The first large installation with purely continuous-current locomotives was on the New York terminal of the Pennsylvania Railroad.

Fig. 1 shows the curve of the motor for this locomotive, which has only two motors. The usual series-parallel connections combined with field control give four speed curves. These curves simply show the maximum range of speed at which the motor is designed to operate at normal and half voltages, but there are two intermediate speed curves on each voltage which may be used if desired between the full field and the normal field position.

There have been criticisms of electric locomotives in comparison with steam in several papers, notably that by Mr. Roger T. Smith. The electric locomotive scarcely received justice in those comparisons, owing to insufficient information on the subject, and if a continuous-current locomotive with the range of speed at constant output which is given by the Pennsylvania locomotive were applied to a given load condition, it would prove to be better adapted to the service than any steam locomotive, notwithstanding the very great improvements that have been made in steam locomotives in recent years. The Pennsylvania locomotive curves, for instance, show that it will develop an output of 1,200 h.p. at any speed between 42 and 76 m.p.h. It will develop 1,600 h.p. over a range of speed from 36 to 60 m.p.h., or 2,000 h.p. between 32 and 52 m.p.h.; it will develop 3,000 h.p. over a range from 27 to 41 m.p.h., or 4,000 h.p. from 25 to 35 m.p.h.

In cases where a heavy tractive effort is required for short periods of time, the electric locomotive has the enormous superiority of being able to handle the load at a higher speed. With a locomotive such as the Pennsylvania, the rheostatic losses will be so small as to be of very little importance, as combination of control giving series, series-parallel, and parallel control with variations in field strength is adopted.

Ordinarily it may be assumed as certain that when maximum use is made of a field-control equipment it will reduce the rheostatic losses to not more than one-half of what they would be with the usual series-parallel arrangement. The total saving per ton-mile will, of course, depend on the number of accelerations made.

In general, if it is desired to reduce the power consumption to a minimum, the unsaturated motor having a steep speed curve is to be recommended either with or without field control wherever the service requires frequent acceleration or very heavy grades are encountered. It is a mistake to think that the field-control motor is going to be materially heavier for a given service than the simpler form of series motor.

Regenerative Control.—A great deal has been written and spoken in regard to the possible savings that can be effected by regenerating the power that is stored in a moving train during the stopping period, and also by saving the energy developed by the train in descending grades; 50 per cent. of the total power taken from the line is expended in this way on a great many lines, so that it is a matter of great importance.

The scheme adopted long ago on the Central London Railway, of saving this energy by elevating the station tracks, is one that can be tried in special cases with excellent results. It adds nothing to the equipment and makes the work easier, so that smaller motors may be used. However, it has its limitations; a train operating at 30 m.p.h. would stop without brakes if allowed to climb to a height of 30 ft., and a 14-ft. elevation would be required to absorb all the energy in a train moving at 20 m.p.h. It would not be feasible to save all of the stored energy, nor, in fact, would it be feasible to save any large part of it on a line having long trains and a high schedule speed. Such a plan is not practicable for the large majority of railways, but any scheme of electrical regeneration may be supplemented by the elevated station tracks.

Such a scheme is already pretty well developed and will soon be in commercial operation; it involves the use of the standard series motor, with separate excitation during

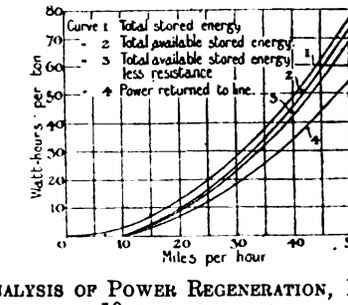
Curve 1 Total stored energy
2 Total available stored energy
3 Total available stored energy less resistance
4 Power returned to line.
Watt-hours per ton
Miles per hour

Fig. 2.—Analysis of Power Regeneration, Regenerating to 10 miles per hour.

regenerative periods. The control may be entirely automatic from the time it is applied until the lowest speed is reached at which the motors when connected in series can develop the line voltage. At the same time it can be stopped at any desired speed. The regeneration at high speed is with the motors connected in parallel, and the change from parallel to series is effected by a bridging method especially adapted to this purpose. There is no break in the retardation of the train from the maximum speed until it comes to a standstill; for the control is so arranged that the air brakes may be applied as soon as the minimum regenerating speed is reached. The use of the standard series motor in this connection is of the greatest importance, and the motor designed for field control assists in securing the maximum saving of energy owing to the fact that the regeneration can be carried to a lower speed.

It is usual practice in equipments for heavy multiple-unit service for city and suburban traffic to have the motors geared

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for a speed of about 15 to 18 m.p.h. at the one-hour rating of the motors. Such an equipment will retard the train by regeneration down to a speed of 8 to 10 m.p.h. Fig. 2 is plotted so as to show the possible saving that can be effected by regenerating down to a speed of 10 m.p.h. The top curve shows the amount of energy that is stored in the car. From that is deducted the amount left in the car at a speed of 19 m.p.h. The next curve deducts the amount that is required to overcome train resistance at a specified rate of braking down to 10 m.p.h. From this curve is deducted the amount of power that is lost in the equipment during regeneration. In this case the efficiency of regeneration is assumed to be 80 per cent., which allows for a considerable loss in the auxiliaries. The lowest curve shows the energy in watt-hours per ton that should be restored to the line under the specified conditions from any speed under 50 m.p.h. down to 10. It is probable that in any case at least 45 per cent. of the stored energy can be returned to the line. If this stored energy amounts to 50 per cent. of the power taken from the line, the net reduction in power consumption should be more than 20 per cent.

Line Voltage.—By successive steps the line voltage has been raised until the standard for most tramways and suburban lines is now 600 volts. This seems to be the economical limit for small equipments such as tramway motors, and to have many advantages for heavy suburban work. In the United States a voltage of 1,200 to 1,500 has become the standard for interurban railways, whilst pressures of 2,400 and 3,000 volts are being used in one or two instances. A continuous-current voltage of 5,000 has also been in use on an experimental equipment of the Michigan United Traction Co. for the past seven or eight months. In England 1,200 and 1,500-volt lines are now in operation, and a 3,500-volt experimental equipment has been in use for several years on the Lancashire and Yorkshire Railway. The tendency among the railways centring in London seems to be to adopt the 600-volt third-rail system. The 1,500-volt line is on the North-Eastern Railway, where it is used for the haulage of mineral trains, the locomotives taking current from two overhead wires in parallel. The 1,200-volt line on the Manchester end of the Lancashire and Yorkshire Railway is used in connection with a new type of third rail, the contact surface of which is located on the side of the rail farthest from the running rail.

In view of the possibility of still higher voltages and other contact systems being introduced in Great Britain, the question of interchangeability of equipments has become very prominent, especially under war conditions.

Two conditions of prime importance are necessary, namely:

1. The contact conductors must be so arranged that any equipment can take power from any line without change.

2. Every equipment must be so designed as to operate at required speeds over the various voltages of the different lines.

It is possible where the contact surfaces are properly located to have a single contact-shoe satisfactory for collecting current from either the under-running or the over-running type of rail. There is no reason to suppose that it would be impossible to shift the shoes in order to make contact with rails located at different places, provided that the distance were not too great to be covered. However, such things should be avoided if possible. The author can see no possibility for interchanging equipments between the top and bottom contact rails and the side contact such as is used on the Lancashire and Yorkshire Railway. With regard to overhead conductors, the problem is much simpler, and it should be possible to adopt a collector which will operate satisfactorily on any overhead line.

It may be assumed as correct within a very few per cent. that the horse-power or kilowatt rating of a motor is proportional to the voltage applied to its armature terminals. To obtain the rated output from an equipment of motors operating on multiple voltages, it is necessary to manipulate the control circuits so that each armature will always receive the same running voltage regardless of the line voltage.

As 600 volts is recognised as the standard voltage for most city and suburban railways, the higher voltages adopted or proposed are usually 1,200, 2,400, 3,600, and 4,800. A voltage of 1,500 has been adopted in several notable instances and is a very desirable voltage, as it is about the maximum on which the motors and control equipment of the form usually used on the 600-volt line can be used without considerable increase in the cost. It is not, however, usually considered to be high enough for trunk-line service.

Fig. 3 shows the speed curves that will be secured on a motor designed for a normal voltage of 1,500 when operated at lower voltages. With a current of 150 amperes, giving a tractive effort of 4,500 lb., the speeds are 22¼, 17.6, 10.7, and 8.4 m.p.h. respectively at 1,500, 1,200, 750, and 600 volts.

The 5,000-volt car equipment which is in operation on the Grass Lake Line of the Michigan United Traction Co. is required to operate over about 10 miles of suburban line with 5,000 volts on the trolley and also over two miles of 600-volt line in the City of Jackson. Series-parallel control is used on the 5,000-volt line, and a balancing speed of 50 m.p.h. is normally reached. On 600 volts the four sets of armatures are connected in parallel and a speed of 18 to 20 m.p.h. is reached by shunting the fields of the motors. This method of operation can be followed successfully in a great many instances where equipments designed for high-voltage service are required to operate for short distances over low-voltage lines. It is quite practicable to shunt the motor fields down to a very low value in such cases, as there will be no danger of flashing at the low voltages.

It is undesirable to equip cars with more than four motors each, as the complication and cost would become too great. With the locomotive, however, it is quite practicable to operate with eight motors.

As far as the motors themselves are concerned, there is very little additional complication from the necessity of interchangeability on different voltages. It simply requires the use of more armatures and at a greater cost than would otherwise be necessary. The motors, of course, would have to be insulated for the highest voltage on which they would be used. The complications introduced would be mainly in the control system.

A scheme by which eight armatures may be operated, four in series and two series in parallel, two in series and four series in parallel, or all in parallel, corresponding to full speed on 2,400, 1,200, and 600 volts, or full speed on 4,800, 2,400, and 1,200 volts and half speed on 600 volts, requires a total of 56 switches, most of which would have to be designed and insulated to handle the maximum voltage. The same number of motors arranged for operation on two voltages, when connected permanently two in series requires 36 switches.

The combinations may, to a certain extent, be made by means of drum-type change-over switches; such a scheme is usually used for car equipments operating interchangeably on 600 and 1,200 volts. This is shown on fig. 4, which is a standard arrangement for such an equipment. It will be noted that the change-over switch changes both motors and resist-

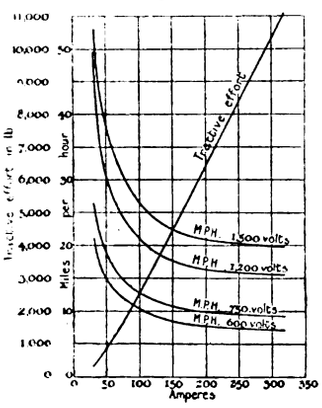

Fig. 3.

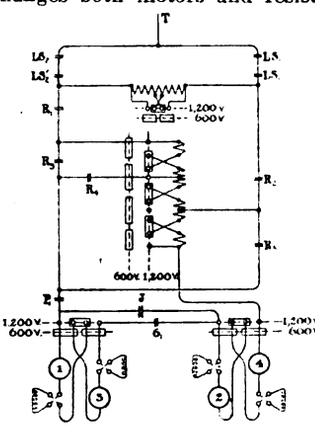

Fig. 4.

Fig. 3.—250-h.p. (187.5-kw.) Railway Motor, Normal Voltage 1,500.

Fig. 4.—Diagram of Main Circuits for Standard H L Car Equipment at 600 and 1,200 volts.

ances from series to parallel or *vice versa*. While such a scheme is quite satisfactory for lower voltages, especially for car equipments, it is generally considered to be better practice so to arrange the motor circuits of high-voltage equipment as to effect all changes possible by means of unit switches, sometimes using them for reversers as well, especially for large locomotives.

(To be concluded.)

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SPAIN.—A recent Spanish Royal Order provides that the reduced import duty of 10 centimos per 100 kilogs. net, prescribed by the Royal Decree of January 1st, 1916, in respect of iron and steel scrap is suppressed, so that such scrap can now be imported into Spain free of duty. A further Royal Order provides that the export duty of 100 pesetas per 100 kilogs. net imposed on zinc in bars, lumps, cake, and scrap by the above-mentioned Decree is also suppressed.

UNITED KINGDOM AND CERTAIN FOREIGN COUNTRIES.—A Supplement to the *Board of Trade Journal* of February 17th contains complete lists of articles which are prohibited to be exported from the United Kingdom and certain foreign countries, viz.: Denmark, France, Greece, Italy, Japan, Netherlands, Norway, Portugal, Roumania, Russia, Spain, Sweden, and Switzerland. This Supplement, which embodies information received by the Board of Trade up to February 14th, replaces that issued by the Board on October 28th, 1915. Copies may be obtained from Messrs. Wyman & Sons, price 3d., post free 4d.

EAST AFRICA PROTECTORATE.—By an Ordinance dated December 18th, 1915, the export duty on rubber, other than plantation rubber, exported from the East Africa Protectorate has been reduced from 10 per cent. *ad valorem* to 4 per cent. *ad valorem*.

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MEXICO.—Information has been received at the Board of Trade, through the Foreign Office, that the Mexican Constitutionalist Government, having decided not to recognise the Mexican Consuls who held office during the Huerta *régime*, desires to draw the attention of exporters residing in places where there is no Mexican Consul authorised by the Constitutionalist Government to exercise Consular functions, to the provisions of Articles 54 and 55 of the Mexican Customs Regulations. The following is a translation of these Articles:—

Article 54.—In places where there is no Mexican Consul or Consular Officer, the shippers should make out their invoices in triplicate only (in other cases *four* copies are required); and in other respects in accordance with the regulations established in the preceding Articles of the Customs Regulations. Shippers are to forward on the same day, through the local post-office in registered envelopes (Sec. II of Article 6 of the Postal Union), one copy of the invoice to the Head Office of the Customs in Mexico, and another to the Collector of Customs at the Mexican port to which the goods are being dispatched.

The shipper must be careful to obtain from the postmaster the receipts for the registered letters, which receipts he must transmit to the consignee in the port to which the goods are dispatched. The consignee, in turn, must present them to the Custom house with the third copy of the invoice on making the request for clearance.

The fact that the certification of the invoices may have been performed by the Consul of some friendly nation does not exempt the shipper from the obligation of complying with the provisions of this Article.

Article 55.—Failure to produce an invoice certified by the Mexican Consul or the receipts for the registered letters which, in accordance with Article 54, are required to be presented to the Custom house by the consignee of the goods, will be punished by the collection of double Customs duties on the goods imported; and in this case the specification of the goods in the corresponding Petition for Clearance will not require to be made, as this must be made by the examining Custom-house officer at the moment of clearance, when the Collector of Customs must be personally present, whatsoever the rank of the Custom house may be.

The same penalty will be applied in the case of goods exempted from the payment of the duties to which they are subject by the Tariff.

BRAZIL.—Various changes have been made in the Brazilian tariff by the Budget Law for 1916, including the following:—Incandescent electric lamps with carbon or metal filament are to pay 2 milreis per kilog. (gross weight). The surtax of 10 per cent. (paper) on the registration charge (*expediente*) on duty-free goods is maintained in force. As in previous Budget laws, the Government is authorised (1) to levy, for the benefit of a port improvement fund, a tax not exceeding 2 per cent. (gold) upon the official import valuations—to be levied at the Custom houses at Rio de Janeiro, Recife, Bahia, Rio Grande do Sul, Maranhao, Ceara, Rio Grande do Norte, Parahyba, Espirito Santo, Paraná, Santa Catharina, Matto Grosso, Alagoas, Parnahyba, Aracajú, and Para; and (2) to levy a tax of from 1 to 5 reis per kilog. on merchandise loaded or discharged at Brazilian ports, according to the value of the goods, when proceeding from or destined for other ports. Exemption from Customs duty is accorded to machines and their accessories for new freezing establishments. A reduced duty of 8 per cent. *ad valorem* is payable on the following, when imported on the requisition of a State Government or a Municipality for works undertaken by them:—Apparatus and accessories destined exclusively for the industrial application (power, light, and heating) of alcohol; material for the first public installation of light, power, water supply, and other public services, and articles for the improvement and maintenance of electric tramways; machines and accessories for first installation for certain industries.

Commercial Travellers' Samples.—The duty-free admission of goods intended for re-exportation, subject to the deposit of the amount of duty payable, or to the furnishing of adequate guarantees is extended to samples imported by commercial travellers, if the samples are accompanied by a Consular certificate issued in the country from which the samples are imported, and if all the samples contained in each package are properly specified in a detailed note. The "expediente" charge is in this case reduced to 5 per cent. Catalogues, prospectuses, posters, and showcards of any kind are, if containing prints, to be subject to half the duties fixed in Tariff No. 604 (2nd section, & Note)* if their sole purpose is to advertise industrial products; articles suitable for advertisements or propaganda of such products (such as small knives, pencil-holders, cigar-holders, &c.) shall pay the duties fixed for such articles in the Tariff, with a reduction of 50 per cent., provided they are not intended to be offered for sale and that their use (as advertisements, &c.) is indicated on the articles.

Payment of Import Duties.—The Government is authorised to levy import duties on *all goods* in the proportion of 40 per cent. in gold and 60 per cent. in paper, thus abolishing the provisions of earlier Laws regarding the proportion of duty payable in gold.

*The duty under the second section of No. 604 is 3 milreis per kilog. The Note provides that prints gummed on cardboard for posters and advertisements shall enjoy a rebate of 30 per cent. of the duty.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

3,331. "Means of control for petrol-electric cars." W. A. Stevens. March 6th.

3,334. "Electric arc lamps." H. J. Eck & G. A. Knapton. March 6th.

3,336. "Incandescent electric lamps." J. T. Corneille. March 6th.

3,346. "Dynamo-electric machinery." H. F. Joel & J. H. St. H. Mawdsley. March 6th.

3,364. "Electric time switches." A. M. Coates. March 7th.

3,365. "Container vessels for portable electric lamps, and means for preventing corrosion of same." J. H. Braime & T. F. Braime. March 7th.

3,376. "Magnetic separators." A. Davies. March 7th.

3,382. "Electrically-illuminated flexible cords or ropes." C. Bryan and F. Bryan. March 7th.

3,388. "Alternating current electro-magnets." Waygood-Otis, Ltd. (Otis Elevator Co.). March 7th.

3,389. "Alternating current electro-magnets." Waygood-Otis, Ltd. (Otis Elevator Co.). March 7th.

3,390. "Alternating current electro-magnets." Waygood-Otis, Ltd. (Otis Elevator Co.). March 7th.

3,391. "Vacuum apparatus." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 7th.

3,394. "Telegraphic or signalling systems." H. W. Sullivan. March 7th

3,410. "Miners' electric safety lamps." O. Oldham. March 7th.

3,413. "Controlling apparatus for electric motors." Sir A. T. Dawson and J. Horne. March 7th.

3,420. "Means for operating electric lamps." J. S. Highfield. March 8th.

3,442. "Portable electric incandescent lamps for attachment to pencils, &c." F. J. C. Carruthers. March 8th.

3,460. "Means for the electrical repetition, determination, or distant control of movements, specially applicable to order-signalling systems, &c." E. A. Graham & W. J. Rickets. March 8th.

3,474. "Overload switches or cut-outs." P. G. van Wijk. March 8th.

3,480. "Means for laying field telephone wires, &c." E. W. Brown. March 8th.

3,509. "Electric relays." Naamlooze Vennootschap de Nederlandsche Thermo-Telephon Maatschappij & Baron R. A. van Lynden. March 9th.

3,515. "Electron discharge devices." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 9th.

3,533. "Multiple-contact microphones." Signal Ges. m.b. H. March 9th. (Germany, January 9th, 1915.)

3,534. "Electrolytic condenser or valve." G. Giles. March 9th. (Germany, March 9th, 1915.)

3,536. "Electro-magnetic guns with propulsive retro-action." E. Mercsh. March 9th.

3,543. "Apparatus for recording electric signals." E. R. Clarke. March 9th.

3,559. "Electric car-lighting equipments." Albion Motor Car Co. and T. B. Murray. March 10th.

3,566. "Protective relay for alternating-current systems." A. E. McColl. March 10th.

3,598. "Electric furnaces." T. Balmforth & Co., and H. J. Kitchen. March 10th.

3,599. "Circuit arrangements for telephone exchanges provided with selecting devices." Siemens Bros. & Co. and T. Pettigrew. March 10th.

3,601. "Thermic telephones and microphones." Naamlooze Vennootschap de Nederlandsche Thermo-Telephon Maatschappij and Baron R. A. van Lynden. March 10th.

3,603. "Obtaining high vacua." British Thomson-Houston Co. (General Electric Co.). March 10th.

3,606. "Couplings for transmitting rotary motion at a variable angle." Hasler Akt. Ges. vorm Telegraphen-Werkstatte von G. Hasler. March 10th. (Switzerland, April 28th, 1915.)

3,622. "Processes for enamelling and colouring electric lamp bulbs." F. B. Dehn (Soc. J. Schmitt et Cie). March 10th.

3,629. "Changing frequency of alternating currents." A. M. Taylor. March 11th.

3,657. "Impulse-control systems for automatic telephone exchanges." Western Electric Co. & F. R. McBerty. March 11th.

3,658. "Starting mechanism for automobiles." British Westinghouse Electric & Manufacturing Co. March 11th. (U.S.A., April 6th, 1915.)

3,659. "Starting mechanism for automobiles." British Westinghouse Electric & Manufacturing Co. March 11th. (U.S.A., March 24th, 1915.)

PUBLISHED SPECIFICATIONS.

1915.

2,516. Electro-magnetic Motors. W. E. Clifton. February 17th.

2,957. Machines or Apparatus for Sheathing or Braiding Wire, Ropes, Cables, Hose, and the like, with Cotton, Silk, Wire, or like Protective Coverings or Casings. P. Huntingdon. February 24th.

3,001. Electric Circuit Breakers. F. B. Holt. February 24th. (Addition to 28,746/13.)

3,657. Electric Switches. E. G. K. Anderson. March 8th. (March 7th, 1914.)

3,763. Electrical Fuse Boards. J. H. Tucker & J. A. Crabtree. March 9th.

5,002. Means for Regulating Electrical Circuits. Igranic Electric Co. (Cutler-Hammer Manufacturing Co.). March 31st.

5,385. Intercommunication Telephone Systems. International Electric Co., R. G. le Neir & E. Funccius. April 9th.

7,269. Apparatus for the Calculation of Mathematical Problems arising in the Transmission of Electric Power. W. D. Reid and Callender's Cable and Construction Co. May 14th.

8,294. Fittings for Conduits for Electric Wiring and the like. J. Dyson. June 4th. (July 2nd, 1915.)

10,192. Centrifugal Compressors. British Thomson-Houston Co. (General Electric Co., U.S.A.). July 13th.

10,438. Hand Levers Controlling Electric Motors for Operating Railway Signals and Points. J. H. Hibbert. July 19th.

15,196. Device for the Protection of Electric Installations against Excess Voltage. G. Giles. October 27th. (October 27th, 1914.)

17,172. Magneto Driving and Adjusting Mechanism. R. Bell. December 7th.

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THE

ELECTRICAL REVIEW.

VOL. LXXVIII. MARCH 31, 1916. No. 2,001.

ELECTRICAL REVIEW.

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WHO'S WHO?

EVEN in normal times the difficulty of ascertaining the exact character and personnel of companies and firms with which or whom there were opportunities of doing business occasioned a certain amount of trouble and anxiety to practically every British manufacturer. The liberty and freedom which have always characterised the conduct of trading operations in the United Kingdom have encouraged privacy, and too frequently that privacy has been abused. In respect of limited liability companies, there were facilities available for examining lists of shareholders and their individual holdings, but even then it was not possible easily to discover whether the real parties were concealed behind nominees bearing names which excited no suspicion. In the case of private firms, however, it has always been practically impossible, save through private sources, to find out as much as could be ascertained in the case of companies, and private agents might be representing and selling the products of those with whom, had the purchasers known the real facts, they would have flatly declined to have relations. We believe that in the foregoing we have expressed the peace-time reflections of many a business man engaged in the electrical, engineering, and hardware trades and industries. The secrecy and some of its undesirable consequences may have been more or less inevitable drawbacks of our commercial system, and they cannot easily be avoided unless all business transactions are to be so restricted, controlled, and hide-bound as to interfere with the free play of business initiative and enterprise. Hundreds of men who have built up great, necessary, and successful businesses never would have engaged in trade at all had it been required that their operations should be conducted in the full glare of publicity. So long as they conducted their transactions on sound and honourable lines, keeping to their contracts, and paying their debts, of what concern was it to anybody else who was or was not interested in the profits or who did or who did not pull the wires? And for the sorting out of the undesirables it was for traders to establish as perfect as possible an intelligence service, and failing the efficiency of such service, or indisposition to make use of it, Carey Street revelations and a needlessly large percentage of bad debts were sometimes the ultimate reward. Yet the most efficient intelligence service conceivable respecting either firms or companies cannot afford us complete immunity—in all businesses we must run risks and try to look pleasant, cutting our losses as philosophically as we can.

But in war-time, when we are engaged in a deadly struggle with a nation which has striven to undermine the industries of our Empire in ways which have been a revelation to most of us during the last twenty months—much as we thought we knew before—there enters an entirely new factor which inevitably seriously affects our most elementary business considerations. Under such exceptional circumstances sentiment will assert itself even in our trade affairs, and if we intend to prevent certain lines of foreign manufactures from having so free an entry as hitherto, we shall have to do a good many things

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for which we have not yet made any definite plans. Before the war it mattered far less than it does to-day who was who in the electrical trade, and if we mistake not it will continue to matter very much indeed after the war. Nobody really British to-day wants to touch with a long pole any business house in which there is reason to believe enemy influence to be present. Are there not special Acts of Parliament and fears of big penalties turning aforetime miserable sinners into the most patriotic of saints? But everybody who knows now of the activities of German agents in the past, of the way in which offices of German concerns have been opened under the most innocent sounding names, and how foreign supplies have been sold by concerns having British titles, is eager that there shall be safeguards provided for the future. In recent months these foreign connections have taken a great deal of tracing out and unearthing and extirpating, whether by Government departments, by trade associations, or by privately instituted investigations and action. In the interests of the future of British industry, nay, more than that, of the future of the British Empire and the world civilisation for whose cause it struggles and pours out its life-blood and its wealth to-day, we hear a clamant voice calling for preventive measures. What should those preventive measures be? It is for our legislators in the last resort to say; but in the first instance suggestions should be conceived in the brain of industry and trade, and they should be urged tactfully, intelligently, and forcefully upon the minds of legislators before it is too late. We have set up new Government departments during the war, and though even these are sometimes lamentably short of information, they have an organisation and system and an abundance of material which should not be scrapped at the end of the war, but should be utilised in the most efficient manner possible in ways in conformity with future national policy whatever that is destined to be.

There are in the world a few querulous people—some of them are even to be found within the confines of the electrical trade—who appear to regard editors as possessing a sort of superior intelligence for sorting out the chaff from among the wheat. Editors ought to black-list firms and companies though the law allows them to trade! They ought to publish lists of private and other parties who are even only suspected of enemy influence! And so on. We have alluded to our correspondence bag, with its rejected epistles, more than once during the war; we do not think we shall ever be tempted to publish all that it contains—our correspondents need have no fear, they need not write to us now reporting change of mind, for what we have done we have done. But all this correspondence, and some other things besides, have proved beyond doubt that the electrical industry at any rate has not been overburdened with trade associations which made it their business to collect trade information, or such associations would have received innumerable inquiries that have come to us. In view of the lack of organised facilities for such collection, we feel inclined to favour such measures as the Registration of Firms Bill that Lord Southwark brought before the House of Lords again last week. We have no more sympathy with grandmotherly and meddlesome legislation to-day than we ever had before, but we believe that the effective working of such a scheme, if it can be conducted without restriction or limitation of legitimate private enterprise, will be a boon to traders who want to know things about those with whom they wish to have business dealings, even if the information in regard to firms be limited to what is ascertainable under limited liability law. Lord Southwark explained that the principle upon which the proposed Bill was based was that there should be an effective registration of all persons and firms trading in this country in names other than their own. Foreigners would not be prevented from trading, but they would be compelled to disclose their names. In addition to this being a concession to the sentiment which will undoubtedly prevail for some time after the war, it will also prevent secret partners escaping their proper liabilities. We should hardly expect so limited a proposal to meet with serious objection. We observe that the Government which turned the idea down a few months ago, because there was not time to deal with it, is still unable to promise that it will be proceeded with in "another place," but it is something gained to have the Bill referred to a Select Committee. We read that one peer of the realm held that "a man ought to be allowed to manage his own business in his own way," and if that were a complete statement of the matter we should agree with him, but it is not so by any means. Ordinary mortals have learned things in recent days. Even Lord Loreburn plumps for the measure by saying that it is a straightforward course for business people to state their names to those who trade with them, and we approve his sentiment, born within us by painful experience in the electrical industry, even though he be a lawyer and supported by the Lord Chancellor who likewise sees no reason why a man should be ashamed of trading or of using his own name for the purpose. His lordship sees, as we do, and as new Government departments must assuredly see, that at the present moment a situation of difficulty is being dealt with which has arisen because no provision such as the proposed Bill exists upon the Statute Book. And yet no undertaking can be given in regard to progress in "another place"! We certainly should like to see the matter dealt with now if it were not regarded as so controversial as to absorb too much valuable Parliamentary time; but if that cannot be, it should be among the earliest trade measures to be passed in the first after-the-war Parliament.

Copper.

An extraordinary state of affairs has arisen in copper circles within the last few weeks, chiefly as a result of the Government policy in interfering with the market by prohibiting all speculative transactions, under the Defence of the Realm Act. Since the market was reopened under the new regulation restricting transactions to *bona-fide* business, the liquidation of old speculative commitments to be completed by the end of May next, has been proceeded with, and rather exciting developments have ensued with prices fluctuating within a range of fully £25 a ton, and thus swiftly forced to new high records up to about £118 for cash delivery, which at one period last week commanded a premium of £6 a ton. The extreme lowest touched a few weeks ago was £93, with a short-lived lull in the demand. The new regulation has certainly enabled speculative holders to realise their commitments at huge profits, at the expense, of course, of the short interest whose position has been anything but comfortable.

This sequel of the new regulation was inevitable in view of the present famine conditions as indicated by the virtual disappearance of the warehouse stocks in this country. The object of the proclamation was doubtless to keep down prices by stopping speculation, but technical conditions were such that precisely the reverse has happened. There has been a constant demand from consumers for all descriptions of copper for early delivery, which tends to accentuate the present stringent conditions, and although there has been some reaction from the extreme figures recorded in the past week, there is no prospect of any material relief being forthcoming in the near future. In the absence of a free market, it is obvious that forward business on the part of dealers has been severely interfered with, which is calculated to aggravate the impoverished state of the market.

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There are now under the new regulation virtually no facilities for "hedging" operations on the part of either producers or consumers. There is no denying the fact that the new conditions brought about by the Government interference are responsible for the drastic adjustment in the price of rough bar copper, which is more consistent with the phenomenally high level of value ruling for American fine copper, the latter having remained throughout pegged at upwards of £135. The huge premium on fine copper having thus been automatically reduced through the recent quick rise in standard copper, the position of American producers has, if anything, been strengthened by the prohibition of speculative dealings in this market, for the latter have in the past frequently interfered with their control. As hinted by an American authority, the copper magnates would similarly like the elimination of speculation in America so as to have transactions in the metals confined to direct negotiations between producers and consumers. There is no sign of a falling off in the huge consumption in copper, and unsold stocks are extremely reduced.

The Metropolitan E.S. Co.

Exceptional interest attaches to the report of the Metropolitan Electric Supply Co.'s annual meeting, to which we have devoted a considerable amount of space in our "City Notes" this week. It will be observed that, in spite of the adverse effects of the war, as manifested by the loss of 20 per cent. of the lighting revenue and an advance of at least as much in the price of coal, the company has increased its gross revenue by nearly 7 per cent., and has even recorded an increase in its net revenue, doing better, the Chairman stated, than any of the other electric supply companies in London, and carrying a larger amount to reserve than in any previous year. The improvement in the company's affairs during the last two years was due to the rapid development of the power supply, which showed an advance of 50 per cent. over the year before the war, while the returns since the beginning of this year indicate that the growth of this load is still progressing at an even faster rate. Moreover, the company has increased the price charged for power, without adverse effect upon the demand. In the face of these facts, some of the shareholders recently issued a circular to their fellows in which, according to the Chairman, the complaint was made that the dividend had fallen from 10 per cent. in 1905 to 3 per cent. for 1915; the Chairman justly pointed out that this heavy drop was due mainly to the sale of the Marylebone section of the undertaking, and that the shareholders had received the bulk of the price paid for their goodwill, to the amount of no less than £6 for every £10 share; naturally they could not have it both ways. Then came the metallic-filament lamp, which so severely hit those supply authorities that were dependent upon a lighting load, and their dividends fell until 1911 (the year in which Mr. Highfield was appointed manager); since then their profits had improved year by year. Three of the directors had resigned, because they disapproved of the proposed internal reorganisation of the company, and the imposition of higher charges for power supply; the board of directors had unanimously decided to separate the duties of engineer and manager, as in the early days of the company, but when the delimitation of the respective spheres of duty of the engineer and of the manager came under consideration, a split took place. Mr. Gregory, one of the signatories to the circular, pointed out that the directors in whose ability they had the greatest confidence had resigned, together with the general manager.

Mr. Tuckett, one of those directors, gave a number of quotations from reports drawn up by Mr. Leverton Harris and the Chairman, Mr. W. H. Cripps, which certainly embodied views which, at this date, can only be characterised as astounding: assuming that the load factor and other conditions are reasonable, to assert that a charge of £4 per kw. and ½d. per unit for power is not remunerative is to court the ridicule of every competent manager, and the statement that *all* power prices should be raised to a minimum of 1½d. per unit is equally absurd. We cannot too strongly protest against this highly reactionary attitude towards the power load, which stands condemned in the chairman's own speech, wherein, as we have indicated above, he showed that in spite of the heavy loss on the lighting revenue and the increased cost of coal, the rapid development of the power load had enabled the company to show better results than any other London company! What could be more astonishing, in view of the mass of experience and information at his command, than the statement of the chairman, in spite of his lengthy and distinguished association with electricity supply, that he could find no evidence that the works cost of generating a power unit was less than the cost of a lighting unit, and that the destination of any unit seemed quite immaterial, as regarded the cost of its production? And what of the incidence of the capital charges? We repeat that we are astounded that such views should be held by the chairman—or any director—of an electricity supply undertaking. It is not a question of opinion, but of fact—facts well known to every electrical engineer, and perfectly familiar to the manager of any similar business. We do not wonder that Mr. Highfield should feel compelled to dissociate himself from such views, and we think it is very plainly manifest that the action of the shareholders in calling for an investigation of the management of the company by the board of directors is thoroughly justified.

The I.E.E. and Alien Enemy Members.

On Monday last the Council of the Institution of Electrical Engineers dispatched to all the corporate members an account of the recent proceedings in connection with the proposed expulsion of enemy members, together with a card bearing the four resolutions that were voted on at the informal meeting, to enable the members to express their views on each proposition. The proceeding is in the nature of an informal postal ballot, though under the Companies' Act, by which the Institution is governed, the "voting" has no legal value, and the result will only serve as an indication of the views of the corporate members as a whole to those who are present at the special general meetings that will follow. We have no doubt, however, that not only the Council, but also the members who are able to attend those meetings, will give due weight to the views of the majority, and that they will regard themselves as the medium whereby those views may be translated into action.

We were pleased to observe that, by overwhelming majorities, the informal meeting endorsed the views which we put forward in our issue of January 14th, and which are embodied in three of the resolutions. The fourth proposal is designed to perpetuate the exclusion of our present enemies, a question which was first raised at the special general meeting of March 1st; on this point the voting at the informal meeting was 2 to 1, a much less emphatic expression of opinion than in the case of the other items. It is, however, a matter of much less moment, for while the other decisions will take immediate and irrevocable effect, this one merely outlines a policy which in the future may be reversed at the pleasure of the members.

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ELECTRICITY SUPPLY AT BALLATER.

As a result of negotiations which took place in 1913, between Mr. James Duncan of the firm of T. C. Smith & Co., electrical engineers, Aberdeen, in regard to the introduction of electric light into Ballater, this charming Deeside resort has since been provided with an up-to-date public electricity supply.

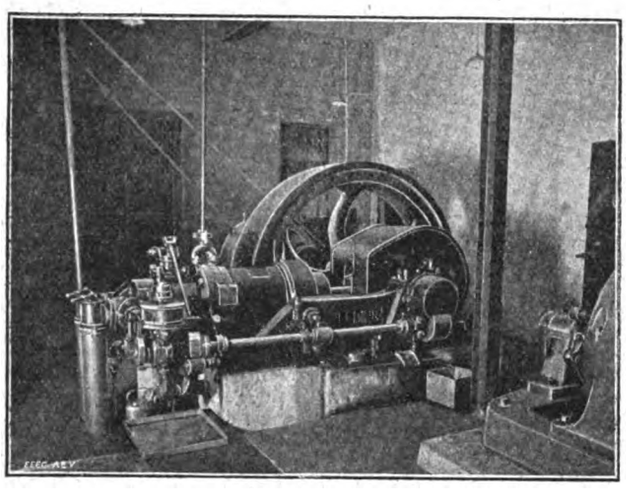
It was tentatively arranged that power should be obtained from the River Gairn, and a provisional order was applied for accordingly, but certain opposition being encountered from the proprietors of the fishings in the river, Mr. Duncan determined to abandon the idea of employing water as the means of generating power, and to install instead a suction gas plant.

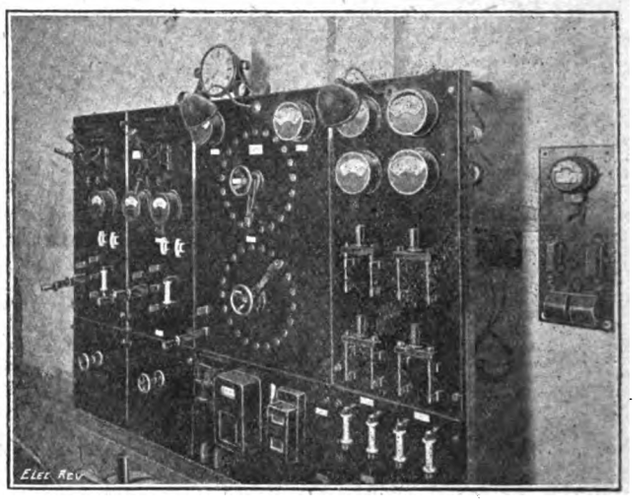
Previous to the advent of electric lighting, the streets of the burgh were illuminated by paraffin lamps, and the householders for the most part adopted the same means.

The generating station—a stone building—occupies a site near the railway station. In it are installed two 68-H.P. anthracite suction-gas plants and engines, by Messrs. Fielding & Platt, Ltd. The suction-gas producers are interconnected in such a way that either engine can work from either plant. The starting of each engine is by means of a high-pressure air self-starter, and the engines are fitted with heavy fly-wheels suitable for electric drives, and throttle governing, by means of which an extremely steady voltage is obtained. Each of the engines is directly connected by means of a flexible split coupling to a 42-KW. 220/300-volt compound-wound dynamo, with a single-pole switch direct on the dynamo to cut off the compound windings when charging the battery. These machines were supplied by the British Electric Plant Co.

A house, which has been erected on the lower floor for the attendant in charge, forms part of the generating station.

Considering the climatic conditions which prevail in winter, Mr. M. K. Cooper, A.M.I.E.E.—the manager of the electrical department of Messrs. T. C. Smith & Co., who carried out the work—advised his firm to install Heenan and Froude water coolers in lieu of the ordinary tank water coolers. He has now had considerable experience of these coolers, and the results have been extremely satisfactory. Their chief advantages are that they produce a constant cooling effect which is practically independent of climatic conditions, and the space taken up by them is very much less than that taken up by tanks.

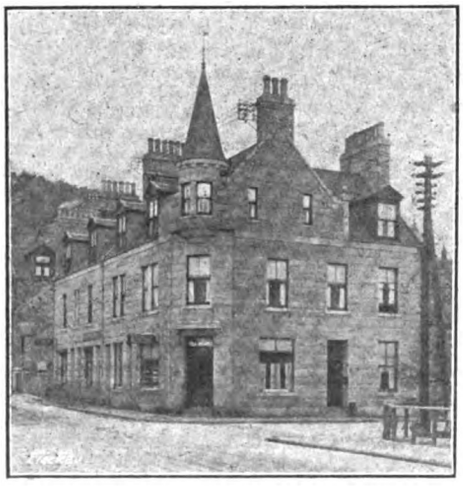


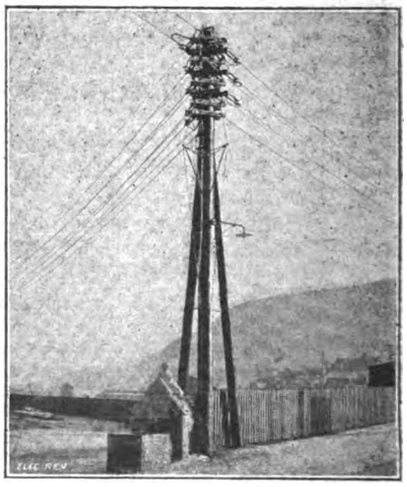


Gas-engine Plant and Main Switchboard, Ballater Electricity Supply.

The whole of the electrical machinery is controlled from a switchboard consisting of the usual dynamo, battery and feeder panels. The dynamo panels are fitted with the necessary volt and ampere meters, shunt regulators and circuit-breakers.

The battery panel is fitted with two 200-amp. 19-way charge and discharge switches, an automatic cut-out and cut-in relay, two 200-amp. S.P.Q.B. knife switches, an integrating recording ampere-hour meter, and charge and discharge ampere-hour meters.





Overhead Mains at Ballater; Main Distribution Pole on the right.

The main feeder panel contains four 200-amp. meters, and four 200-amp. D.P.Q.B. switches, and eight single-pole porcelain-handle fuses.

The battery was supplied by the Chloride Electrical Storage Co., and consists of 120 cells of Plantide type, with a capacity of 580 ampere-hours in five hours, or 696 ampere-hours in 10 hours. The plates are mounted in glass boxes; the wires leading from the regulating switches are suspended from the roof by special porcelain ceiling plates.

The mains and sub-mains, consisting of hard stranded copper wire, are carried through the walls of the power

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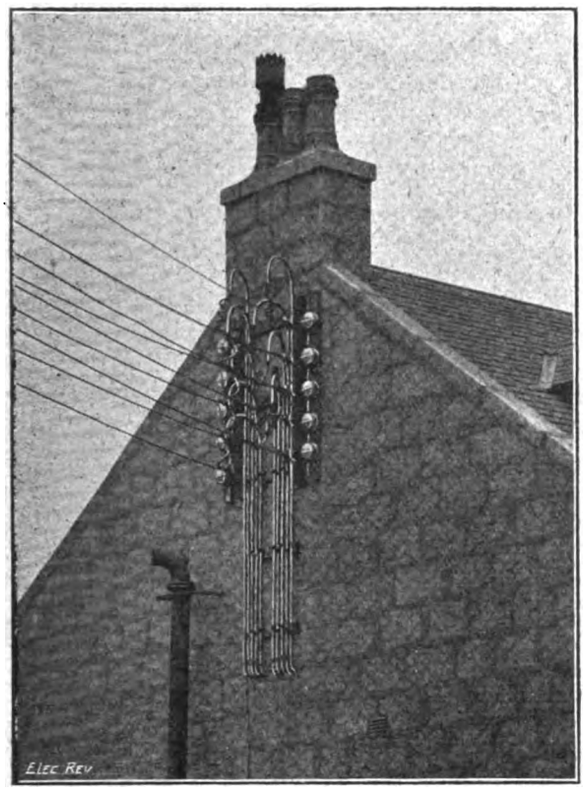
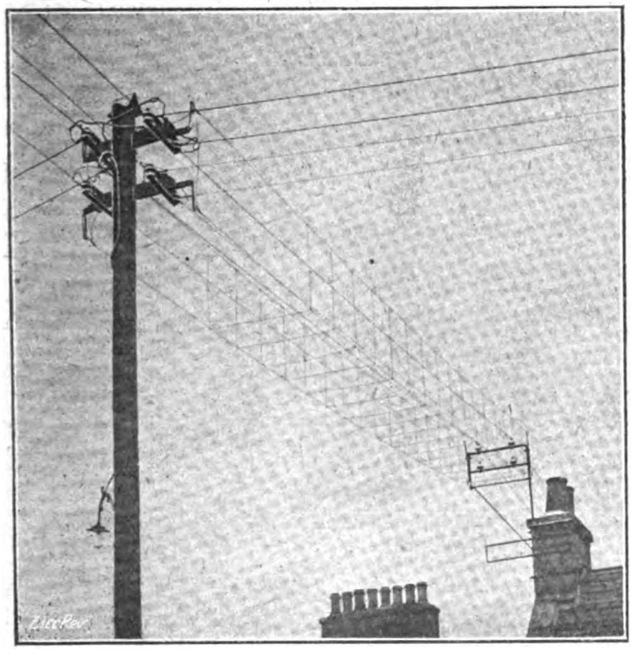
station to a main pole, and thence overhead, throughout the burgh, on larch poles, being carried on cross arms and attached to insulators. The sizes of cables vary from 37/14 to 7/20. Where Post Office telephone and telegraph wires cross the route, underground cables are laid. On the top of each pole is a zinc roof, and a galvanised wire leads from



Leading-in Wires, Lightning Arresters, &c., at Generating Station, Ballater.

the roof to the bottom of the pole serving as a lightning conductor.

Lightning arresters have been erected outside the power station where the mains come out.



Wire Cradle Crossing, over Telephone Line.

The street lighting is divided into four circuits. The consumers' connections consist of aerial braided wire, connected from the nearest pole either to upright, or swan-neck insulators, erected either on chimneys or walls; thence a pair of wires of the necessary size is led into a double-horn porcelain inlet, screwed into a galvanised tube terminating in a pair of ironclad fuses. It is worth mentioning that the inlet pipe leading-in through the slates of the roof, is led through sheet lead, soldered to the galvanised pipe, which makes the roof absolutely waterproof. The porcelain double-horn inlet was employed to get over the moisture which, in the autumn and winter, gathers round the inlet and forms condensation, in course of time making an earth and ultimately a short. The double-horn insulator prevents this entirely, for the distance of the inlet is 4 in. and the wires are apart. When moisture gathers, therefore, it simply acts as on an ordinary upright insulator. Over one year has passed since the completion of the installation and no trouble has arisen.

The work of the erection of the plant, mains, and the wiring of houses started in January, 1914, and the opening ceremony was on December 24th of the same year. About 165 houses have installed electric light or power, including about 2,400 lamps.

The original cost of the installation amounted to about £6,000, which was borne by Messrs. Duncan's Electricity Supply Co., Ltd.

A similar installation for the town of Ellon, Aberdeenshire, was begun and completed under Mr. Cooper's supervision during the same period.

In conclusion, we are indebted to Mr. Cooper for the particulars and views of the Ballater installation.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

The "Perfect Burglar Alarm" System.

The ordinary electric burglar alarm employs contacts of various types fixed to windows and doors, by which a bell or other warning device may be rung, a simple switch providing for the setting in action of the installation. The principal drawback to this system has been the question of maintenance; burglar-alarm installations are generally fitted upon premises where there is nobody of sufficient technical skill to look after them properly, and little care is taken to see that the system is in working order.

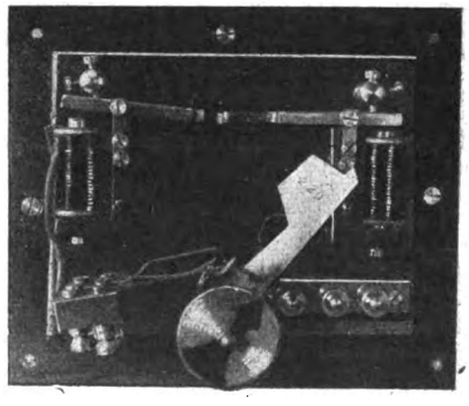


Fig. 1.—Control Gear with Cover Removed, "Perfect Burglar Alarm" System.

Moreover, the modern burglar is an expert electrician, who would never think of attempting to force an entry into a building unless he had assured himself that he had removed every means of creating any alarm.

One of the systems designed to overcome these objections is that now made by the Perfect Burglar Alarm Co., Ltd., of 53, New Broad Street, E.C. This company recognised that the only method of dealing with the question of maintenance was to provide a method of automatic testing, performed daily by the owner of the premises upon which the installation was fitted. This is effected by a special control gear, illustrated in fig. 1, which has three principal positions—"normal," "set" and "alarm," with an indicating pointer to the control handle. During the daytime, when the installation is inactive, the indicator points to "normal." Before the premises are closed the pointer is turned to "set," when, if any short circuit or other defect exists in the detection devices or the wiring thereto, a warning buzzer is sounded. With the controller at the same position, each of the detection devices may be tried by hand, when the buzzer will operate, if all is in order. Upon leaving the premises, a small push fitted outside the entrance is pressed, which removes the testing features in the control gear, and sets the alarm for the night. Once the push has been pressed, nothing whatever can restore the

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installation to an inactive position, and nobody can get into the building without due alarm being given. In the morning entry can only be effected to the accompaniment of the ringing of the alarm bell, but at such hours this would not be objected to, and it furnishes proof of the effective working of the bell and whole installation. The bell can be instantly stopped by restoring the indicator to "Normal."

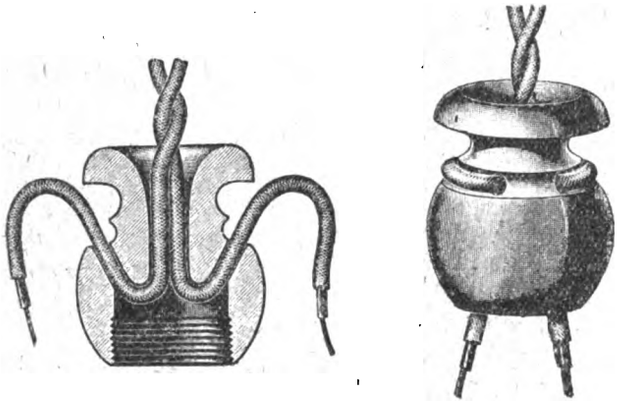
The company have also provided for a forgetful owner who may omit to set his alarm before leaving the premises. Contacts are fitted to the ordinary door locks of the building, so that any attempt to lock the doors without having set the alarm and pressed the push results in the outside alarm bell ringing furiously. In addition, they can also provide an indicator for police purposes, which shows, upon a second push being pressed, that the installation is in the set position.

The detection devices adopted by the company are very effective. The principal of these is the system of concealed floor contacts, which are laid over large patches of floor surfaces in entrances, lobbies, staircases, and around safes and other vulnerable positions. There are also special devices for protecting windows and skylights, doors and other possible entrances. In some of these, the use of nickel-steel wire has been adopted to overcome the objection due to variation in expansion and contraction by temperature changes. All these devices are placed so that it is impossible to avoid them. The control gears are built up in cast-iron protecting boxes, and the alarm bells in weatherproof enclosed cases with invisible hammers. The system can be installed by electrical contractors.

The "Marlor" Cord Grip.

Messrs. Sturge & Baker, of Premier Works, Sheepcote Street, Birmingham, are placing on the market a new pattern of cord-grip—the invention of Mr. Sturge and Mr. Marlor, of the Manchester Electricity Department—which is intended to overcome the drawbacks of the usual pattern of wedge-grip having a sharp upper edge over which the flexible, owing to continual bending, usually comes to grief.

The "Marlor" device consists of a specially-shaped Litholite or hardwood cap, which is tapped to screw on to the top of the ordinary lampholder in place of the usual collar for securing the



Figs. 2 and 3.—Sectional and Exterior Views of "Marlor" Cord Grip.

wood cone; the flexible is threaded through it, and its rounded entrance offers no sharp edge for acute bending of the flex. The cord is not "gripped," but locked, by being threaded through, that no strain comes on the terminals.

The firm are also introducing a flex. preserver, consisting of a hood to slip over lampholders wired in the ordinary way, the bell-mouthed entrance saving the flexible from acute bending, as in the case of the previously-mentioned device.

A Parsons Electric Generating Set.

The electric generating set, comprised of internal combustion engine and dynamo on one bedplate is now a more or less commonplace plant, but the illustration, fig. 4, shows that the convenience of such plant can be very greatly extended by a careful design incorporating all the accessories of such a set, making the whole plant, therefore, absolutely self-contained, and also portable. The Parsons Motor Co., Ltd., Southampton, have recently been supplying an exceedingly large number of these plants, both of this size and also very much larger.

The plant in question is of 12 kw. output, and the paraffin engine is of the maker's regular type, with all the well-known features of pump lubrication and oil cooler, high-speed sensitive governor, variable timed magneto ignition, forced water circulation, oil-pressure gauge, oil-level gauge, and we may also mention that the pistons and connecting rods are removable through the crank chamber doors, without disconnecting any of the cylinders or pipes.

The dynamo, in this case is somewhat hidden by the instrument board, and the latter comprises ammeter and voltmeter, D.P. main switch, two single-pole main cut-outs, voltmeter switch, six double-pole distributing switches, 12 single-pole cut-outs, and a shunt regulator. These are mounted on a superstructure formed of channel iron. The radiator has removable top and bottom headers of cast aluminium, so that all tubes can be got at if necessary. The air blast through this radiator is furnished by a suitable fan, the efficiency of which is greatly increased by its operating in a casing as shown. The fan is driven by a flat belt running over pulleys of useful diameter.

The fuel tank will be seen mounted at the top of the frames; in some recent plants it has been placed a little lower. The necessity of preventing any overflow from the radiator reaching the dynamo has not been lost sight of, and not only is the overflow pipe carried well clear, but a tray is fitted beneath in order to catch any slight leakage that may occur in time. As a matter of

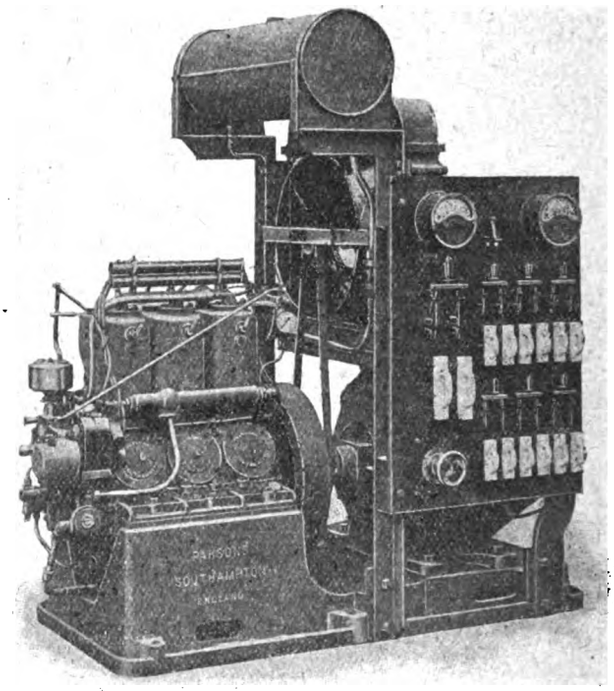


Fig. 4.—Parsons 12-kw. Self-Contained Generating Set.

fact, the radiator is not actually over the dynamo at all, but between it and the engine.

The engine itself is fitted with a large and heavy fly-wheel, and the governing is exceedingly good, usually within 2 per cent. either way.

The speed of the engine and dynamo is moderate, viz., 900 R.P.M.

LEGAL.

Soldier Electrician's Claim against his Employers.

In the King's Bench Division, on March 23rd, before Mr. Justice Bray and a special jury, an action was brought by Mr. Thos. Wm. Geo. Budgett, head foreman in the electrical department of the Stratford Co-operative and Industrial Society, Ltd., and now serving in the Army Service Corps, against the Society, claiming a declaration that he is entitled to recover, during the period that he is with the Forces, half wages from the Society. The defendants denied any contractual obligation.

Mr. Powell, K.C., and Mr. Preedy were counsel for the plaintiff, and the defendants were represented by Mr. Rose Innes, K.C., and Mr. Morle.

Mr. Powell, K.C., in opening the case, said that soon after the outbreak of the war the defendant Society, like a good many other concerns, decided to do what they could to induce men to join the Army, and the directors passed a resolution that they would pay wages as follows to men enlisting:—Half wages to married men, half wages to single men with dependents, and 5s. a week to single men without dependents, it being provided that the money should be invested in the Society's capital. Notices were posted up to this effect, and the plaintiff, with numerous other servants of the Society, enlisted. The plaintiff was married, with three children; and he was the head of the electrical department, and was formerly a foreman electrician in the service of the Central London Railway. In February, 1915, Mr. Budgett told Mr. Banks, the Secretary of the Society, that he thought of joining the Army, and Mr. G. Banks told the plaintiff that, of course, the notice applied to him as well as to the other employés, and a form of authority was written out for the plaintiff's wife to receive half wages. Mr. Banks gave the plaintiff an excellent character in the following terms:—"We understand that Mr. Budgett is anxious to join the Colours. He has been in our employment since September, 1906, and has in every way given satisfaction. He is honourable, honest and trustworthy, and one to be trusted with any position of responsibility." The plaintiff joined the Mechanical Transport Section of the Army Service Corps. There was also a reference from Mr. W. H. Coxcroft, the works manager, to the effect:—"Mr. T. W. Budgett started here in September, 1906, as foreman

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over the electrical department. He has had charge of the electrical installation from the commencement, and has carried out many complete equipments . . . &c." Some time after the plaintiff had gone, his wife received a letter asking if her husband had joined up, and she kept it until Mr. Budgett came home, and then he replied giving the facts, and said he felt much hurt at the inquiry that the Society had made. Somebody on the Committee (said Counsel) must have got the idea that he was likely to do better, and the Committee wrote to him asking what his pay was, and what allowance he was making to his wife. He replied that he enlisted at 6s. per day, and was paying his wife 4s. 6d. per day. On May 26th the Committee met, and the result was that Mr. Banks wrote to the plaintiff to say that the Committee had decided not to grant the war allowance in his case, as by joining the Colours he had benefited his position as compared with the post held with the Society. The plaintiff appealed for reconsideration of his case, saying that his wages before the war were £2 10s. a week, and he enlisted at 6s. per day, so that he was no better off, and if they could not pay him half wages, he asked them to make up the difference. The Committee declined to depart from their previous decision.

Mr. Powell, concluding his address to the jury, suggested that some firms had arranged to pay men joining the Forces half wages, believing the war would have been over soon, but as it had lasted longer than they thought, they found they were having to pay more than they expected. If there had been any legal obligation on the plaintiff to join the Army, the notice of the Society would not be a promise that could be enforced, but there was no legal obligation at the time at all, and the Act relative to single men had not then been passed. Counsel also suggested that the Society was benfited by men joining the Army, having regard to the possibility of a raid on our coasts.

Mr. Rose Innes, on behalf of the defendants, said that the notices were undoubtedly posted up, but in order to make the notices a contract, there must be acquiescence, and the plaintiff was distinctly told that the notice would not apply to his case, but only to the cases of men who suffered financial loss by joining the Army.

The evidence of the Plaintiff, who was at Bulford Camp, was read in Court, and in this he deposed that he told Mr. Banks he wished the money to be paid to his wife, and Mr. Banks promised that this should be done.

Cross-examined: The separation allowance to his wife was £1 3s. 6d. per week, and he allowed her 4s. 6d. per day out of his pay. Mr. Banks never told him that he was not entitled to half wages, and he (Mr. Budgett) suggested that the action of the Society was the outcome of petty spite by some of the members.

Mr. Rose Innes, K.C., said that the object of the notice exhibited by the defendants was to secure that if a man joined the Army he should not be out of pocket by so doing. The authority given by Mr. Banks to the plaintiff's wife was to draw dividends upon a share in the Society, and not to draw half wages. In fact, half wages for six weeks were paid on an authority in the plaintiff's handwriting, but this was a mistake.

Mr. Geo. Leonard Banks, secretary of the defendant Society, said that the plaintiff told him that he proposed to join the Army Service Corps (Mechanical Transport), and witness told him that if he did so he would get more than a soldier's pay. Mr. Budgett said he would get 6s. a day, and witness said, "If that is so, you will not be entitled to the half wages allowance provided by the Committee," and plaintiff answered, "I quite understand that." The plaintiff also attended a meeting of the Committee, at which the chairman told him that he was not entitled to half-pay.

Cross-examined: Witness said the war allowance had not been granted to men joining since May, 1915, because of the prohibitive cost.

The jury eventually found that the plaintiff was not informed before he enlisted that he would not receive the allowance mentioned in the defendants' notice, and upon this the plaintiff was given judgment, with costs.

Mr. Justice Bray said that the only legal question in the case was whether this was a good contract between the plaintiff and the defendants, and he was satisfied that it was a good contract, and that there was ample consideration for the money. He gave the plaintiff the declaration that he claimed, to the effect that the plaintiff was entitled to £1 2s. 6d. per week, and judgment would be entered for him for what was due to date, and the judgment would be with costs.

British Thomson Houston Co., Ltd., *v.* Stonebridge Electrical Co., Ltd.

Mr. Justice Younger, in the Chancery Division, delivered his reserved judgment on the summons taken out by the plaintiffs in this action for further and better particulars of the defendants' particulars of objection to the plaintiffs' patent.

His Lordship said that the plaintiffs asked that the defendants should identify what matters they said were common knowledge and what were public knowledge. In his opinion, the plaintiffs were entitled to the particulars they asked for. The defendants had very ingeniously for the first time endeavoured to set up a pleading describing as common knowledge that which really was public knowledge. It had been laid down that particulars should not be relied upon as to what was common knowledge of a particular art or science, and for the obvious reason that it was in the interest of the public that both time and expense should not be unduly extended. In his opinion, however, where a defendant pleaded public knowledge, if particulars were not given a burden would be laid upon the plaintiff, and he would come into Court unprepared to meet the case that was made against him. He thought, therefore, the plaintiffs were entitled to the order that they asked for, and the costs of the summons would be theirs in any event.

Mr. Frost asked for leave to appeal if necessary, which was granted.

Farrell *v.* Bloxam.

At the County Antrim Assizes, on March 22nd, before Mr. Justice Pim and a special jury, the action in which Alexandar Bryce Farrell claimed £1,000 damages from Thomas W. Bloxam, city electrical engineer, Belfast, for alleged libel and slander, came on for hearing. The details are fully reported in the *Irish News and Belfast Morning News*, from which we extract the following particulars:—

In his statement of claim the plaintiff set forth that at the date complained of he was resident superintendent of the central electrical station, East Bridge Street, and had been 15 years in the service of the Belfast Corporation. He alleged that the defendant falsely and maliciously spoke of and concerning him in respect of his office as superintendent on or about October 29th, 1915, to Mr. John Tyrrell and Mr. James A. Duff, at the central electrical station, the following words:—

> Main feeder cables in the tunnel in sub-way were supported and clamped in a manner likely to destroy the cable, and be a danger of fire in the station, and Farrell was responsible for this. Cheap cotton "flex" was used where cables should have been used as a "lead" for current to a lamp at a small auxiliary engine, and Farrell was responsible for this. Farrell is irreconcilable, and causing disorganisation in the station, and is a danger to the station, so much so that I would prefer to carry on the next two months without anyone rather than with Farrell.

The plaintiff alleged that the words meant that he had been guilty of gross misconduct and negligence in the discharge of his official duties, and was incompetent and unfit to be superintendent of the electrical station, and was deliberately interfering with the harmonious working of the station.

The defendant, in his defence, denied that he spoke or published the words complained of; and he said that in their ordinary and natural signification they were not capable of the defamatory meaning alleged; and that they were spoken and published on a privileged occasion, *bonâ fide* and honestly believing them to be true, and without malice.

Mr. J. Chambers, K.C., opened the case for the plaintiff. He said that he thought he would be able to show by the evidence that the allegations were not only wholly baseless, but that they were baseless to the defendant's knowledge, and were made with the ulterior motive of injuring the plaintiff. Both parties entered the employment of the Corporation in 1900, and Mr. Bloxam was appointed engineer-in-chief in 1907, and the plaintiff became his second in command. The defendant recognised plaintiff's capacity and ability, for on his recommendation plaintiff was appointed resident superintendent engineer in 1907. In 1912 defendant wrote a testimonial in plaintiff's favour when he was applying for the position of resident electrical engineer at Tunbridge Wells. At the instance of a member of the Belfast Corporation, an inquiry into the working of the city electrical undertaking was instituted in January, 1914. Plaintiff had nothing whatever to do with the bringing about of that inquiry, and did not know he was going to be examined as a witness. When the inquiry opened, Councillor Curley, at whose instigation mainly the inquiry had been instituted, made this remark: "In the hurry I omitted to mention that we should make it a *sine qua non* that any person brought here as a witness to give evidence must be protected from persecution or dismissal if he tells the truth." Mr. Bloxam then said: "If nobody is to be penalised after this inquiry is over I think I am justified in asking for the same to apply to the manager. If he is to bear the result of his action, others must be prepared to do the same." After further observations had passed, Mr. Bloxam said: "If any members of my staff are defaulters in respect to the support of the manager, those men shall be summarily dealt with." The jury would be astounded to hear that practically every man who gave evidence at all reflecting on the management of Mr. Bloxam ceased to be employed in the electricity works within a year from the time of the inquiry. Farrell was the last to go, and if he (counsel) had to establish malice he would willingly accept the onus. Mr. Farrell spoke the truth, as he had sworn to do. His evidence formed rather a grave indictment of the management of the electricity station. From that time his life was made a burden to him in the works, and everything possible was done to make it hot for him. Continuing, counsel said Mr. Bloxam did all in his power to goad plaintiff into resigning his position, but without success. In June, 1915, a joint Sub-Committee was appointed, and they recommended that there was no use in proceeding further with the reorganisation of the electricity department unless Mr. Bloxam was asked to resign. When the Sub-Committee's report came before the Corporation that body, by a majority of one, ignored the recommendation.

On July 15th a turbo-dynamo burst and it was a mercy that the whole place was not blown up. On August 22nd a serious fire broke out at the station, and Mr. Bloxam tried to make plaintiff responsible for it, but a Board of Trade inquiry showed that it was due to an escape of gas from coal—a sort of spontaneous combustion that had been going on for some time, and that Mr. Farrell was in no way responsible for it. On October 29th defendant sent a letter to plaintiff, in which he said he reluctantly came to the conclusion that it would not be in the interests of the department to retain Farrell's services, and he asked him to vacate his position on the 6th prox. That letter went before the Electricity Committee on November 3rd, and, without making the slightest inquiry from Farrell, without communicating with him in any way, they confirmed the dismissal. The slanders complained of

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were alleged to have been spoken immediately after the plaintiff had received his notice of dismissal.

Plaintiff was called and gave evidence in the course of which he said that his evidence at the inquiry was unfavourable to the management. The chairman of the Committee asked him to prepare a report with reference to extensions to the power house, and as to the adequacy of the transforming plant at the sub-station. He prepared it. He asked a firm of engineers for some particulars, and when their reply came into Mr. Bloxam's hands, he said to witness, "What have the reports of the Committee got to do with you? You attend to your own work." Later Mr. Bloxam reported him for insubordination. At the Committee meeting the chairman told witness it was none of his business to get out reports; it was Bloxam's duty. Subsequently he apologised to Mr. Bloxam. After the committee meeting, Mr. Bloxam sent for him and told him not to leave the station, night or day. Witness could not get out for luncheon for three days, but after that the old regulations prevailed. Evidence was then given by the plaintiff as to the defendant directing him to remove the contents of his workshop from the residence as soon as possible. The lathe was a small thing, and had been in the shop for seven years to the knowledge of Mr. Bloxam. It in no way interfered with the working of the place. Witness denied that the bursting of the turbine dynamo had anything to do with the working of the electrical side of the establishment for which he was responsible. The fire was due to spontaneous combustion in the coal bunker. In both cases Mr. Bloxam endeavoured to put the blame on witness and his department.

On March 23rd plaintiff continued his evidence. Mr. J. A. Duff, a member of the City Council, and Alderman J. Tyrrell, who was chairman of the tramways and electricity at the time in question gave evidence, and at the conclusion of the plaintiff's case, Mr. Henry, K.C., for the defendant, asked his Lordship to rule that the alleged slander was spoken on a privileged occasion, and also that there was no evidence of actual malice. His Lordship ruled that the words were spoken on a privileged occasion, but refused to rule on the question of malice. Mr. Henry then opened the case for the defence, and on the following day Mr. Bloxam gave evidence. The judge having put a number of questions to defendant, the Court rose for the day.

In summing up on the 25th inst., the judge said that the plaintiff asked the jury to say that his reputation had been maliciously attacked, and that he must suffer bitterly if he did not put himself right with the public. The reputation of the defendant was also at stake, and the Belfast Corporation was also involved. The big question of the case was: did Mr. Bloxam make his report about Mr. Farrell to Alderman Tyrell and Councillor Duff merely to benefit the electrical department, or was there any other motive in his mind? Before the time of the inquiry there did not seem to be anything strikingly unpleasant in the relations of the parties. Plaintiff, who gave a good deal of evidence at the inquiry, was a man who evidently thought a good deal of himself. He had been asked to make a report, and for that purpose had applied to Messrs. Babcock & Wilcox. The reply went to Mr. Bloxam, who asked Mr. Farrell for an explanation, and according to plaintiff Mr. Bloxam shook his fist at him. Proceeding, his Lordship said the gravamen of the charge was the accusation by Bloxam to Alderman Tyrell and Councillor Duff that Farrell was a danger to the station.

The questions submitted to the jury, with their answers, were as follows:—

1. Did the defendant speak the words complained of?—Yes.
2. Did he speak them honestly believing the same to be true?—No.
3. Do the said words mean that the plaintiff had been guilty of gross misconduct and negligence in the discharge of his official duties, and was incompetent and unfit to be superintendent of the electrical station, and was deliberately interfering with the harmonious working of the said Belfast electrical station?—Yes.
4. Were the words spoken maliciously?—Yes.
5. What damages, if any, should the plaintiff be paid?—£500.

A verdict for the plaintiff was entered accordingly.

Freeman v. Edwards Bros.

In the King's Bench Division, on Monday (March 27th), Mr. Justice Shearman heard the settlement of this action, in which the plaintiff claimed damages for alleged slander. Mr. Harold Simmons, for the plaintiff, said that the action had been settled. Plaintiff answered an advertisement and saw a man named Davis, who offered him a situation provided he deposited £25. A business in electrical fittings was opened at Kentish Town, and Mr. Freeman was appointed manager at £2 5s. a week. Davis was an agent for the defendants for the supply of electrical appliances, and the business, as far as counsel knew, was really carried on by means of deposits from other people. Davis gave orders to the defendants in the name of the plaintiff, and when plaintiff's salary became in arrears Davis persuaded him to purchase the business, most of the purchase price being the arrears of salary and plaintiff's deposit. In April, 1915, the defendants wrote to Mr. Freeman for payment of the debt for appliances ordered by Davis, which plaintiff, naturally, repudiated, and correspondence ensued in which it was suggested that the plaintiff had improperly obtained the goods. However, since then they had realised the position in which the plaintiff was when the goods were ordered, and they now desired to withdraw all imputations against the plaintiff. The record would be withdrawn, each party to pay their own costs.

Counsel for the defendants agreed to the settlement, remarking that when they wrote the letters they believed what they said was correct. Since then they had realised that they had been wrong.

His Lordship allowed the settlement to be recorded, and said he thought the difficulty arose through a misapprehension.

German Telephone Co.'s Contracts Dissolved.

In the King's Bench Division, on Monday, Mr. Justice Bray heard an action brought by the Lancashire and Yorkshire Private Telephone Co., Ltd., who carry on business at Queen Street, Albert Square, Manchester, against the Telephon and Telegraphenbau Gesellschaft G.m.b.H. and Mr. H. Fuld, of Frankfort-on-Main, Germany, asking that the Court should grant declarations to the effect that certain agreements between the plaintiffs and the defendants were determined by the outbreak of the war.

For the plaintiffs Mr. Disturnal, K.C., and Mr. Green appeared, and the defendants did not enter an appearance.

Mr. Green, in opening the case, said that the defendants were manufacturers of an apparatus for telephonic communication in works and offices, and before the war broke out they secured the formation in this country of companies to acquire from them, and let out on hire in different parts of the United Kingdom, the apparatus and accessories. The plaintiff company was a body incorporated for the installation of private telephones, and in 1910 it entered into agreements with the defendants to deal with the defendants' apparatus within a specified area for a period of 35 years, and to pay the defendants a royalty. In consequence of the war it was altogether impossible to carry out the contracts, and the plaintiff company asked for a declaration that the contracts had been determined by the war.

Mr. Fredk. Thos. Jackson, managing director of the plaintiff company, deposed that he had disclosed to the Public Trustee Mr. Fuld's interest in the company, and the amount due to the defendant company for instruments supplied. The plaintiff company had hired out a number of instruments, and, in order to keep them in working order, it was necessary to have spare parts. It was impossible to get these from Germany, and, therefore, in order to carry on their business, the plaintiff company must have power to enter into contracts with firms in England.

Mr. Justice Bray: Is that one of the things that this agreement prohibits you from doing?

The Witness: Yes.

Mr. Justice Bray made the declarations asked for.

There was a second case, in which the I.T.C., Ltd., proceeded against the Telephon and Telegraphenbau Gesellschaft G.m.b.H. and Mr. Hugo Mayer, asking for declarations of a similar character. The case had relation to similar agreements, and in this instance it was intimated that the area covered by the agreement was London and practically the whole of the South of England.

His Lordship made similar declarations.

A third case was brought by the New System Private Telephone Co., Ltd., against the Deutsch Privat Telephon Gesellschaft, and similar declarations were also made.

THE PRODUCTION OF CONSTANT HIGH POTENTIAL WITH MODERATE POWER OUTPUT.

An article on the above subject, by Mr. A. W. Hull, appeared in a recent issue of the *General Electric Review*, of which the following is an abstract:—

Up to the present time only two methods have been available for the production of constant high potential, viz., the electrostatic induction machine, and the combination of a large number of low-voltage D.C. generators in series.

The electrostatic induction machine was invented simultaneously by Holtz and Toepler in 1865. Machines have been built, having 20 movable and 20 stationary disks, which can generate as much as 80 milliamperes. But surface leakage becomes so great at about 50,000 volts that it is usually impossible to exceed this voltage.

Some recent machines with special composition plates will give 4 milliamperes at voltages of nearly 100,000, and can deliver a little current even at 150,000 volts. The chief limitation of such machines, besides their small power, is that the voltage is not constant, but builds up indefinitely until limited by spark-over or brush discharge.

The combination of D.C. generators in series is used in a few power installations where long-distance or underground transmission is necessary, and its chief disadvantage is that the generators must be mounted on insulated beds and driven with insulating belts or shafts.

Recent developments in the field of electric conduction through vacuum, and especially the development and extensive use of high power X-ray tubes, have created a considerable demand for a source of power that will furnish from 1 to 50 KW. at voltages between 10,000 and 200,000. The apparatus to be described was not designed to meet this general demand, but as an accessory to a definite investigation on X-ray spectra. It has, however, proved so satisfactory as

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to recommend itself for quite general use where constant high voltage of a few kilowatts' power is needed.

The method used was the rectification by kenotrons of high-tension alternating current, this rectified current being used to feed a high-voltage condenser of such capacity that

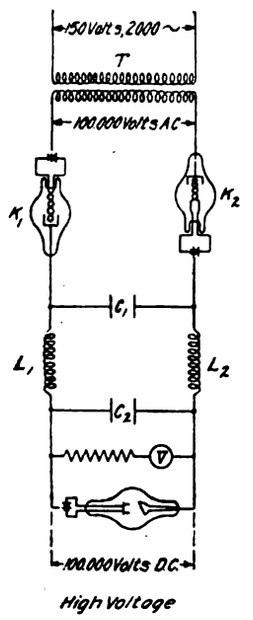


Fig. 1.

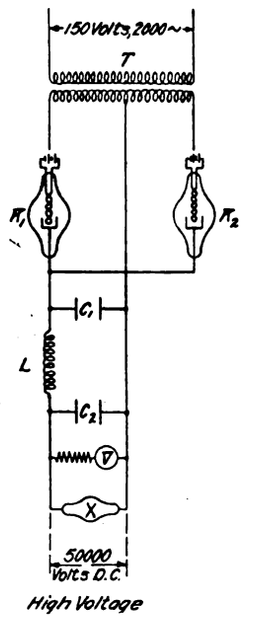


Fig. 2.

Diagrams of Connections for the Production of High-voltage Direct Current.

it can supply the desired current during the part of each cycle when it is receiving nothing without having its voltage drop more than a small specified amount. In the present case the capacity used was much smaller than that necessary to keep the voltage fluctuations within the desired range, and these fluctuations, which were about 25 per cent. for full load, were damped out by the use of another small condenser of the same size and a small choking coil. The arrangement is shown in fig. 1. Single-phase alternating current of 2,000 cycles at 150 volts is stepped up to the desired voltage by a transformer T, rectified by kenotrons K_1 and K_2 and smoothed out by the condensers C_1 and C_2 (0.001 microfarad capacity each) and inductance L_1 and L_2 (about 200 henrys each). The voltage is measured by an ordinary voltmeter V in series with a 10-megohm resistance.

By this means it was possible to supply 5 KW. at any voltage between 10,000 and 100,000 volts with a voltage fluctuation of less than 1 per cent. This output could, if desired, be more than quadrupled by the use of 4 kenotrons instead of 2, and still further increased by the use of three-phase alternating current.

The generator is of the "dynamotor" type, designed for a 10-KW. single-phase 2,000-cycle output, and operates on a 440-volt, three-phase, 60-cycle line. It can be built equally well to operate on any voltage, A.C. or D.C.

The transformer is built for 75 KV. R.M.S. It has an air gap in the magnetic circuit, and when untuned takes 75 amperes magnetising current. By the use of 50 microfarads capacity across the primary this is reduced to about 3 amperes.

This use of an open circuit transformer makes it possible to use only one-half of each wave, as in the arrangement shown in fig. 1, without appreciably distorting the voltage wave, and it gives a very convenient means of voltage control, viz., by varying the capacity it is possible to vary the voltage over the entire range from 40,000 to 100,000 volts. This is the method of control used.

The kenotron has already been described in the Electrical Review.* It consists of a hot-filament cathode and a metal anode, generally tungsten or molybdenum, which is so thoroughly freed from gas by intense heating during evacuation that no gas phenomena ever appear, even at 100,000 volts. Under these conditions the conductivity of the tube is entirely unidirectional, the current being carried only by the electrons emitted by the hot filament.

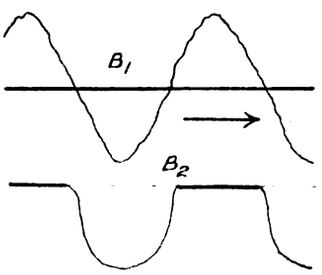


Fig. 5.—Upper Curve: A.C. Voltage (Base Line B_1). Lower Curve: Rectified Current (Base Line B_2).

Figs. 3 and 4 show the types of kenotron, and fig. 5 shows the completeness of the rectification. On the positive half of the cycle the current and voltage follow the A.C. wave, the voltage drop in the kenotron being only 200 or 300 volts. On the negative half the current is zero, and the voltage drop in the kenotron is the full voltage of the A.C. wave.

It is evident from the manner of operation of the kenotron that it has two advantages over other types of high-voltage rectifier, which make it especially adapted to the production of constant potential:—

1. It allows current to flow in only one direction, whatever the voltage may be. Hence, if used to charge a condenser it will feed current into the condenser whenever the A.C. voltage is higher than that of the condenser, but will never take back anything it has given. A mechanical rectifier, on the other hand, is just as likely to discharge the condenser as to charge it, unless the timing is exactly right.

Fig. 3.

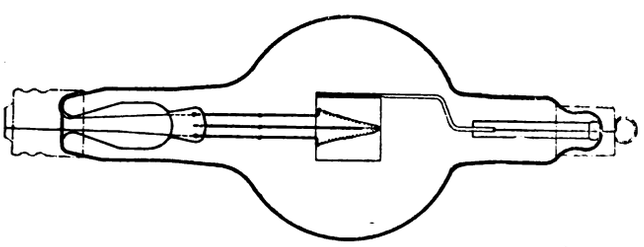
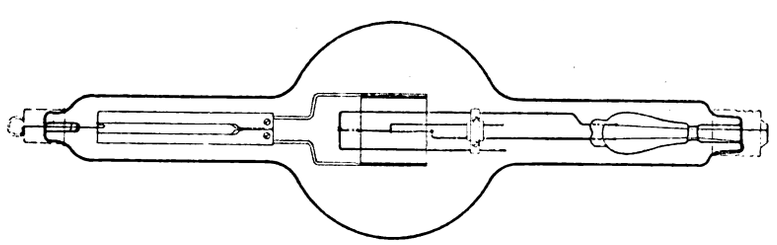


Fig. 4.



Figs. 3 & 4.—Standard Kenotrons for Rectifying 20,000-volt and 100,000-volt Alternating Current.

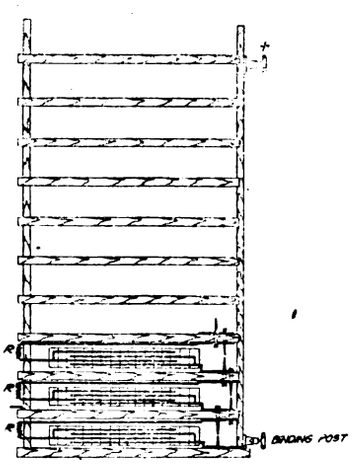


Fig. 6.—Diagram showing Arrangement of Condensers.

2. Being free from all lag, such as is inherent in a gas rectifier, and having no moving parts, it operates equally well at all frequencies. This is very important, as it allows the use of a high-frequency generator which greatly reduces the amount of capacity that has to be used. For example, in order to obtain from 60 cycles the same power with the same constancy as that given by the 2,000-cycle outfit, viz., 5 KW. with ½ per cent. fluctuation, it would be necessary to use a capacity of 0.35 microfarad, nearly 200 times the amount necessary for 2,000 cycles, and this would cost, at present prices, $35,000.

Since no satisfactory high-voltage condensers are on the market, it was necessary to use a number of low-voltage condensers in series. When series condensers are used on A.C. there is no tendency for the voltage to become unequally divided between them. With D.C., on the other hand, unless the leakage over each condenser is exactly the same, the tendency would be for the voltage to become more and more unequally divided between the condensers until, finally, one would break down, the process being repeated until all broke down.

To avoid this, each condenser was provided with a corona gap, such that leakage over it would be larger compared with

* "The Kenotron Rectifier"; Elec. Rev., May 7th, 1915, p. 644.

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all other leakage at the rated voltage. The arrangement is shown in fig. 6. The condensers are of paraffin paper, rated at 10,000 volts each, ten in series. The gaps are standard sewing needles spaced ¾ in. between points, and in order to prevent injury to the gaps in case of spark over, each gap is provided with a small resistance R in series with it. The best evidence of the effectiveness of this arrangement is that it has been in operation eight hours a day for eight months, often at 10 per cent. above rated voltage, without an accident. At 110,000 volts, *i.e.*, 11,000 across each condenser, spark over across the gaps occurs quite frequently, but is mild and harmless. At 100,000 volts, for which the gaps are set, it does not occur.

As regards inductance, the high-tension winding of a 6,600/110-volt, 200-watt instrument transformer has proved quite satisfactory as a high impedance. It is difficult to calculate or to measure the effective impedance for a given frequency under operating conditions, because the actual current is an A.C., or, rather, a series of A.C. components, superimposed upon a D.C., and the effective permeability of the iron depends very much upon the degree of its saturation by the D.C. component. The best measurements obtainable indicate that the inductance varies from 1,000 to 200 henrys. The 10-megohm resistance consists of 1,000 voltmeter spools, 10,000 ohms each, in series. They are mounted 1 in. apart on lattices of ½ in. by ½ in. hard wood, 100 to each lattice, and the lattices are spaced 3 in. apart vertically above each other. The whole unit is immersed in oil, but this would not be necessary where more space is available.

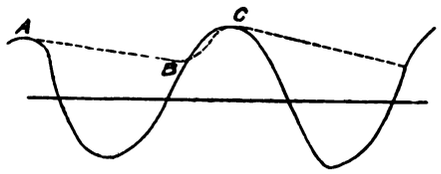

Fig. 7.—Full Line: 2,000-cycle A.C. Voltage. Dotted Line: Rectified Voltage at Terminals of Condenser C_1 (fig. 1).

The kenotron is a device of low resistance, 1,000 ohms, for current in one direction and infinite resistance for current in the other direction, and is entirely free from the lag and "breakdown" necessary to the starting of gas rectifiers.

The condenser C is a simple electric reservoir which absorbs energy from the transformer, through the kenotrons, during a small part of each cycle, and delivers it to the circuit at a nearly constant rate during the remainder. Its operation can best be understood from fig. 7, where the full curve represents the voltage at the transformer terminals, and the dotted curve that at the terminals of C_1. At the point A, on the peak of the A.C. wave, the condenser is charged to the full potential of the transformer. From this time on, for nearly a whole cycle, it receives nothing from the transformer, and its potential therefore falls at a given rate. At the point B the transformer voltage becomes higher than that of C, and current again begins to flow through the kenotrons into C_1, charging it to the potential of the transformer at the point C, where the process of discharge begins anew. In practical cases the current is nearly constant.

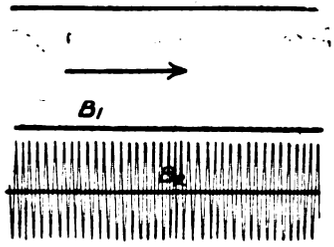

Fig. 8.

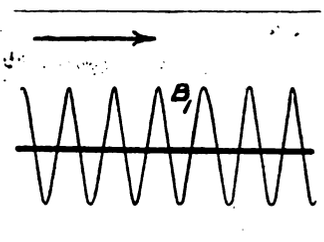

Fig. 9.

Fig. 8.—Upper Curve: Constant Potential 50,000 volts at Terminals of C_2 (Base Line B_1).
Lower Curve: 2,000-cycle Primary Voltage (Base Line B_2).

Fig. 9.—Upper Curve: Constant Potential 50,000 volts (Base Line B_1).
Lower Curve: 2,000-cycle Primary Voltage (Base Line B_1).

In a given case, if the total voltage is 100,000, in order to reduce the fluctuation to 1 per cent., or 1,000 volts, one would have to use 0.025 microfarad capacity, if the inductances L_1 and L_2 (fig. 1) were omitted. The actual value $C_1 + C_2$ that is needed *with* the inductance is only 0.002 microfarad, which means a very great saving of expense, and demonstrates the value of using inductance.

The maximum amplitude of the voltage fluctuation across C_1 is 25 per cent. at 100,000 volts and 50 milliamperes, and if we take this as the amplitude of the 2,000-cycle component, then the amplitude of this component at the terminals of C_2 would be 1/64 of 25 per cent, or less than ½ per cent.

In like manner, the ratio of the amplitude of the second harmonic, the 4,000-cycle component at the terminals of C_1 and C_2 respectively comes out to be 1/256; it is evident that the higher harmonics need not be considered at all.

A word should be said about the effect of inductance without capacity in the position C_2. It is often carelessly assumed that inductance in a line will of itself absorb current fluctuations. It is evident from the above reasoning that this is true only when the load itself has a low impedance. For small loads this is by no means the case, and for an X-ray tube of the Coolidge type, in which the current is constant and independent of voltage, the impedance is infinite for all loads and all frequencies. Hence, in this case, the use of inductances L_1 and L_2 without capacity, or some other low impedance, in the position C_2 would be entirely ineffectual.

The actual capacity used was $C_1 = C_2 = 0.001$, nearly twice the amount necessary to reduce the fluctuations to 1 per cent., and the oscillograms show that the fluctuations were actually about ½ per cent.

If 60-cycle current were used instead of 2,000-cycle, the capacity necessary to keep the fluctuations to ½ per cent would be, $C = 0.35$ microfarad; $C_1 = 0.19$ microfarad; $C_2 = 0.16$ microfarad.

The constancy of the voltage obtained under different conditions is shown by the oscillograms, which were taken with a water resistance load in series with the oscillograph coil across the line, the end of the line adjacent to the oscillograph being earthed. For voltages above 50,000, where the end of the line could not be earthed, two water tubes of nearly equal resistance were used and the middle point between them was grounded. Oscillograms were then taken on both sides of the ground, in order to detect any asymmetry in the form of a current to earth.

Fig. 8 shows the voltage obtained with the apparatus arranged as in fig. 1, with a load of 50 milliamperes at 50,000 volts. The fluctuations scarcely show in the reproduction, but on the negative they measure about ½ per cent. Fig. 9 shows the results of using the two kenotrons in parallel, as in fig. 2, thus rectifying both half waves of each cycle. The base line for the D.C. potential was made coincident with that of the primary wave. The film was run at high speed so as to resolve the 4,000-cycle or higher frequency fluctuations if any were present, but no fluctuations whatever can be seen, even on the original negative. This increased smoothness produced by rectifying both halves of the cycle, which means doubling the frequency of the lowest A.C. component, was anticipated.

In the oscillograms the primary A.C. wave shows no trace of distortion, even at maximum load, which is a strong advantage of the open magnetic circuit type of transformer.

By the use of three-phase 2,000-cycle current and six kenotrons it would be possible with present apparatus to furnish 100 KW. at 100 KV. with the same constancy as that of the 5-KW. installation described above, and there is every reason to believe that this can be increased to 1,000 KW. in the near future.

WAR ITEMS.

Lighting Prosecutions.—Mr. S. Pauls, the borough electrical engineer of Middleton (Lancs.), was summoned at the local police court last week for a breach of the lighting restriction regulations. It was stated that shortly after 10 p.m. on March 6th, a constable saw light coming from the electricity works right into the roadway. On proceeding inside the works he saw nine electric lights on at full. There was some brown paper on them, but they were not effectively shaded. When the attention of the defendant was drawn to the matter, he told the officer that they had done their best, and that they had expected blinds for the windows that day, but had been unable to get them. A fine of 7s. was imposed.

At Eccles last week, Ebenezer Beal, electrician, of Wellington Road, was summoned for a breach of the lighting restriction order. He stated that the only light in his shop was in the centre, and after an early warning had been given by the police another constable had told him it was now all right. He complained that he need not have been brought before the court if the present officer had informed him that further reduction of the intensity or reflection was necessary. A fine of 5s. 6d. was imposed.

The "City Press" states that, at the Mansion House, for contravening the Lighting Order by means of a business advertisement lighted by electricity, Charles Brownhill, 84, St. Paul's Churchyard, was fined 40s.

Companies to be Wound Up.—Further companies which are to be wound up under orders of the Board of Trade include the following:—

United Berlin and Frankfort India-Rubber Co., Ltd., 11a, Upper Thames Street, London, E.C., manufacturers of india-rubber goods, etc. Controller: P. D. Leake, 25, Abchurch Lane, London, E.C.

Ship Carbons, Ltd., 5, Chancery Lane, London, E.C., dealers in carbons for electric lamps. Controller: William Hancock, 90-91, Queen Street, London, E.C.

Schoen Bros., 29-30, Cock Lane, Snow Hill, London, E.C., agents for the supply of electrical goods. Controller: J. W. Barratt, 19a, Coleman Street, London, E.C.

Fischer Ball and Bearings Co., Carlton House, High Street, Birmingham, manufacturers of ball bearings. Controller: H. Heaton, 95, Colmore Row, Birmingham.

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Exemption Applications.—At the Southwark Tribunal, on Monday, Messrs. Burdette & Co., electrical and mechanical engineers, applied for the absolute exemption of three electrical improvers. The men had already been given ten groups. Mr. Ferne, on behalf of the applicants, pointed out that the Minister of Munitions had stated that men in this trade should be kept in the country. The men were all skilled or semi-skilled in electrical fitter's work. The applications were refused.

The Southport Tribunal, on March 24th, refused an appeal by the Southport Tramways Co. on behalf of a tram driver. It was urged that his was a certified occupation, and that conditional exemption had already been granted to a driver who had since joined the Royal Engineers.

At the Sheppey Rural Tribunal, Mr. W. E. Charlton, manager of the Sheerness and District Electric Power and Traction Co., applied for exemption for one inspector and three motor-'bus drivers. Short terms of exemption were given to two drivers, but it was decided to take no action with regard to the inspector and one of the married drivers, as the groups to which they belong have not yet been called up.

At the Hastings Tribunal an electrical and mechanical engineer claimed on the ground that he was in a starred trade. The application was refused, it being remarked that he must have been starred under a misconception.

At the Chester-le-Street Tribunal an electrical engineer, of Birtley, applied for exemption on the ground that he was in a certified occupation and that he was carrying out a contract at munition works. At the beginning of the war he had five men, but now only had a lad. Temporary exemption to April 30th was granted.

At the Sunderland Tribunal a man, aged 19, asked for temporary exemption to enable him to pass his final examination three months' hence as a wireless telegraphist. The case was adjourned for a week, so that it could be ascertained what instructions had been issued by the Government in regard to students of wireless telegraphy.

At the Gloucester Tribunal Mr. Corson supported claims for the exemption of four electrical workers employed by the Corporation. One of the claimants was exempt by reason of his occupation, another was considered to be indispensable and was given until September 30th. Of the other two, one, a storekeeper, was given until September 30th, and the other, a motorman, was given until April 15th.

At the Islington Tribunal a twenty-year-old student of electrical engineering, studying at a college in Kensington, asked for exemption. It was suggested that a young man with the applicant's knowledge should place his services at the disposal of the country, as other students had done. The application was refused, and the young man then said that he desired, under those circumstances, to be trained as an officer of the Royal Engineers.

Before the Dover Tribunal the Deputy Borough Engineer applied for W. J. Marley, a driver of one of the electrical scavenging vehicles. He was 20 years of age. Six months' exemption was allowed.

At the Barrow Tribunal William Drysdale, electrical engineer, made an application in respect of an electrical wireman. The employer stated that he had lost 17 men since war broke out, and if this one were taken, he would have to close his establishment. He was engaged on Government work. Temporary exemption was granted until July 1st.

At the Bexley Heath Tribunal Gilbert North, electrical and mechanical engineer, managing director of the Dickinson Electrical Manufacturing Co., and foreman mechanic applied for total exemption. Exemption was granted conditional on applicant continuing to act as foreman mechanic.

Electrical Wages at the Pulitoff Works.—In regard to the suspension of work at the Pulitoff works which, according to Reuter, was discussed by the Duma with closed doors, the Minister of War is reported as stating that on February 7th the men in the electrotechnical workshops demanded 70 per cent. increase in wages. This was refused as exorbitant, and a strike having broken out, the military authorities closed the works, but having come to an understanding with the electricians, they posted notices saying that men would again be taken on. Work was then resumed. Later, trouble occurred in other departments, and the works were closed on March 7th and placed under the Ministry of War, since when they have been idle.

Trading with the Enemy.—In the "London Gazette," for March 24th, there appear amended lists of persons and bodies of persons in the following countries with whom or which trading is prohibited. Many additional names are given, including a number of electrical firms:—Argentina and Uruguay, Brazil, Ecuador, Peru, all countries in Central and South America, Netherlands, Netherlands East Indies, Philippine Islands, Portugal, and Spain. These lists are sent to H.M. representatives in the several countries, and they will notify British Consular officers, to whom persons abroad may apply for information as to the names on the list.

Use of Electric Torches Forbidden.—Intimation has been given by the Beverley authorities that the indiscriminate sale of electric torches and flash lamps is now forbidden, and that no person may use them in the streets or open country between sunset and sunrise. The penalty for infringement of these restrictions is six months' imprisonment or a fine of £100.

After-the-War Trade.—At the annual meeting of the Birmingham Chamber of Commerce, to be held yesterday, the following resolution was to be proposed by the Mayor:—"That this general meeting of the Birmingham Chamber of Commerce strongly urges upon his Majesty's Government the necessity for their taking, in conjunction with the Governments of his Majesty's Dominions, definite and immediate steps for the purpose of fostering and safeguarding the commerce and industries and the natural and material resources of the Empire, and preventing any possibility of a return to pre-war conditions."

It is now announced that M. Bonar Law will attend the Allied Economic Conference as well as Mr. Runciman.

A Coming Problem.—A matter of some interest to municipal bodies, who decided to keep open the situations of employés who enlisted, was raised at a meeting of the Bury Tramways Committee last week. The tramways manager reported that men formerly employed in the tramways department were now being discharged from the Army, and some of them had been rendered unfit for their old duties. He was unable to find sufficient light work for those discharged, and asked for instructions on the matter. The question was remitted to the General Purposes Committee for consideration.

Haslingden and its Contractors.—When a resolution was introduced, at Haslingden Town Council, on March 23rd, asking that body to join in a resolution not to trade with enemy firms, Councillor Waddington said the Council had business with a well-known electrical firm whose capital was largely German at present. Under the new Act they had the privilege of clearing out the German element, however, and if they did that it would become purely an English firm, British controlled. If those steps were not taken, Haslingden Council ought to finish trading with them.

Tramways and Ministry of Munitions.—In response to the application of the Bolton Tramways Committee, the Ministry of Munitions has issued a certificate, declaring that the supply of tramway facilities is of importance for the purpose of carrying on munitions work. This means that the department and its employés are subject to the provisions of the Munitions of War Acts in regard to leaving work and strikes. A similar certificate has been issued to the South Lancashire Tramways Co.

After-the-War Electrical Manufacturing in Russia.—The A.E.G. works of Riga have been removed to Karkoff. Work has already been begun there in rented premises, where about 2,000 men are employed, all from Riga. When in full work the number will be raised to 4,500. The company is planning to introduce, after the war, the production on a large scale of small electrotechnical equipment, such as before the war came from abroad, chiefly Germany.

Exports to China.—The "London Gazette" (March 24th) contains a further list of persons and bodies to whom exports to China may be consigned.

Controlled Establishments.—The number of controlled establishments has been increased to 3,337.

BUSINESS NOTES.

Catalogues and Lists.—Pritchett & Gold and Electrical Power Storage Co., Ltd., 82, Victoria Street, London, S.W.—An expanding binder has been prepared containing a number of recently issued pamphlets giving full information respecting the company's storage batteries for lighting and power. B 10 deals with the use of storage batteries in central stations and factories; B 11 gives notes on the capacity and efficiency of storage batteries; B 12 gives a specification of cells, stands and fittings for batteries for lighting and power installations; B 13 is devoted to accumulator accessories; B 14 relates to accumulators in glass boxes; and B 15 to accumulators in wood boxes. Copies of these publications can be obtained on application.

Messrs. Pooley & Austin, Westminster, S.W.—Folder giving particulars of "Panda" electric pumping plant.

The British Thomson-Houston Co., Ltd., Rugby.—Price list No. 5 313, of eight pages, giving in their usual form illustrated particulars, dimensions, and prices of automatic control for electric capstans and winches.

A French Amalgamation.—It is stated that the Société des Tréfileries du Havre has decided to amalgamate with the Société Electro-Métallurgique de Froges. The effect of the combination will be to permit the former to obtain more easily the supplies of aluminium which are needed, and of which the latter is a large producer, whilst at the same time the electro-metallurgical company will be able to utilise its power resources to a greater extent. The capital of the Havre company is to be increased.

Monometer Furnaces.—The Monometer Manufacturing Co., Ltd., of Birmingham, are supplying their Monometer patent furnaces, melting furnaces, and hardening furnaces and heat controllers for a large number of important factories in the Provinces and in London that are engaged in the melting, &c., of lead, Admiralty metal, aluminium, tin, zinc, &c.

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Cape Asbestos.—The Cape Asbestos Co., Ltd., whose factory, employing about 250 hands, is situated at Barking, Essex, has been working day and night for some months past. The company, besides owning large Blue Asbestos mines in South Africa, possesses factories also in France and Italy, and thus forms a link in the commercial "entente" between the three countries. We are informed that 96 per cent. of the shares are under British control, and Lady Wernher, one of the principal shareholders, has demonstrated her loyalty to this country by subscribing for approximately £1,000,000 War Loan Stock.

Electrical Trade at Johannesburg.—The Imperial Trade correspondent at Johannesburg reports that electrical materials are being purchased as fast as they are being received in Johannesburg.

Concerning Discounts.—The references to this subject which have been appearing in our "Correspondence" columns have attracted the attention of sales departments, with beneficial effects. We have received from Messrs. W. T. Henley's Telegraph Works Co., Ltd., a booklet which is described as *their* answer to the discussion—we will not call it the indictment. The booklet contains, in convenient form, particulars of conductors as adopted by the Engineering Standards Committee (V.R. insulation), and *net prices* for taped and braided wires and cables and the Henley wiring system, per mile and per yard, without any discounts, though the successive discounts on which the net prices are based are given in a footnote. Here is an excellent example, only slightly marred by an intimation that all prices are subject to a certain slight advance; we commend it to the trade in general.

Bankruptcy Proceedings.—W. D. Birkett, factor of electrical goods, of Arnside, Windsor Avenue, Whitley Bay, Northumberland.—At Newcastle-on-Tyne Bankruptcy Court, on March 23rd, this bankrupt came up for examination. The statement of affairs showed liabilities expected to rank amounting to £294 and a deficiency of £175. In reply to the Official Receiver (Mr. Chas. Woollett), the debtor stated that he was engaged as a commercial traveller for about three years prior to June, 1915, when he commenced business as a factor of electrical goods under the style of the Northern Wholesale Electrical Supply Co., in Whitley Bay, with capital amounting to £6. He had also £20, which he borrowed from his wife and repaid to her. He denied that he had represented to any one that he had capital amounting to £250. Keen competition, and being unable to obtain goods owing to the war, were the causes of his failure. The hearing was adjourned.

Book Notices.—"Science Abstracts." Vol. XIX, Part 3. March 25th, 1916. Sections A and B. London: E. and F. N. Spon, Ltd. Price 1s. 6d. each.

"British Destiny." By Mr. D. N. Dunlop. London: The Path Publishing Co. Price 3s. 6d. net.

Dissolutions and Liquidations.—Messrs. J. W. Willoughby & E. Wilcox, electrical engineers, of 44A, Trafford Road, Salford.—Messrs. J. W. Willoughby and E. Wilcox have dissolved partnership. All debts, &c., respecting the electrical business will be attended to by Mr. Wilcox, who is continuing in business as Edward Wilcox & Co., electrical and mechanical engineers and contractors, at Central Buildings, Trafford Road, Salford.

Parana Power Syndicate, Ltd.—A meeting is to be held on May 3rd, at 1, Cornhill, E.C., to hear an account of the winding up from the liquidator, Mr. L. Maltby.

Messrs Alfred Graham & Co., St. Andrew's Works, Crofton Park, and Kilmorie Works, Forest Hill, London, electrical engineers.—Messrs. A. Graham, J. A. L. Dearlove, and E. A. Graham have dissolved partnership. The Messrs. Graham will attend to debts, &c., and continue the business under the same title.

Adnil Electric Co., Ltd.—The report of the Official Receiver in this matter has been issued to the creditors and shareholders, and will be referred to in our next issue.

Trade Announcements.—The Electrical Engineering and Equipment Co., Ltd., of New Oxford Street, W.C., announce that their stores will be closed for stocktaking from April 1st to 7th.

The Keighley Gas and Oil Engine Co., Ltd., have removed to Imperial House, Kingsway, London, W.C.

We are informed that on the 22nd inst. Mr. Handel Booth, M.P., took over the sole management of Messrs. W. B. Haigh, Gruban & Co., Ltd., of Oldham. Mr. J. Gruban placed his resignation in the hands of the directors, and ceased all connection with the company.

For Sale.—As announced in our advertisement pages to-day, Messrs. Fuller, Horsey, Sons & Cassell are offering for sale by tender, in one lot, the assets of the Float Electric Co., Ltd.

LIGHTING AND POWER NOTES.

Aberdeen.—The Electricity Committee reports that the number of units generated during February amounted to 1,373,750, an increase of 255,130 units over the amount generated for February last year. The increase was the largest for any month during the last 2½ years.

The Committee has decided to meet the directors of the Great North of Scotland and the Caledonian Railways in connection with the charge for the supply of electricity.

Abertillery.—Price Increase.—The District Council has decided to increase the price of electricity by ½d. per unit. It was reported that there would be a deficit of £2,303 on the electricity undertaking for the year.

Australia.—The carrying out of the Wollongong (N.S.W.) electric lighting scheme has been deferred; the average price tendered amounted to nearly £9,000, which was about £3,000 in excess of the consulting engineer's estimate. A modified scheme has now been suggested, and the matter has been referred back to the Lighting Committee for further report.

The inauguration of the electric lighting scheme for the municipality of Coonamble took place recently. The installation will provide 9,750 c.p., at an annual cost of £442. The cost of the installation is estimated at between £7,000 and £8,000.

The formal inauguration of the Doncaster (Vic.) electric lighting scheme took place last month. The scheme has been installed at a cost of £1,750, and an extension is now being carried out to Doncaster East, at an estimated cost of £1,000. The local Council has been guaranteed against loss on the scheme for a period of five years by a Committee of ratepayers. About 60 houses have already been connected with the mains, and others are wired in readiness for connection.—*Melbourne Age.*

The electric lighting scheme for the Blue Mountains (N.S.W.) towns of Lawson, Wentworth Falls, and Springwood has been deferred pending the passing of the new Local Government Bill and the conclusion of the war.

The Melbourne City Council has been notified that the 5,500-kw. turbo-generator on order from the British Westinghouse Co. has been requisitioned by the British Government; as the growth of the demand next winter is likely to be less than originally estimated, the Electric Supply Committee does not anticipate that the non-delivery will cause any serious difficulty.—*Tenders.*

Aylesbury.—Price Increase.—The U.D.C. has increased the price of current for lighting by 10 per cent., and for power by ½d. per unit.

Birmingham.—The Electric Supply Committee has had under consideration the operation of the coal clause in agreements with H.T. consumers. Messrs. Cadbury have intimated that although their agreement does not include the coal clause, they are willing to pay for current at the rates in force under the new agreements, and the Committee hopes the example will be followed by other H.T. consumers. As regards the effect of the shortage in coal supply, the Committee has been able to maintain the output, and is hopeful that, with the advance of spring, its difficulties will be overcome.—*Birmingham Daily Post.*

Bispham.—Street Lighting.—Instead of paying the Electricity Committee £400 per annum for current for street lighting purposes, the Highways Committee has decided to pay for current for public lighting, at the rate of 2½d. per unit. It was stated that there had been little public lighting for the last two years, and the fresh arrangement was much more satisfactory than the old one.

Blackpool.—Despite lighting restrictions, the supply of electricity for private lighting during February increased by 11,736 units, which was practically counteracted by a drop of 11,408 units for public lighting. However, increased traction supply amounted to 28,432 units. For the last 11 months there has been a decrease of 293,658 units sold, as compared with the same period of 1914-15.

Bo'ness.—Plans of a proposed addition to the generating station at the distillery of James Calder & Co., Ltd., have been approved by the Dean of Guild Court. The addition is estimated to cost £6,000.

Canada.—The new Hydro-Electric Commission has been appointed for the city of Ottawa, in terms of the new Act passed at the last session of the Ontario legislature. It consists of James A. Ellis, appointed by the city, with the Mayor *ex officio*, and an appointee of the Ontario Hydro-Electrical Commission.

The big wheat crop in the West and the splendid prices received, and the possibilities of a bigger crop and even better prices this year, is begetting confidence, so much so, that many of the Western towns which have allowed public utilities to remain in *statu quo* in the last three years, are taking steps this season, to extend and improve the various municipal electrical plants.

Chatham.—Price Increase.—The Kent Electric Power Co. has further advanced the price of energy by 13½ per cent., as from April 1st. Reduced rates for special supplies and discounts have been withdrawn, and a revised scale of charges has been fixed for apparatus on hire.

Chelmsford.—E.L. Charges.—The Electric Supply Corporation has informed consumers of electricity that, from the end of the March quarter, a minimum charge will be made for electricity of 8s. 1½d. per quarter for any quantity up to 15 units (for cash payments this will be reduced to 7s. 6d.). After the first 15 units the charge will be 6½d. per unit, less ½d. cash discount.

Chile.—Permission has been granted to the Chile Exploration Co. (a United States syndicate) to install a 5,000-volt overhead transmission line from Chuquicamata to El Banco, and to the San Salvador station of the Antofagasta-Bolivia Railway, covering a distance of about 5½ miles.—*Board of Trade Gazette.*

Crayford.—Street Lighting.—The P.C. has approved a draft agreement with the West Kent Electric Co. for public lighting at the new estates opened out in the parish.

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Clifden (Co. Galway).—At a recent meeting of the District Council it was stated that £300 expenses had already been incurred in connection with the electric lighting scheme for the town, and the Clerk was instructed to furnish details to the L.G.B., as requested by it.

Continental. — Switzerland. — The distinction of utilising the highest fall of water (1,640 metres) in a hydroelectric works in Switzerland now belongs to the Usine de Fully, recently completed; the highest previous cases were the plant at Orlu, in the Eastern Pyrenees, with a fall of 925 metres, and the Vouvry Usine in Canton Valais, 917 metres. The installation has been carried out for the Société d'Electrochimie, of Paris, from the plans of M. A. Boucher, to whom was due the design of the other two works. The plant includes 3,000-H.P. turbines built by Messrs. Picard-Pictet, the high-pressure pipes feeding the turbines having a total length of 4,625 metres.

Dartford.—Price Increase.—The U.D.C. has decided to increase the charges for current as from April 1st, by 20 per cent.

Darlington.—Year's Working.—The Electricity and Light Railways Committee recently reported an increase of £2,300 in the revenue of the electricity undertaking. Revenue from the supply of electricity for lighting was almost the same as in the preceding year, but there was an increase of £3,000 in the amount received for the supply of power. The increased cost of fuel and the increase in rates and working expenses generally amounted to about £4,000, and the profits are about £2,000 less than anticipated. It was decided that the available profits should be placed to a reserve fund. Last year £3,000 was transferred from the electricity undertaking for rate relief.

Dumfries.—The Sanquhar and Kirkonnel Collieries, Ltd., are extending their operations, and constructing a haulage road and new screening plant, both of which are to be electrically operated.

Dundee. — Gas Works Power Plant. — The gas manager recently reported to his Committee that the cost of running the electric plant at the gas works entirely by their own generating plant for 12 months would amount to £152; as compared with this, the cost for running with the public electric supply, allowing for a weekly run of the gas works plant as stand-by, amounts to £78 per annum.

Edinburgh.—Plant Extension.—The T.C. has adopted the recommendation of the Electric Lighting Committee for additional expenditure on the McDonald Road station, amounting to £11,000. The Council has agreed to the acceptance of estimates for the building and steelwork of the new generating station at Portobello, amounting to £30,570.

Halifax.—Rate Relief.—The chairman of the Finance Committee, in moving the adoption of the estimates for the next 12 months, and the levying of a total rate of 10s. 4d. in the £, stated that the profit from the Corporation electricity works was £14,355, and from the tramways £14,014, which, with the profit from the gas department, represented 9·03 per cent. on the gross capital expenditure.

Haslingden.—Bulk Supply.—The Council has been informed that the Accrington Corporation, which is under agreement to supply the Council with electricity in bulk, has now agreed to Haslingden obtaining a supplementary supply from the Rawtenstall Corporation. Terms have been arranged which will be no higher than those charged by Accrington.

High Wycombe.—Street Lighting.—With reference to the dispute regarding the public lighting contract between the U.D.C. and the Electricity Co., the former body has decided to let the matter stand over pending the result of the appeal in the case of the Leiston Gas Co. and the Leiston U.D.C., it being made clear that the Council will not be bound by the result. The company had asked for payment of £100 per quarter for standing charges, 15s. per lamp per quarter for lamps used, and the existing contract to be extended for the period of restricted lighting.

Ipswich.—New Plant.—The T.C. has adopted the recommendation of the Electricity Committee to install an induced draught fan in connection with the boiler plant at the electricity works, at a cost of £850.

Itchen.—Prov. Order.—The Council has decided to apply to the Board of Trade for an extension of the period for the electric lighting order, until three years after the termination of the war.

Leyton.—Price Increase.—The Electricity Committee recommends that the charges for electricity be increased as follows:—An addition of 15 per cent. upon the amount of each quarterly account for private lighting, power and heat; an addition of 5 per cent. upon the amount for public lighting and 5 per cent upon the amount for current supplied to the tramways. The Committee pointed out that of the total of 3,400 consumers, there were 2,320 quarterly accounts, the annual income from which was under £5 each; if the average were taken at £2 10s., the 15 per cent. increase would only represent the meter rent, which was abolished in 1910.

London.—Woolwich.—The Finance Committee of the B.C. disagrees with the suggestion of the Treasury that the expenditure of £3,290 to cover capital expenditure on mains, transformers, &c., should be met from the rates, having regard to the heavy charges which have already fallen on the rates in connection with the undertaking. Application is to be made to the L.C.C. for sanction to borrow £24,785 for a 3,750-KW. turbo-alternator with boiler, switchgear and accessories; £2,330 for transformer plant, switchgear, &c., and £385 for mains.

Ripon.—E.L. Schemes.—The Northern Counties Electricity Supply Co. has informed the T.C. that it cannot, under present circumstances, consider the establishment of an E.L. scheme for Ripon; the Harrogate Corporation has replied to the same effect. The Electricity Committee, therefore, considers that no useful purpose can be served by extending negotiations for the present.

Southampton. — Price Increase. — The Electricity Committee recommends the Corporation to increase the charges for lighting, power and heat by 10 per cent. from Midsummer next, and that the increased charges in respect of the tramways commence as from April 1st.

Stratford-on-Avon. — Electricity Prices. — The Electricity Co. has approached the T.C. for permission to increase the charges for lighting from 5d. to 6d. per unit, and the matter has been referred to a Special Committee for report.

Tasmania.—Mr. C. T. Milne, H.M. Trade Commissioner for Australia, reports that while in Tasmania at the end of last year he had an interview with the general manager of the Tasmanian Government hydro-electric department with reference to the scheme which is now in process of realisation. This scheme has in view the utilisation of water power derived from the Great Lake and its conversion into electrical power for distribution at Hobart and throughout the Island. It is expected that at least 26,000 actual H.P. at the turbine shafts could be generated for 12 hours per day or 39,000 actual H.P. for eight hours per day, and it is believed that this can be increased eventually to 70,000 H.P.

Owing to the difficulty in obtaining delivery of certain parts of the machinery, the completion of the installation (which has cost about £350,000) has been delayed, but the general manager stated that he fully expected that the work would be completed this month (March) or early in April.

West Ham.—The Corporation has been recommended to apply for sanction to the borrowing of the following amounts for electricity purposes:—Mains, £8,000; transformers, £5,000; cables, &c., £11,000; linking up connections, £4,500; generating station, £3,275. It is proposed to defray the item of £1,000 for electricity meters direct out of revenue. The Corporation is also recommended to adopt a coal clause in connection with the supply of current to the tramways department, the rate of payment for which was fixed in 1913, when the price of coal was 11s. 6d. per ton, at ·75d. per unit. The clause will operate as and from November 1st last. In view of the results of the working of the undertaking for the nine months ending December 31st last, the borough treasurer reports that he has agreed with the engineer (for the purposes of fixing the district rate) a figure of £16,000 as the estimated deficiency for the year, in addition to a further £4,300 for the allowances to men on active service.

TRAMWAY and RAILWAY NOTES.

Australia.—The Victorian Railways Department has appointed an "Economy Board," and in several directions there is to be a heavy curtailment of expenditure. The electrification scheme is to be restricted, and various other works are to be held over.

Blackpool.—Traffic Returns.—From April 1st of last year to March 16th of this year the tramway receipts have amounted to £77,506, an increase of £3,253, by comparison with the similar period of the previous financial year.

The Tramways Committee has had under consideration the question of renewing the lease of Dickson Road tramway to the Blackpool and Fleetwood Tramroad Co., and also the lease to Blackpool and Lytham Tramways Committee. There was a feeling in favour of the Corporation working all the sections within the borough. When the present leases expire, two or three years hence, the probabilities are that the Corporation will introduce a service of through cars, though it does not follow that outside tramway undertakings will be prohibited from entering the borough.

Continental.—Russia.—Electric Railway Schemes.—Two electric railways were approved in 1914 by the Russian Government—namely, the Petrograd Northern Electric Railways Co., promoted by O. N. Herding, and the Petrograd Electric Auxiliary Lines, promoted by F. A. Lipsky. Permission to form companies was granted on condition that at least 50 per cent. of the share capital should be paid up not later than a year thereafter, but, owing to the war, this condition could not be fulfilled, consequently the promoters have approached the Government, asking for an extension of time. The Minister of Finance and the Minister of Communication have signified their willingness to grant this, and the condition is to take effect one year after the ratification of peace between Russia and her present enemies. The approved extension now goes before the second department of the Imperial Council for confirmation.

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Darlington. — Year's Working. — The Corporation tramways show an increase of revenue of about £1,000, but the working expenses have increased by £500, and special items account for another £500. The deficiency on the year's working is £1,000, as compared with £1,900 in the previous year.

London.—The L.C.C. has applied to the B. of T. to extend the time for the construction of the junction line to connect the existing tramways in Mitcham Road with those in Southcroft Road.

A tramway accident, which was fortunately unattended by serious results, occurred on the Southern L.C.C. tramways on Monday, when a car ascending Dog Kennel Hill, East Dulwich, for some reason ran backwards, leaving the track at the bottom, and after passing through a fence came to a stand in an adjoining field. No glass was broken, though the front of the car was damaged.

Stanley. — Delayed Tramway Extensions. — The U.D.C. has decided to lodge an objection with the B of T. against the application of the Yorkshire (West Riding) Electric Tramways for an extension of the period to March 19th, 1918, for the completion of the lines as yet unconstructed, viz., Wakefield to Alverthorpe, a portion of line from Rothwell to Oulton, and a portion of the Ardsley line.

West Ham.—It is proposed to defray the cost of doubling the Connaught Road terminus track (£970), and making good the carriageway of Beckton Road (£350), out of revenue.

TELEGRAPH and TELEPHONE NOTES.

Atlantic Cables.—The French Ministry of Posts has denied a German report that seven of the trans-Atlantic cables had been destroyed, and that only two remained serviceable. The situation, it is declared, is normal, and communication between the countries of the Allies and North America is being kept up regularly by 16 cables, not nine.

Canada.—Telephone communication has been opened by the Bell Telephone Co. between Montreal and Vancouver, a distance of 4,227 miles, by way of the United States lines.—*T. and T. Age.*

Italy.—In the seven years from 1907 to 1913 the Italian State Telephone Administration has spent 23,000,000 lire on the State telephone system. Of this sum, 13,600,000 lire stands for imports from abroad. In another seven years, says *l'Elettrotecnica*, a sum of 90,000 000 lire will be expended on like objects, under the powers conferred by the Calissano Law. British and French manufacturers will have the opportunity to secure a share in such future orders for material as the Italian Government may be compelled to place abroad.

New Zealand. — According to an American Consular report, during 1914 12 new telephone exchanges were opened by the Government in New Zealand, and the number of exchange connections increased by 4,816. A length of 2,136 miles of wire was added to the telegraph and interurban telephone system, and 34,325 miles of wire to the telephone exchange local system. The telephone service in Auckland is rapidly being changed to the automatic system, the instruments for which are coming from the U.S.A.

Storm Interruptions.—The stormy weather of the past week played havoc with the overhead telegraph and telephone lines of the whole country, and the underground lines proved invaluable, preventing the isolation of many towns. The worst effects were experienced in the Midlands and West of England, the interruptions to communication being the worst for 30 years. The telegraph lines along all the great railway systems suffered very severely, and many trains were delayed for several hours owing to the disorganisation of the signalling service. The damage was due to the accumulation of snow on the wires and the prevalence of exceptionally high winds.

Telegrams to the Forces.—The Postmaster-General announces the provision of special facilities for week-end letter telegrams to members of the British Forces in places abroad other than France and Belgium.

United States.—The report of the American Telephone and Telegraph Co. for 1915 shows that the gross revenue of the Bell system, not including the connected independent companies, was $239,900,000, an increase of over $13,900 000 over 1914. After allowing as provision for depreciation $14,900,000, the available surplus was $66,200,000, of which $18,100,000 was paid in interest and $32,900,000 was paid in dividends. The net permanent capital obligations of the whole system outstanding in the hands of the public amount to $736 156,756, although the telephone plants stood on the books on December 31st at $880,068,520 and their appraisal value is over $61,000 000 in excess of the book value. It is estimated that $57,000,000 will be spent in plant additions during the current year.—*T. and T. Age.*

Wireless Telephony.—According to the *Revue Electrique*, the American Telephone and Telegraph Co. has recently succeeded in establishing telephonic communication, by means of Hertzian waves, between Seattle and Yokohama, a distance of 7,800 kilometres.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—May 1st. Two 300-kw. turbo-alternators, condensers, switchboard, &c., for the pumping station at Ryde, for the Metropolitan Board of Water Supply and Sewerage at Sydney.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-kw. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.*

May 24th. N.S.W. Government Railways and Tramways. 16/600-volt d.c. motors for tramway stores, Randwick.*

Melbourne. — April 11th. City Council. 533,000 arc lamp carbons. See "Official Notices" March 25th.

April 18th. P.M.G. 8,500 fuses.*

April 26th. Victorian Government Railways. Car-lighting material—cables, switches, fuses, &c.*

May 10th. Victorian Government Railways. Motor-generator set and accessories for battery-charging of baggage trucks.*

Tamworth (N.S.W.).—May 1st. Additional generating plant, switchboard, mains, &c, in connection with the municipal electricity undertaking. Specifications from Mr. V. G. Kable, Town Clerk, Council Chambers.

Edinburgh.—April 3rd. Midlothian and Peebles District Asylum, Rosslynlee. Stores, including electrical fittings. Forms from Clerk and Treasurer, 19, Heriot Row, Edinburgh.

April 1st. Corporation. Maintenance of telephone and electric bell installations: City Superintendent of Works. Engineers' stores, electrical material: Resident Electrical Engineer.

Keighley.—April 3rd. Concrete foundation work for 5,000 kw. turbo-alternator at Coney Lane electricity works. Mr. H. Webber, Electricity Offices.

Manchester. — April 1st. Electricity Committee. (*a*) Low-pressure water and exhaust steam pipes, valves and supports; (*b*) valves for circulating water pipes. Specifications from Mr. F. E. Hughes, Secretary, Electricity Department.

Salford.—April 3rd. Concrete foundations for 5,000-kw. turbo-alternator. Borough Electrical Engineer.

Spain.—April 13th. The municipal authorities of San Feliu de Guixols are inviting tenders for the concession for the electric lighting of the town during an unnamed period.

May 19th. 60 years' electric tramway concession at Bilbao, to connect the existing system with the Irala-Barri district. An option on the concession is held by the Sociedad Tranvia Urbano de Bilbao. The contract will probably be placed with a Spanish concern, but material will have to be purchased abroad.—*B. of T. Journal.*

Tenders have lately been invited by the municipal authorities of Banolas (Province of Gerona) for the concession for the electric lighting of the town during a period of five years.

Warrington.—April 11th. Electricity and Tramway Committee. Motors and transformers. See "Official Notices" to-day.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Australia.—The following contracts have been placed:—

P.M.G.'s Department, N.S.W.

300 table-pattern common d.c. type telephones, 150 ditto wall sets, and 50 portable telephones, £1,111.—James Paton & Co.

400 automatic wall-pattern common-battery telephones, £1,093.—Automatic Telephones (Aust.), Ltd.

50 miles of twisted-pair conductor wire, £462.—James Paton & Co.

9,740 protectors with lightning arresters, £1,437.—British General Electric Co., Ltd.

P.M.G.'s Department, Victoria.

240 common-battery wall-pattern telephones, £657; 240 table-pattern ditto, £720.—Automatic Telephones (Aust.), Ltd.

400,000 insulators, £6,350.—Commonwealth Art Pottery Co. Pty., Ltd.

Victorian Railways.

15-ton electric crane with accessories, for Bendigo goods traffic, £1,187.—Babcock & Wilcox, Ltd.

Installation of automatic sprinklers and thermostats, £4,314.—Wormald Bros. —*Tenders.*

Sydney.—The Electric Lighting Committee recommends the acceptance of the following tenders:—

High-tension cable testing outfit (Specification 423): Section A, £495; Section B (alternative tender), £521; Section C, £785; Section D, £91.—Aust. General Electric Co.

Weather-proof copper cable (Specification 425), £690.—B.I. & Helsby Cables, Ltd.

With regard to the tenders received for the 33,000-volt outdoor transformers and switchgear, the city electrical engineer reports that conditions have somewhat altered since he made his recommendations, and it is now improbable that the Council will require during the next two months any additional 33,000-volt transformers and switchgear. He recommends that the firms who have tendered be informed that the Council does not propose to accept any tender at present.—*Tenders.*

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London.—Battersea and Islington.—These Borough Councils have placed contracts for meters for the ensuing twelve months with Messrs. Chamberlain & Hookham, Ltd.

Battersea.—The Electricity Committee recommends that the tender of Messrs. Callender's Cable & Construction Co. be accepted for the supply of bitumen for one year.

Willesden.—The U.D.C. has been recommended to accept the tender of Messrs. Watson, Marsh & Co., Ltd., for re-wiring Block D at the Borough Hospital.

Sutton-in-Ashfield.—U.D.C. Tenders accepted:—

Single cylinder, enclosed type, self-lubricating engine, direct coup'ed to a 1·5-kw. dynamo, £75; switchboard, £10; lamps, &c., £25.—General Electric Co., Ltd.

Wiring firemen's houses for bells, £20.—Geo. Cooper, Mansfield.

West Ham.—Under existing circumstances the buying of transformers is very restricted, but as the engineer considers it desirable to continue to purchase under contract against any requirements which may arise for war or other work, the Corporation has been recommended to extend the British Westinghouse Co.'s contract for a further two years, with the addition of a sliding scale based on the cost of iron and labour.

Whitehaven.—T.C. Earthenware troughs for a year, Messrs. Doulton & Co., Ltd.

FORTHCOMING EVENTS.

London Association of Foremen Engineers.—Saturday, April 1st. At 8 p.m. At Cannon Street Hotel, Cannon Street. Paper on "Copper Alloys, with Notes on Brass Foundry Practice," by Mr. H. L. Reason.

Royal Institution of Great Britain.—Saturdays, April 1st and 8th. At 3 p.m. At Albemarle Street, W. Lectures (IV and V) on "Radiations from Atoms and Electrons," by Prof. Sir J. J. Thomson.

Society of Engineers.—Monday, April 3rd. At 5.30 p.m. At Caxton Hall, Westminster, S.W. Paper on "Modern Coal and Coke Handling Machinery," by Mr. J. E. Lister.

Council for the Organisation of British Industry.—Tuesday, April 4th. At 4 p.m. At the School of Technology, Sackville Street, Manchester. Lecture on "Industrial Research," by Mr. A. P. M. Fleming.

Institution of Electrical Engineers (Manchester Local Section).—Tuesday, April 4th. At 7 p.m. At the Engineers' Club. Annual general meeting. Lecture on "Recent Researches in X-rays," by Sir E. Rutherford, F.R.S.

(Western Local Section).—Monday, April 3rd. At the Merchant Venturers' Technical College, Bristol. At 5 p.m., annual meeting; paper on "The Hire and Maintenance of Direct-current Motors," by Mr. H. Joseph. At 7 p.m., dinner.

Association of Supervising Electricians.—Tuesday, April 4th. At 7.15 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "A.C. Motors," by Mr. H. C. E. Jacoby.

Roentgen Society.—Tuesday, April 4th. At 8.15 p.m. At the I.E.E., Victoria Embankment, W.C. Papers on "A Chronograph Constructed to Work with the Electroscope," by Mr. P. J. Nease; "The Enclosed Tungsten Arc as a Source of Ultra-Violet Light," by Mr. B. H. Morphy and Mr. S. R. Mullard; "Experiments with a Coolidge Tube," by Mr. E. Schall; "A New Modification of the Ionisation Method of Measuring X-rays," by Mr. H. E. Donnithorne.

Faraday Society.—Thursday, April 6th. At 8 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Lecture on "The Making of a Big Gun," by Dr. W. Rosenhain, F.R.S.

Chemical Society.—Thursday, April 6th. At 8.30 p.m. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, April 7th. At 7.30 p.m. At Bolbec Hall, Newcastle-on-Tyne. General meeting.

North of England Institute of Mining and Mechanical Engineers.—Saturday, April 8th. At 2 p.m. At Neville Hall, Newcastle-on-Tyne. General meeting.

NOTES.

The Batti-Wallahs' Society.—This Society held its annual general meeting on March 20th. Mr. H. T. Harrison is president for the year. Mr. F. Pooley is secretary and treasurer, and Mr. Greenly is entertainment secretary.

An Electric Bullet Extractor.—Experiments have been carried out with a new method of extracting bullets, with the continuous aid of X-rays. The room is darkened, and an X-ray tube is placed below the operating table, throwing the shadow of the bullet and the surgeon's forceps on a fluorescent screen which is fixed above the patient, so that the operator can indirectly see what he is doing. In order to avoid the danger of gripping arteries, &c., together with the bullet, the jaws of the forceps are insulated from one another, and connected in circuit with an electric bell; hence, when both jaws of the forceps close upon the bullet, the bell rings, but if any structure intervenes between the bullet and either jaw, the bell is silent, and the operator knows that the conditions are not right for the extraction of the bullet.

Trade Union Differences.—According to the *Morning Post* a conference between the Executive Committees of the Miners' Federation of Great Britain, the Amalgamated Society of Engineers, and the Electrical Trades Unions, respecting the demand of the miners that engineers and electricians employed at collieries should become members of their Federation, took place in London last week. A joint committee was appointed to draft a scheme for the settlement of the differences between the Unions.

Chief Technical Assistants' Association.—The first annual general meeting of this Association took place on Saturday, March 18th, at the Tavistock Hotel. The Chairman referred to the satisfactory results of the first year's work of the Association, and the following officers were elected for 1916:—Chairman, J. T. Baron; vice-chairmen, T. K. Richardson and W. Young; committee, H. F. J. Thompson and J. H. Parker; hon. treasurer, J. R. J. Bowden; hon. secretary, A. P. MacAlister. We understand that the membership includes practically every deputy electrical engineer in Greater London and, in the large stations, the senior technical assistants, and as consequently it will no longer develop, it has been possible to define exactly the scope of the Association. As it is associated with the Associated Municipal Electrical Engineers (Greater London), questions of policy are not dealt with by the deputies' association, they having resolved between themselves to hold monthly meetings, at which papers on technical matters are read and discussed, thus ensuring that by the informal discussion of matters of vital interest or importance to central station engineers, a thorough interchange of knowledge and experience is arrived at which can only have one ultimate result, viz, the general betterment of the undertakings whose staff is included in the membership. During the past year the following papers have been read (and, where the subject permitted, discussions have taken place):—

The Chairman, in his opening address, embodied details of the undertaking at St. Pancras.

H. F. J. Thompson: "The Advisability or not of Earthing the Neutral of a three-phase High-tension System, and the Best Method of so Earthing"; also discussion on "Safety Devices on High-tension Systems."

J. H. Parker: Discussion upon "Station Economies."

D. M Mason: "The Principle of High-Tension Switchgear from a Central Station Engineer's Point of View."

W. E. Bradshaw: "The Advantage and Disadvantage of the Various Systems of Laying Mains."

During the coming year it is anticipated that further discussions will take place. The meetings will be held at the Tavistock Hotel, Covent Garden, on the following dates, unless otherwise arranged, at 3 o'clock:—Saturdays, April 15th, May 13th, June 10th, July 8th, September 9th. We have received a copy of the Rules of the Association. Undoubtedly there is a good field for such an Association, and we hope that the intentions of those connected with it, that it shall tend to the elevation of the profession generally, will be realised.

Wolves in Other Dress.—As an example of German "slimness" we may commend to the attention of our readers an important dispatch, sent to the Australian Premier from the Trade Commissioner to the East, stating that it has been brought to notice that certain German firms in Japan have commenced doing business in Japanese names, the following being the cases so far brought to notice, the Japanese name being given in parentheses:—Yokohama: Winckler & Co. (T. Miyabe), Bergmann & Co. (Nigo Shoten), Otto Reimers & Co. (Asada Shokai), Becker & Co. (Kato Gomei Kaisha). Kobé: Bergmann & Co. (Sawada & Co.), M. Raspe and Co. (Kato & Co.), Becker & Co. (Toyo Bussan Export Co.), Carlowitz & Co. (Takashito), Winckler & Co. (Kubota Exporting Co.), Van Nierop & Co. (Tanaka T. Goda), V. Hermann, of Siemens, Schuckert & Co. (Kasai & Co.). The dispatch proceeds:—"It is highly probable that other German firms will do likewise, and endeavour to carry on business as usual with Australia and other British possessions. The Japanese laws, so far, afford no means of preventing trading with enemy subjects, but may, later on, come into line. As it is highly probable that the German firms above referred to, as also others, may endeavour to continue business with Australia under the cover of Japanese names, I advise that the strongest measures be adopted in Australia accordingly, and that the Commonwealth authorities should be approached on the matter."—*Eastern Engineering.*

Dundee Electricians' Wages.—Sheriff Laing, Aberdeen, who was appointed arbiter in the wages dispute between the Dundee Electrical Contractors' Association and the Electricians' Trade Union, was in Dundee on 23rd inst., hearing parties' evidence. His award will be issued later. The electricians are asking an advance of 2d. an hour on their present rate of pay, which is 9d. an hour.—*Dundee Courier.*

The Organisation of Science.—At the instance of the Royal Society, a conference was held last week at Burlington House to consider the advisability of forming a "Conjoint Board of Scientific Societies" with a view to the organisation of scientific effort in the national interest. Delegates were present from 25 societies, including the Institutions of Civil, Electrical, Mechanical and Mining Engineers, and a committee was appointed to draw up a scheme for presentation to a future meeting.

Electro-Metallurgy in Finland.—According to the *Wir Nyh* the Electro-Metallurgical Co., of Ruokalacksy, has decided to construct an electro-metallurgical factory near the station of Nokia. The electric current will be supplied by the Nokia Co., which owns the electrical works near Vuoksenniska.

German Tramway Fares.—A general meeting of the Association of Tramway and Light Railway Administrations, following conferences of local groups, has decided to approach the Imperial, Federal State and local authorities with a view to the general increase of the 10 pfennigs (1½d.) fare to 15 pfennigs (1¾d.) It is contended that the future prosperity of the undertakings depends upon the fares being raised, owing to the constant growth in the working expenses.

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Electrical Trades Benevolent Institution.—The annual general meeting was held on Monday afternoon, at the Institution of Electrical Engineers. The year book, which had been prepared in the usual form, contained the report of the Executive Committee and the accounts for the year 1915. Owing to the war, the annual festival was not held in 1915; due to the loss of this means of collecting, the income for the year was seriously affected, and no doubt the many other calls on the Institution's supporters, due to the war, have had a further adverse influence. The result of the year's work has been a net income of £663, out of which grants amounting to £149 have been paid, and the following investments made:—£100 3½ per cent. war stock (subsequently converted into 4 per cent. stock), £94; £300 4½ per cent. war stock, £295; total, £389. This brings the total of the invested funds to £8,116. The cost of printing, postage, &c., was somewhat higher than in the previous year, as it was necessary to send out an appeal in view of the fact that the annual festival was not held. On the other hand, the other expenses were considerably lower than in the previous year. Sir David Salomons and Mr. Hugo Hirst have been appointed trustees. Owing to the fact that it was easier to find employment for those who applied for help, the number and amount of the grants for temporary relief was less than in 1914, but every person who applied, and who was qualified, received assistance. It is noted with regret that there is a falling-off in the number of persons making use of the collectors' books. The Committee expressed their thanks to those collectors who had again so ably assisted, especially in view of the fact that their task this year was far more difficult than in previous years. The Committee hope that the heads of firms will give this matter their consideration, as every electrical firm ought to have a collector amongst the members of its staff. The Committee again expressed indebtedness to the I.E.E. for the use of rooms for holding meetings, and to the electrical Press for its continued valuable assistance.

Lord Vaux of Harrowden presided at the annual meeting, and, in presenting the report and accounts for 1915, he drew attention to the serious drop in donations, the amount for the year being only £586, compared with £3,139 in 1914. The total income for the year was £886, which he thought, in the circumstances, need not be considered an altogether unsatisfactory state of affairs. In view, however, of the calls which were certain to come after the war, these receipts were totally inadequate. It was hardly to be expected that at the conclusion of the war all men returning would be at once absorbed into civil employment, and although, no doubt, large numbers would be able to return to the positions they occupied previously, which were being kept open by generous employers, it was inevitable that this would not be so in every case, and the calls upon the Institution for pecuniary assistance would undoubtedly be very great. The sum of £389 was invested last year, and it was felt that War Stock was the right investment at the present time. In 1915 the grants amounted to £149, a considerably smaller amount than in the previous year, but the reduction was due to the fact that it was less difficult at the moment to find employment for those requiring assistance. An appeal had been sent out by the President, Sir David Salomons, to a large number of persons, and it was to be hoped that all who received it would realise that they should do all they could for the Institution, notwithstanding the many other pressing claims upon them. Sir David Salomons had kindly accepted the position of trustee, and the securities had now been transferred into the names of Sir David Salomons and Mr. Hirst; the latter was appointed trustee in 1914. These two gentlemen, together with Mr. Justus Eck, were now the three trustees of the Institution. It was sad to notice the falling off in the list of the returns of collectors. In his opinion, every electrical firm should look upon it as a duty to see that one of their staff was a collector, who should also induce other employés and colleagues to become members. If only a sufficient number of people were interested in this way, it would be a most efficient means of obtaining contributions and increasing the membership. It was important to remember that it might become necessary one day to restrict the benefits conferred by the Institution strictly to its own members, and for this reason it was highly desirable to increase the membership in every possible way, for not only would this allow the benefits to be spread over the industry, but it would also appreciably add to the income and possibly enable greater benefits to be conferred. The total number of members at the present moment was extremely small. He regretted the death at the Front of Mr. E. G. Byng, who had done a great deal of work for the Institution. The life governor whose contribution was shown in the accounts was Mr. W. B. Esson, and it was to be hoped that his example would be followed by others. In regard to the balance-sheet, the total investments now amounted to £8,117. The chairman concluded by again pointing out the necessity for increasing the investments, the amount being small compared with similar benevolent Institutions.

Mr. Justus Eck, who seconded the adoption of the report and accounts, confirmed all that the chairman had said as to the financial position of the Institution, and the need for increasing the membership and subscriptions. He said he would like to point out a new possible source of income from companies before they closed their books for the purpose of declaring dividends, and that was in connection with the excess profits tax. He believed that all subscriptions to the Electrical Trades' Benevolent Institution would be considered as expenses of a business; therefore, if a company had £1,000 excess profits, and paid £500 of it into the funds of the Institution, it would only be taxing itself £250, whilst benefiting the Institution by £500. At any rate, this was worth trying. As the chairman had said, it would be necessary in future to restrict the benefits to members of the Institution, and in this connection he mentioned the instance of a mains superintendent who was not a member, but whose widow and two children had been assisted by the funds. In this particular instance the Corporation employing the man stated that they had no powers to assist in the matter, and he put this forward as supporting the appeal to all members of the industry to subscribe and become members of the Institution.

The report and accounts were then unanimously adopted.

Mr. H. Oppenheimer having retired from the Committee of Management, a vote of thanks was passed to him for his services.

The following were re-elected members of the Committee of Management:—Messrs. Justus Eck, E. F. Johnson, P. A. Lundberg, W. C. Mountain, F. H. Nalder, E. A. Nash, W. R. Rawlings, L. G. Tate.

Messrs. Price, Waterhouse & Co. were re-elected hon. auditors, and Messrs. Sugden and Hextall, hon solicitors.

The last business of the meeting was to consider some proposed alterations in the rules. A Sub-Committee was appointed 18 months ago, and decided upon certain alterations, which tend to make the rules a little clearer than they have been hitherto. Thus membership is now defined as life governors, governors, life members, and other members. There is no alteration in the effect of the rules.

The proposed alterations having been adopted, a hearty vote of thanks to the chairman closed the proceedings.

"E.V.C." Standard Batteries.—In the recent announcement of the Electric Vehicle Committee, relative to standardised overall sizes for lead-plate batteries, it should have been stated that the overall sizes agreed upon by the members of the Accumulator Manufacturers' Section of the B.E.A.M.A. are the maximum sizes, the intention being that the dimensions shall cover any maker's cells containing each the same number of plates. This has been done in order that vehicle makers may so construct the battery boxes on vehicles that cells of a specified number of plates of any make may be fitted.

To Wireless Telegraph Engineers.—We are informed that more officers are required for the Corps of Royal Engineers, Wireless Section. Candidates should forward their applications to Major A. Handley, R.E., St. Martin's Gate, Worcester. It is essential that they should have a thorough knowledge of the theory and practice of wireless telegraphy. In sending in their applications candidates should state fully their training and experience, and whether they have had any previous military service. The term of service will be for the period of the war, and successful candidates will be required to serve at home or abroad.

Institution and Lecture Notes.—Institution of Electrical Engineers.—The following have been nominated by the Council for the vacancies which will occur on the Council on September 30th, 1916:—

President.—Mr. C. P. Sparks.

Vice-Presidents.—Messrs. R. A. Chattock and J. S. Highfield.

Honorary Treasurer.—Mr. J. E. Kingsbury.

Ordinary Members of Council, Members (Two Vacancies).—Messrs. C. Bright, F.R.S.E., F. Gill, G. H. Nisbet, and W. Ll. Preece.

Associate Members (Three Vacancies).—Messrs. F. W. Crawter, H. H. Harrison, and W. R. Rawlings.

Associates (Two Vacancies).—Messrs. J. O. Callender and J. Devonshire.

Greenock Electrical Society.—At the annual general meeting the following office-bearers were elected:—

Hon. President.—Mr. Alex. Norwell.

President.—Mr. Duncan Angus.

Secretary.—Mr. F. B. Humphriss.

Treasurer.—Mr. Wm. M'Gibbon.

Association of Mining Electrical Engineers.—At a meeting of the Yorkshire Branch last Saturday, a paper on "The Installation, Erecting, and Starting-up of High-Speed Machinery" was read by Mr. J. A. McLay, hon. secretary of the Branch. At the next meeting, on April 29th, Mr. J. W. Harbottle will discuss the "Whinney Leakage Detector."

Mr. H. C. Crews, of Manchester, recently delivered a popular lecture on "Electricity in the Home" before the Marple Literary Society, his remarks being illustrated by a demonstration of apparatus in use.

Chadwick Public Lectures.—In the last of a series of lectures on "The Domestic Arterial System," at King's College for Women, on March 29th, Dr. Charles Porter dealt with warming and lighting. In connection with the former, he referred to the various advantages and disadvantages of coal, coal gas, and electricity as heating agents, and expressed the view that, of the three, that which most deserved the claim of being an hygienic heater was undoubtedly electricity. As regarded safety, cleanliness, and convenience, it was ahead even of gas, in favour of which so many claims were advanced. In the matter of cost he showed that, so far as electricity was concerned, installation was the great trouble, but where there was choice in any house as between coal, coal gas, and electricity, he advised that it should fall on the last-named. The many advantages of central heating were also referred to, and it was made clear that much could be said in favour of its adoption, even in the case of ordinary-sized houses. The suggestion was offered that in these days of gas and electric cookers and hot water heaters the kitchen range might very conveniently be abolished. One of the great difficulties in the way of its abolition was the necessity for a fire in the kitchen; in this connection an appliance specially designed for use as a combined sitting-room fire, cooker, and water heater, was described and greatly praised, being cheap to purchase and install, and economical and efficient in use. In relation to lighting, the ordinary artificial agents were described, and their comparative advantages and disadvantages considered. In the view of the lecturer, electricity was the only hygienic artificial lighting agent.

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Inquiries.—A correspondent wishes to get into touch with the makers of low-temperature industrial electric furnaces, who can supply particulars of existing installations.

Patents and Alien Enemies.—Application has been made to the Board of Trade by the Rapid Magnetting Machine Co., Ltd., of Birmingham, for the avoidance or suspension of patents Nos. 14,082/08 and 29,230/11, issued to Ullrich, and 4,595/13, issued to Fried. Krupp A.-G. Grusonwerk, for magnetic separating apparatus.

Volunteer Notes.—Engineering Institutions' V.E.C.—Orders for week commencing April 3rd, 1916.—By Lieut.-Col. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, April 3rd.—Sections 1 and 2, Technical; Sections 3 and 4, Squad and Platoon, Signalling Class and Recruits.

Tuesday, April 4th.—School of Arms, 6 to 7 p.m.

Thursday, April 6th.—Shooting for Sections 1 and 2 and Signalling Class.

Friday, April 7th.—Sections 3 and 4, Technical; Sections 1 and 2, Squad and Platoon. Signalling Class and Recruits.

Saturday, April 8th.—Uniform Parade at 2.45 p.m.

Sections for Technical, Parade at Headquarters, London Electrical Engineers, 46, Regency Street, S.W.

Sections for Shooting, Parade at Miniature Ranges.

Unless otherwise ordered, all Parades at Chester House, Eccleston Place, S.W.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, March 30th, 1916:—

Battalion Parades.—Saturday.—The Battalion will Parade outside Baker Street Station at 2.30 p.m., and proceed by train to Wembley Park Camp, for Parade under Company Officers. Guard duties will be practised.

Sunday (first Sunday in the month).—The Battalion will Parade, as strong as possible, at St. Pancras Station (Midland), at 9.10 a.m., and proceed by train to Chiltern Green, for Field Operations with other units. In the afternoon a march past will take place.

The Battalion will arrive at St. Pancras, on the return journey, about 6.15 p.m.

North London men can travel (single tickets advisable) from King's Cross, 8.50 a.m., to Luton Hoo, calling at Finsbury Park, 8.59, New Barnet, 9.14, Hadley, 9.20 a.m.

Musketry.—Practice will take place at Bisley on Saturday next, the 1st prox., for the Inter-Battalion Match. Targets will also be available for other members of the Corps wishing to shoot. Names must be sent in to the Musketry Staff before 12 noon, Friday. All men proceeding to Bisley must Parade, in uniform, at 12.45 p.m., No. 6 Platform, Waterloo Station.

The Acton Range will be open on Saturday, 1st prox., at 2 p.m. Members wishing to shoot must send in their names to the Musketry Staff by first post Saturday morning.

A. G. Joiner, *Major and Adjutant*, O.B.C.

New Ignition Plug Factory.—According to the *Commercial Motor*, the Lodge Sparking Plug Co., Ltd., of Birmingham, is engaged on the erection and equipment of a new factory for the production of its well-known plugs, on a scale if required, of 10 millions per annum.

Appointment Vacant.—Station engineer for the Southern Command, Salisbury. See our advertisement pages today.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The Battersea B.C. is recommended to grant the following increases to officers in the electricity department:—

Mr. Magrath, mains assistant, from £125 to £132 10s. per annum; Mr. Knights, installation inspector, from £117 10s. to £125 per annum; Mr. Adams, clerk, £100 to £107 10s.; to take effect from January 1st last.

The West Ham Corporation is recommended to appoint Mr. King, nominally power representative, to the position of power constructional superintendent at a salary of £156 per annum, plus commission according to scale.

The Coventry Tramways Committee recommends the Corporation to increase the salary of Mr. T. R. Whitehead, engineer and manager of the undertaking, from £500 to £600 per annum.

The Bray U.D.C. has agreed to increase the salary of its electrical engineer, Mr. W. J. U. Sowter.

The Greenock Corporation has approved of the Electricity Committee's recommendation to advance the salary of Mr. W. B. Smith, first assistant, by £25 per annum.

Mr. Chas. W. Salt, A.M.I.E.E., borough electrical engineer of Torquay, has been gazetted as Second-Lieutenant, Royal Engineers (Territorials), London. His private address is "Glenside," Teignmouth Road, Torquay.

General.—Mr. Sydney F. Walker has removed to 85, Shakespeare Avenue, Alexandra Park, Bath.

Mr. E. O. Catford, chief electrician and keeper of the Platte Fougère Lighthouse since 1909, is leaving to return to the Edinburgh & District Tramways Co., Ltd., in whose service he was engaged before going to Guernsey.

Mr. F. K. Cooke, secretary of the Unbreakable Pulley and Mill Gearing Co., Ltd., has been appointed secretary of the Cheshire Society in London, the former secretary having resigned and joined H.M. Forces. We have received a very interesting Year-Book of the Society, containing a list of members.

The marriage was solemnised at Blackburn, on March 23rd, of Mr. Wilfred Pickup, electrical contractor, and Miss Sarah Eccles.

Mr. W. White, a London representative of the General Electric Co., Ltd., has received an appointment in the Aeronautical Inspection Department of the War Office.

Mr. A. W. Empson, who has been serving in the Motor Machine-Gun Service for nearly a year, has recently been promoted to the rank of sergeant. Mr. Empson was previously chief engineer at the Merida electricity works, Yuentun, which position he resigned in order to come home and join the Army.

Roll of Honour.—Private Nicholas Higgins, of the 7th Battalion King's Royal Rifles, formerly a motor tester employed at the Salford electricity works, has been killed in action.

Sergeant R. H. Ward, of the 6th Queen's Royal West Surrey Regiment, reported killed in action in France, was, at the outbreak of war, engaged with Callender's Cable and Construction Co., Ltd.

Obituary.—Mr. Geo. Alfred Neale.—The death is announced of Mr. Geo. Alfred Neale, for many years connected with the electrical department of the Hull and Barnsley Railway Co. He was responsible for several innovations in relation to railway signalling by electricity.

Mr. F. W. Lacey.—We regret to learn of the death, which occurred on March 24th, at the age of 60 years, of Mr. Frederick William Lacey, who was for 27 years borough engineer of Bournemouth.

Will.—The late Mr. John Wood, of Messrs. Mosses and Mitchell, left £14,304.

NEW COMPANIES REGISTERED.

Marshall and Plumtree, Ltd. (143,369).—This company was registered on March 23rd, with a capital of £2,000 in £1 shares, to carry on the business of an electric light company in all its branches, and that of electricians, engineers, &c., and to adopt an agreement with E. Marshall and J. S. Plumtree. The subscribers (with one share each) are: E. Marshall, 8, Netheravon Road, Chiswick, W., electrical engineer; J. S. Plumtree, 39, Vallance Road, Alexandra Park, N., electrical engineer. Private company. The number of directors is not to be more than three; the first are E. Marshall and J. S. Plumtree. Qualification, 200 shares. Remuneration as fixed by the board. Registered office: 20, High Holborn, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Engineering and Arc Lamps, Ltd.—A memorandum of satisfaction to the extent of £1,000 on March 1st, 1916, of debenture dated May 26th, 1911, securing £6,000, has been filed.

Hong-Kong Tramway Co., Ltd.—A memorandum of satisfaction to the extent of £23,400 on various dates between January 19th and March 2nd, 1916, of trust deed dated July 1st, 1913, securing £195,000, has been filed.

Electric Furnaces and Smelters, Ltd.—A memorandum of satisfaction on various dates from May 31st, 1913, to November 30th, 1915, of debentures (no dates given) securing £9,200, has been filed.

Priestman Bros., Ltd.—Particulars of £5,000 debentures, created February 25th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: Freehold and leasehold land and fixed machinery, subject to existing mortgage on part of freehold properties, securing £1,200 and the company's undertaking and other property, present and future, including uncalled capital, ranking after a prior lien debenture for £10,000. No trustees.

Webb Lamp Co., Ltd.—Particulars of £1,500 debentures, created December 30th, 1914, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £1,000. Property charged: The company's undertaking and property, present and future. No trustees.

C. W. Hacking and Co., Ltd.—Particulars of £600 debentures, created February 18th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's property, present and future, including uncalled capital. No trustees.

CITY NOTES.

Metropolitan Electric Supply Co., Ltd.

Mr. W. Harrison Cripps presided on March 22nd, at Salisbury House, E.C., over the annual meeting of this company. The proceedings lasted over two hours, and the great hall was filled with shareholders.

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The Chairman, in proposing the adoption of the report, said the capital expenditure showed an increase of just over £30,000 in the year. The bulk of the capital they had been spending in the past few years had been employed in laying mains, putting up plant, and generally providing for their increasing business in the western area, and it was some years before they got an adequate return. The gross revenue showed an increase of £14,000. He thought the increase was somewhat remarkable, considering the difficulties under which they had been working. Owing to the Government regulations as to lighting they had lost a very large amount of that part of their revenue. It was 20 per cent. less than it was in the year before the war, which meant a loss in revenue of something like £33,000. With such a loss, and with a considerable increase in costs, it was very satisfactory that they were able to make a considerable advance in their gross income, and some increase in their net income. The costs showed an increase of about £13,000. Almost the whole of that was due to coal, and lately they had had to pay something like 30 per cent. more for coal than in 1913, and even then it was of a very inferior quality. The chairman drew the attention of the shareholders to a large cartoon on the walls, showing the figures of the other electric supply companies in London from their published accounts, and said that all the companies mentioned were either in their district or touching their borders. He pointed out that they had all had losses to a certain extent during the year, and at most of the meetings the chairmen told their shareholders that it was a very fortunate and lucky thing that their losses of revenue were so small. One of their competitors—although they worked in perfect harmony with them—the County Co., said at their meeting that they had done as well, if not better, than any other company. That was said by the managing director, and it was perfectly true when he made the statement, as the accounts of this company did not come out until a few days after. There was one company which had done better than any of those mentioned, and it was the only one which had made an actual increase during the year, and that was the Metropolitan Co. They were carrying forward £27,000 out of their net revenue to reserve, which otherwise could have been divided as dividend. It was the largest amount they had ever placed to reserve in any one year, and was £5,000 more than last year. They gave the matter great consideration, but none of them knew what was going to happen month after month during this terrible war, and it was considered wise to keep a little bit more in hand in case of unforeseen emergencies. Their reserve fund was as good, if not better, than that of any London company. They had put £337,000 to reserve, and, as he had told them before, they were really better off than that, because when they sold the Marylebone property they had already put by a considerable sum against the depreciation of the plant there, and the whole of the cost of their plant was given them back at absolutely the price they gave for it, and therefore, although there was no depreciation, they kept the money, and did not take it away from the reserve fund, and there it was now as against comparatively new plant. The progress of the company had been very remarkable during the last year or two, and that was especially so as regarded their power supply. When he told them that in the last two years their power supply had increased by nearly 4,000,000 units, which represented something like 50 per cent. of the supply in the year before the war, they would see the great progress made in that respect, and that progress was still continuing in a remarkable way. Taking the period from January 1st this year as against January 1st last year, they had been turning out 20,000 more units per day, which meant something considerably over one million units in that particular period. But in addition to that, having increased their prices for power, they were a little anxious as to whether people would say that they did not want the dear article, but, as a matter of fact, they had hardly had a complaint. They must remember, when speaking of charges for power, that the smallest fraction in a unit made a great difference when they were talking in millions of units. A tiny fraction added to each unit made all the difference between a loss and a little extra gain, and thus became a valuable asset. In other words, they were selling a very much larger number of power units at the present moment, and at a considerably better price than they obtained a year and a half ago. It was quite impossible for any of them to forecast what was going to happen in the present year. He could only say they were giving a large supply and getting a good price for it, but what the price of coal was going to be, on which, more than anything else, the net profit depended, neither he nor anyone else could say. He felt very strongly that one of the first things that would happen after the war was that they would be able to get their coal and other commodities a great deal easier than they could now, and it was quite certain that having experienced two years' darkness in London, when the Zeppelins were abolished the first thing they would see would be a brilliantly lighted Metropolis, and then their company would get some of their losses back. They regretted having lost two of their old colleagues on the board, Lord Avebury and Sir James Pender, and in their place they had elected Mr. Moncrieff, who was thoroughly experienced in finance, and Mr. Geoffrey Blackwell, a partner in one of the most honoured firms in the country and a very large customer of the company. They had appointed Capt. Rendell as general manager. There was another director whose name was not mentioned in the report, and that was Mr. Tuckett. That gentleman was appointed in October, but was abroad at the time, and was unable to attend any of the meetings of the board until the beginning of January. Having attended two board meetings, for reasons best known to himself, he thought it desirable to resign, and so they only had the advantage of his services for a couple of weeks. Having referred to the loyal services of the staff, the Chairman proceeded to deal with a circular which had been signed by a number of shareholders and sent to all of the holders of shares. He said he did not intend to speak in a hostile manner of the circular, because he did not feel in the slightest sense hostile to those gentlemen who had signed it. There could be no possible objection to any shareholders sending a circular to their fellows, but if it was sent as an *ex parte* statement, then it was incumbent upon them to take every care to see that the statements therein were absolutely accurate, and that nothing was misleading. He ventured to say that without an explanation this circular was misleading. The circular said that the dividend had dropped from 10 per cent. to 3 per cent., and it went on to say that that seemed to have had such an effect on three members of the board that they had found it necessary to resign. That was the inference. It was quite true that the company did pay 10 per cent., but why did the signatories to the circular take the year 1905 and compare it with the war year of 1915? In 1905 they were supplying Marylebone, and their gross revenue that year was £265,000. In the succeeding year, Marylebone was cut off, and their revenue at once fell to £175,000. But that drop had been foreseen, and the arbitrator awarded them £662,000 for that loss—that was for the goodwill of the business they had lost. Of that money £600,000 was returned to the shareholders, who got £6 for every £10 share, and the remaining £62,000 was carried to a special fund in order to help them for a year or two afterwards and increase the dividend for the time being. They could not have their cake and eat it too. They had already had their compensation, and the complaint in the circular seemed to be that they were not getting the dividend as well. That was the explanation of the drop in the dividend. In 1905 there was £122,000 to divide, and the next year there was £66,000; then they got £67,000, and next came in the metallic-filament lamps, with the result that for the next three years there was a gradual falling off in the profit; 1911 was the bottom year. In 1912 their profits began to ascend, and 1913 was a better year still. Then came the war, and he asked any of the shareholders if the board was responsible for that. He did not know the reason why the three members of the board retired, but he knew that when they left they wrote quite proper letters to their colleagues, and there was not a single mention made as to the falling-off of dividend. They all mentioned that they resigned because they did not agree with the internal reorganisation of the company. He had shown there was no cause for alarm in the sudden drop in the dividend, but he would at once say that some of the board had not been altogether satisfied with the management. Before the war some of the directors went into matters very carefully, and came to certain conclusions. Those conclusions were mainly that the charges for their power supply had been allowed gradually for one reason or another to get pretty low for certain large customers, and they thought it desirable that those customers should be raised up to what might be called the standard level which they had in other districts. Some of them on the board thought there ought to be a readjustment in those prices, and others thought it would be better to leave things as they were. Some of the board thought it desirable to reorganise their scale of charges, and that was done, and they already saw the advantage of it. They also looked very carefully into some of the bigger contracts, and came to the conclusion that they ought to readjust them as soon as they fell in, although some would not expire for some time. They found they were losing upon some of those contracts. Of course, the board were responsible for that, but they had always acted upon the advice of their experts. Then some of the board thought it desirable to revert to the old system which was in vogue when Mr. Conacher was there. At that time the engineer made his estimates and then they went before Mr. Conacher, who carefully examined them. They thought it would be better to set free their manager, so that he should have more time to attend to the engineering department, and appoint a purely business manager to take the place of the general manager. That principle of divided management was agreed to by everyone on the board, and it was only when, some months afterwards, they came to fix as to who did this and who did that that there was divided opinion. He contended that reforms had actually been accomplished which would be to the advantage of the company, and one great benefit to the company was that at the present moment the board was absolutely united. The Chairman then spoke of the damage which would be done to the credit of the company by the publication of statements which were not really accurate, and coming again to the circular, which was signed by Sir Gerald Buxton, he said that the board had written to Sir Gerald saying that they were quite willing to have a committee of investigation appointed consisting of two shareholders to be nominated by themselves, and one nominated by the board, and the company suggested that Sir Melville Beachcroft, a late member of the L.C.C. and the Water Board, should act as one of the committee. Sir Gerald Buxton had written

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accepting that suggestion, and, at a later stage, a resolution would be moved with regard to the committee.

Mr. Geoffrey Blackwell, in seconding the motion, said he had joined the board after careful inspection of the balance sheet and accounts and books, with the result that he believed the company was an absolutely sound one and capable of better things than it had recently achieved. The results had obviously been unsatisfactory to the shareholders in recent years, and it was clear to him that some drastic alteration in the management and the policy of the company should be tried. He agreed absolutely with the chairman that it was an unfortunate thing at any time that the functions of a manager and the chief engineer should be united in the same person, as had been the case with that company in the past few years. The policy of the present board was to get higher rates for current and to rigidly restrict capital expenditure, although it would be foolish not to recognise that, with coal at its present price and with the chances of its going higher in the future, it was going to be a slow and difficult matter to improve the condition of the company to an extent which might be possible in more normal times. If, however, after a fair trial their policy did not produce improved results, then he, personally, would be only too ready to vacate his seat on the board.

After some discussion as to procedure, and explanations regarding losses made on the realisation of certain securities, the report and accounts were adopted.

Mr. Gregory, one of the signatories to the shareholders' circular, said that for some time those associated with him, and he himself, had taken a great interest in the affairs of the company, and they found that the dividend had, with the exception of one year, been steadily declining since 1905. They found, also, that there were serious differences of opinion on the board, and they came to the conclusion that the affairs of the company were not altogether in a satisfactory state; and then, just on the eve of the issue of the report, they found that the directors who, in their opinion, had the greatest experience and technical knowledge of the supply of commercial electricity, had all resigned, and that the general manager, who was an acknowledged expert on the subject, had been shelved. Under these circumstances, he was certain they would all feel that their affairs did require a little further thought and attention. He ventured to think the terms of their circular were most moderate. They did not attempt to force down the throats either of the board or the shareholders any particular line of policy. All they asked for was a fair and impartial investigation. They did not get the agreement of the board to the appointment of a committee until their proxies were lodged, and he believed the signatories to the circular represented about half the shareholders, and about half the value of the shares.

The Chairman said he did not know how Mr. Gregory arrived at his figures, as more than half the shareholders had not sent proxies at all.

Mr. Gregory said he had over 70,000 votes and over 800 proxies. It was not material except that he wished the shareholders to know that those who had moved were substantially supported.

Sir John D. Pender moved:—"That Mr. W. S. Poole, Mr. J. R. B. Gregory, and Sir Melville Beachcroft be appointed a committee to examine into the affairs of the company, and to report to the shareholders as to the past and future conduct of the business of the company, with power to examine the books, accounts, and officers of the company, and to employ such expert and other assistance as they may require for that purpose; and that the expenses of the committee and the expenses incidental to the circular of March 7th, 1916, be paid out of the funds of the company; and that this meeting be adjourned until Tuesday, May 2nd, 1916, or such later date as may be arranged by the committee." He explained that the reason why he signed the circular was because his name was on the original prospectus of the company, and at the start he had a good deal to do with the management of it. About 1894 he had to relinquish his seat to take up cable work. Under those circumstances he did not like to see the company going down.

Mr. Johnston seconded the resolution.

Mr. Tuckett, in the course of a very lengthy speech, said he was a director who had resigned his seat, and had listened to the speech of the chairman with astonishment. The chairman, in some particulars, had completely abandoned the attitude which he had maintained for some years. It seemed to him the chairman was hardly competent to come that day and pretend that he was in agreement with directors who had been forced off the board owing to his absolute disagreement with them, whilst at the time the general manager had been also unable to agree with the policy. Were it not that the chairman and Mr. Harris had during the past two years made certain reports, to which he had referred, he thought he would have found considerable difficulty in persuading shareholders that anyone could at this stage of the electrical industry hold such views. Mr. Tuckett proceeded to give quotations from the reports of Mr. Harris and the chairman, which, he said, embodied some of the principles upon which it was proposed that the business of the company should be conducted. The quotations were:—"The question as to what the consumer can afford to pay, or at what price another company can afford to sell, has nothing to do with the Metropolitan Co." "A power load of this sort at £4 and a halfpenny per unit neither pays us nor any London company." "All power prices should be raised to a minimum of 1½d. per unit, and any consumer refusing be disconnected." "As regards power, largely increased prices are, in my view, essential. We shall doubtless lose some of our customers, and connect a smaller number of new ones in the future, but this will be an advantage to the company, as it will set free capital and plant which we shall gradually absorb in supplying a more paying class of business." Dealing with the quotations seriatim, Mr. Tuckett characterised the first as an extraordinary uncommercial proposition. The second dogmatic assertion was made in connection with a large power contract which, he was glad to say, Lord Avebury and Sir James Pender persuaded the board to accept. At present it was returning the company a profit of 13 per cent. Incidentally, he might remark that £4 and a halfpenny per unit was by no means a low or unremunerative price, and there was no London company he knew of which would not welcome such a load at such a cost. They had only to ask any electrical man what he thought of the statement that all power charges should be raised to a minimum of 1½d. a unit, and he would tell them. There were power contracts under 1d. which paid better than others at 1½d. or 2d. It all depended on the nature of the load and the circumstances of the case. Owing to an increase in the power load happening to coincide with a period in which there was no very marked increase in profits, the chairman and Mr. Harris jumped to the conclusion that the power load was unprofitable, and instead of listening to Mr. Highfield, who repeatedly pointed out the true explanation of the results shown, viz., the serious reduction in the lighting revenue and the heavy increase in the price of coal, they set to work to prove their contention by making a series of elaborate calculations which were entirely erroneous and misleading. The standpoint of the chairman was expressed in the following quotation:—"I have not found, as regards the Metropolitan Co., any figures or arguments to show that the works costs of generating a power unit are any less than the works cost of generating a lighting unit. The destination of any unit seems quite immaterial as regards the cost of its production." Consequently, he arrived at the conclusion that every lighting unit sold at more than 1½d. per unit represented so much profit, and every power unit sold at less than 1½d. represented so much loss. The whole argument and the conclusions to which it led were utterly fallacious, but it was, nevertheless, on a policy founded on these conclusions that the business of the company was to be conducted. In conclusion, Mr. Tuckett referred to the position of Mr. Highfield, who, he said, became manager in 1911, and in face of very great difficulties had succeeded in materially improving the position of the company, as would have been apparent to all of them but for the war. Mr. Highfield's insistence on the development of the power and Western area loads, in face of very indifferent encouragement from the board, had gone a long way towards making good the heavy increase in costs and the serious drop in the lighting revenue due to the war. Just as the directors who retired were unwilling to share the responsibility for the policy which the board were inaugurating, so equally Mr. Highfield was unwilling to be a party to carrying it into effect, and no one could blame him, for no one with any regard to his reputation as a business man could afford to associate himself with a policy of sheer stagnation.

Mr. Leverton Harris, M.P., said it was difficult to reconcile Mr. Tuckett's assertion that Mr. Highfield had made the company a success with the fact that the circular had been issued. He stuck to every word he had written in reports made to the board which had been referred to by Mr. Tuckett. The increase in the cost of power had been reasonably received, and he looked for considerable extra revenue from that in the future. He had shares in a number of companies of which Mr. Tuckett was a director, and he did not know of any electrical companies with which he was associated that had achieved any success. The policy of the board was to cut off consumers who did not pay them, and to try and make the Western area a success, but without spending too much new capital.

Mr. A. Samuels appealed to the shareholders to support the chairman, seeing that he held £60,000 of the company's stock.

Several other speakers having addressed the shareholders amidst repeated calls of "Time," the resolution was put and carried.

The auditors having been re-elected, the meeting stood adjourned till May 2nd.

Evered and Co., Ltd.

The net profit for 1915, after providing for debenture and other interest £2,172, income-tax and reserve for war taxes £9,169, and war bonus £2,000, is £22,056, plus £1,925 brought forward. A dividend of 7½ per cent. for the year, free of income-tax, absorbs £12,806, £3,000 is written off plant, £6,000 is placed to reserve, and £2,176 is to be carried forward. The works have been and still are busily engaged on important works. The general trade (home and export), while necessarily suffering from war conditions and the diversion to war work of so much labour and material, has been maintained better than, in the circumstances, might have been expected. The £2,000 mentioned above has been set aside as a war bonus for the staff and certain directors acting as managers. The work of the year has involved unusual efforts on the part of the management and staff.

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Brompton and Kensington Electricity Supply Co., Ltd.

The revenue account for 1915 shows a credit balance of £26,395, plus £5,626 brought forward, and £383 balance of interest received and accrued, and £3,000 is transferred from reserve fund account, making a total of £35,405. After paying the preference dividend of 7 per cent., a further dividend on the ordinary shares of 11 per cent. per annum for the half-year is paid, making 10 per cent. for the year, as in 1914. There is written off the cost of investments £262, and off the shares in and advances to the Brompton and Kensington Accessories Co., Ltd., £3,000; there is placed to credit of depreciation account, raising it to £80,000, £6,394. Directors' additional remuneration accounts for £638, and £6,012 is to be carried forward. The equivalent lamps connected increased by 17,054 to 327,292, and the number of consumers from 6,350 to 6,512. The gross receipts increased from £56,370 to £56,469, and the expenditure from £26,099 to £30,074. The net receipts fell from £30,271 to £26,395. The average price per unit obtained was 4d., as against 3.92d. in 1914. Annual meeting: April 3rd.

Cleveland and Durham Electric Power Co., Ltd.

The capital expenditure on works in 1915 was £9,181. The gross profits, which amounted to £31,157, have been adversely affected by the higher cost of coal and the greater consumption which had been necessary to make up the diminished output from the waste heat generating stations, and also by increases in wages, costs, stores, and other items. After providing for debenture interest, there remains a net profit of £10,972, which, with £8,277 brought forward, makes the available balance £19,249. After paying a dividend of 2 per cent. on the preference shares, absorbing £6,674, transferring to depreciation and renewals £3,000, and putting to reduction of expenses of issue of debentures £1,000, there is carried forward £8,575. The connections to the system aggregated 75,840 H.P., as compared with 66,627 H.P. connected at the end of 1914, an increase of 9,213 H.P. connected. A further 5,785 H.P. has been arranged for.

Arbroath Electric Light and Power Co., Ltd.

Mr. George Balfour presided at the annual meeting. The report for 1915 showed a profit of £1,895, plus £909 brought forward, making £2,804, less interest charges £599, and dividend on preference shares £364, leaving £1,840. Of this, there is to be applied to reserve fund (making it £3,000) £1,000, and to be carried forward, subject to directors' and auditors' fees, £840. Mr. Balfour said the directors had every reason to congratulate themselves upon the result of the year's trade, keeping in view the abnormal conditions now obtaining. The increased cost of coal, wages, and other commodities naturally militated against the company securing the full benefit. Notwithstanding these adverse factors, the net revenue showed an increase of £400. At the beginning of October the price of electricity was increased to both lighting and power consumers, and during the current year the company would obtain the benefit of the increased prices as an offset, at any rate, against a large portion of the increased expenses.

Salisbury Electric Light and Supply Co., Ltd.

Mr. C. J. Woodrow, presiding at the annual meeting on March 21st, said that, considering the circumstances, they had had a very good year. No less than 40 per cent. of the staff were with the Colours, which meant that there was a good deal of anxiety in carrying on a business of that kind. After referring to the increased cost of materials, &c., the chairman said that the revenue from sale of current was £9,322, as against £8,202. The balance on revenue account, £6,342, was £700 more than a year ago. A higher dividend than that recommended might have been paid, but it was wiser not to do so, remembering the uncertainties of the present situation and the Lighting Restrictions Order. They congratulated Mr. Randall, the engineer and manager, on enabling them to present such a satisfactory statement. They were carrying £2,400 to reserve, making it £22,654, so that whatever might happen they were in a strong position.

Bombay Electric Supply and Tramways Co., Ltd.

An extraordinary general meeting of this company was held in London, on March 14th, to consider resolutions providing for the transfer of the control of the company from London to Bombay. The Chairman, Sir Charles Ollivant, explained that the postponed transfer was on account of their present liability to double income-tax, and that the meeting had been called on the requisition of Bombay shareholders—they had on their Bombay register 4,300 shareholders with five shares or less. They had twice memorialised the Government for legislative relief, but without success, and now were advised that they would be exempt from liability for British income-tax if the control of the company's affairs were to cease to be located in the United Kingdom, and that such transfer would not impair their legal status as a British company. Mr. Agnew Turner, representing Bombay shareholders, pointed out that there would be a saving of income-tax alone of £17,000 by the transfer. The resolutions were passed on a poll, showing 86,660 votes for and 5,754 against the proposal.

Automatic Telephone Manufacturing Co., Ltd.

Presiding at the fourth annual meeting at Liverpool, on March 27th, Mr. James Taylor said the profits for the year were £41,867, an increase over the previous year of £3,620. After payment of the preference and 4 per cent. ordinary dividends, providing for depreciation, and writing off preliminary expenses, &c., a balance of £6,774 remained to be carried forward. During the year the company succeeded in completing and bringing into service automatic telephone exchanges at Rosario, Newport (Mon.), Accrington, and Chepstow, as well as some smaller exchanges. In cases where a 24-hour day was worked with a small exchange, it frequently became desirable to install an automatic exchange as compared with eight-hours-a-day conditions, because three operators instead of one were displaced. The company had in hand automatic exchanges at Portsmouth, Paisley, Leeds, and Blackburn, but progress was slow, and the Leeds exchange might be further delayed on account of a large extension. All the automatic exchanges in this country, as well as in Argentina and India, were working quite satisfactorily. Cash in the bank and in hand at the end of the year amounted to £54,000, out of which £45,000 had been invested in Government securities.

British Insulated and Helsby Cables, Ltd.

The annual meeting was held at Liverpool on March 27th. Mr. James Taylor, who presided, mentioned that the company had done a very much larger volume of trade then ever before, many of the branches working continuously night and day. Several new lines of manufacture had been undertaken, and they had endeavoured to obtain foreign business in the open markets with considerable success. At the time of the last annual meeting 625 men had left to join the Forces, and this number had been increased during the year. In addition to ordinary capital expenditure on the business, they had erected a new dining-hall at Prescot for their workers. Stocks and work in progress had increased by £202,000, largely owing to the increased cost of copper, lead, and other raw materials, which had risen to an unprecedented extent. After careful valuation, the directors were of opinion that, despite general depreciation, the value of their securities reached a figure in excess of that in the balance sheet. After Mr. H. C. Woodward had pointed out that the directors were in the happy position of having paid the dividend out of the "carry forward" from the previous year, and urged a more generous distribution of profits, the report and accounts were adopted.

Charing Cross, West End, and City Electricity Supply Co., Ltd.

At the annual meeting, on March 9th, the Chairman, Mr. W. F. Fladgate, in moving the adoption of the report and accounts, pointed out that the drop in net profit on the West End business compared with 1914 was only £3,500, while in the first year of the war the falling off was nearly £12,000. They had recommended a dividend of 5 per cent., to pay which recourse would be made to the dividend reserve account to the extent of £6,000. The result of putting £22,000 to depreciation was that the West End undertaking had now some £171,000 standing to the credit of that account. The war affected the City net receipts by about £2,500 in 1914, and this had been increased last year by some £3,000, but they were able to pay debenture interest, preference dividend, and to carry forward £15,300 to general reserve in respect to the City undertaking, bringing the total to over £86,000. It had been impossible to attempt in any way the amalgamation of their company with others, or to negotiate further with the L.C.C., these matters being deferred till after the war.

Bromley (Kent) Electric Light and Power Co., Ltd.—During 1915 the connections increased from 4,089 to 4,254 KW. There was a profit of £12,150, including £1,621 brought forward, and after paying debenture interest and trustees' fees amounting to £2,979, there is a balance of £9,172. An interim dividend at the rate of 4 per cent. per annum was paid for the half-year in October, and a further dividend at the rate of 8 per cent. per annum, making a total of 6 per cent. per annum, is recommended, £3,000 being placed to reserve and £1,672 carried forward.

Braunton Electric Light Co., Ltd.—The net revenue balance for 1915 was £251. After paying the preference dividend, 2½ per cent., less tax, is to be paid on the ordinary shares, £30 is to be written off formation expenses and 5 per cent. for depreciation of machinery, plant, and accumulators, 7½ per cent. off motors, and 2 per cent. off mains, cables, and services, which will amount to £115, leaving to carry forward £25. At the annual meeting the directors were complimented on the success of the company.

France.—A new company has just been formed in Paris, with a capital of £8,000, and the title La Société de Magnetos and Appareils Electriques S.A.M., to manufacture ignition magnetos and other electrical apparatus. It is also announced that the Société d'Electricité Nilmelior, of Paris, the makers of the Nilmelior magnetos, has reduced its capital from £50,000 to £20,000.

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Reduction of Capital.—*British Vacuum Cleaner Co., Ltd.*—In the Chancery Division, Mr. Justice Neville on Tuesday sanctioned a reduction of the capital of this company. Mr. Manning, who represented the company, said it was proposed to reduce the capital by a sum which had been lost or was unrepresented by available assets, and creditors were not affected. The company was incorporated in 1903 with a capital of £100,000, divided into 100,000 shares of £1 each. The company had been involved in a considerable amount of litigation in support of their patent, more than one case having been taken to the House of Lords; a large portion of their plant had become obsolete and had had to be replaced; and shares in subsidiary and foreign companies had fallen in value. For the last two years the company had traded at a loss, and there was no prospect of the lost capital being recovered. His lordship sanctioned the reduction, in accordance with special resolutions passed by the company, to £30,000.

British Aluminium Co., Ltd.—According to the *Financial Times*, the profit for 1915, together with interest and dividends on investments and deposits, and the revenue derived from Kinlochleven and Foyers estates and transfer fees, is £312,547, plus £24,751 brought forward, making £337,298. As provision for income-tax, legal expenses, bad and doubtful debts, depreciation and proportion of profits payable to directors there has been set aside £41,265, reserve for depreciation £50,000, and to reserve account £70,000. The directors recommend a dividend of 7 per cent. per annum, less tax, on the ordinary shares, carrying forward £24,791. Sales are approximately the same as in the previous year, and, although prices showed considerable advances during the latter part of the year, a large portion of the output was under contract at fixed prices for the whole year.

Newmarket Electric Light Co., Ltd.—During 1915 the equivalent of 692 lamps were connected, making 31,436 total. Including £151 brought forward, the profit for the year was £2,121, which, after providing for debenture and other interest £721, leaves £1,400. A dividend of 2 per cent. is recommended, £650 is to be carried to reserve for renewal of plant, and £219 is to be carried forward. The annual meeting was held on March 20th; the Chairman, Mr. F. E. Gripper, in submitting the report, pointed out that there had been a reduction in revenue, while working expenses remained practically the same; as a final result they had a net balance of £331 less than last year to deal with. A large increase in the coal bill was expected in the coming year, the price having risen from 16s. to 22s. a ton, and it was hoped to recoup the extra cost by an increase in prices. The total equivalent 33-watt lamps connected at the end of 1915 was 31,436.

Alley and Maclellan, Ltd.—For 1915 there is a profit, after providing for excess profits in respect of 1914 and including £1,908 brought forward, of £26,284. After putting £10,010 to depreciation, a dividend of 6 per cent. on the ordinary shares is to be paid, leaving £9,105 to be carried forward.

Folkestone Electricity Supply Co., Ltd.—The profit for 1915 is £16,759, plus £1,438 brought forward. £5,000 is carried to depreciation, £500 to reserve, and 7 per cent. for the year is to be paid on the ordinary shares, carrying forward £2,601.

Prospectus.—The *Times* states that the Scott Electrical Co., which has a share capital of £100,000, divided into ordinary shares of £1 each, is offering for subscription 70,000 shares at par. The company proposes to manufacture complete starting and lighting sets, and also other electrical accessories for motor-cars. The vendor company is the Efandem Co., of Wolverhampton, and the total purchase price will be about £11,000 for patent rights and other assets.

Vickers, Ltd.—The directors announce that, under existing circumstances, the accounts for the year 1915 must necessarily be delayed. In the meantime it has been arranged that the final dividend of 2½ per cent. on the preferred 5 per cent. stock and on the 5 per cent. preference shares will be paid on the 30th inst.—*Financier.*

Simplex Conduits, Ltd.—Including £3,617 brought in, the accounts for 1915 show a disposable sum of £22,127. The directors recommend a dividend of 10 per cent., with a bonus of 5 per cent., transferring £2,500 to reserve, and carrying forward £11,008. For 1914 a similar dividend was paid, but no bonus.—*Financial News.*

Alldays and Onions' Pneumatic Engineering Co., Ltd.—An interim dividend at the rate of 5 per cent. per annum (6d. per share), less income-tax, on the ordinary shares is announced.

Stock Exchange Notices.—Application has been made to the Committee to allow the following to be quoted in the Official List:—

British Ever Ready Co., Ltd.—85,000 seven per cent. cumulative preference shares of £1 each, fully-paid, Nos. 1 to 85,000.

STOCKS AND SHARES.

Tuesday Evening.

Confidence in the Stock Exchange is the corollary to the confidence felt in the country with regard to the issues of the war. That the struggle is nearing its last phases is generally agreed. There are so many indications that the end must be approaching; and so far as Germany's latest loan is concerned, nobody believes that the money which she trumpets as having raised is what we on this side call new capital. Nobody has a fixed date at which the enemy is likely to sue for peace, but the probability of the termination of the war some time, say, within twelve months, is sufficient to hearten people who know that the balance of men, money, munitions and material is all on the side of the Allies.

One of the features during the past few days has been a continuance of the brisk rally in the Home Railway market, prices of the steam stocks going ahead sharply. Amongst them, South-Western deferred gained several points—partly on the idea that the company will benefit from resumption of Continental traffic upon the conclusion of the war, partly because of the statement that the electrification of the line is proving a great success. Underground Electric income bonds recovered their loss of last week, and have risen to 81¼. Districts and Metropolitans are both better. Central London stocks keep about the same as they were.

In regard to Districts, it would not take much buying to raise the price to 20; and this level is quite likely to be touched if the strength of the market as a whole keeps up. It has to be remembered, however, that a good deal of nursed stock is only waiting for a favourable opportunity for realisation; and this factor will hold prices back to some extent until the demand from the public has absorbed whatever may come on offer.

The Metropolitan Electric Supply Co.'s meeting produced a good deal of criticism, but the discussion was less acrimonious than seemed likely in advance, having regard to the extremely pertinent character of the circulars that preceded it. The chairman laid the position before the shareholders with a good deal of frankness, and, in the end, a committee of three was appointed, with the assent of the board, for the purpose of examining the position, and seeing what could be done to help in the restoration of the company's former prosperity. On the strength of this, the shares rose ¼ to 2¼, but in other parts of the electric lighting list the only changes are falls of ¼ in Westminsters and of the same fraction in City of London preference, taking the prices to 5½ and 10½ respectively. Counties keep good at 10½, on their excellent dividend and meeting. There has been a little inquiry for some of the preference shares to which we drew attention in this column last week, and evidently the figures that we quoted as to yields have attracted the notice of the investor as good-class industrial shares.

The Brompton and Kensington report for 1915 shows a reduction of £2,000 to £17,000 in the net profit. To maintain the dividend of 10 per cent., £3,000 has been withdrawn from the reserve. The Bromley (Kent) Electric Supply Co. announces a dividend of 6 per cent., as against 7 per cent. this time last year, which must be accounted a good result for a suburban undertaking.

Considerable disappointment is felt at the dividend on British Westinghouse preference being retained at its previous level of 7½ per cent. Ten per cent. at least had been looked for, and some thought that this rate might be exceeded. The declaration brought in sellers, with the consequence that the price fell 4s. 6d. to £2, which includes the dividend; so that at the present price the return is over 7½ per cent. on the money. The British Aluminium, on the other hand, has increased its distribution from 5 per cent. to 7 per cent.; and the shares are a good market at 23s. 9d. It will be noticed that other manufacturing issues connected with electric supply are keeping steady.

At the meeting of the British Insulated and Helsby Cables, Ltd., held at Liverpool on Monday, the chairman's speech showed that the company had secured a record profit for the year. One of the shareholders thought that the board might have "stretched their consciences a little bit," and given the shareholders more; whereto the chairman replied that if profits still continued in future, the directors would consider the possibility of a larger dividend, and would not begrudge it if it seemed feasible.

Brazilian Traction common shares are a better market at 53. City Services common shares rose to 143 on substantial buying orders from the United States. Canadian industrial shares gave way in sympathy with Americans, which dropped smartly on premature rumours with reference to peace, but there was a fairly quick recovery. The Mexican position is read as being rather better. Mexico Tramways 5 per cent. bonds rose 3 points to 38, though Mexican Light preferred fell a similar extent to 32—which, by the way, is only 6 points below the quotation for the company's first mortgage bonds. The Anglo-Argentine Tramways group is a little firmer after its dullness of last week, but the improvement has not yet found reflection in the prices of its issues. British Columbia Electric Railway stocks remain somewhat depressed.

The telegraph market is quiet, and Westerns are once more

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nearly 13. Indo-Europeans have risen to the round 50. Oriental Telephones are harder, and a dramatic rise in Marconis to 43s. 1½d. has been one of the features of the week. The buying is said to draw inspiration from knowledge of the Government's intentions with regard to the payments to be made to the company, but this is Stock Exchange gossip. Canadian and American Marconis are both better at 8s. and 16s. 6d.; and part of the buying which has raised these prices came from the United States. Henleys are 5s. up at 14½, and India-Rubber shares at 9½ are similarly better.

The animation in rubber shares goes from strength to strength, and has thrown off for the time being its usual allegiance to the market for the raw material in Mincing Lane. In some Stock Exchange offices, the work thrown upon them by reason of the rubber share activity is taxing physical efforts to their uttermost; and some people are seriously asking whether, the country being at war, the Treasury ought to permit the speculation that is undoubtedly going on. However that may be, rubber companies are prospering amazingly; and the batch of spring reports that will be out within the next few weeks will no doubt take up the tale, already told by recent announcements, of the splendid profits and the big dividends that have accrued during 1915, and which bid fair to be surpassed by those of the current twelvemonth. Copper shares have fallen listless after their spurt; and the pyrotechnical rise in the price of metal, so far from inducing speculation in the shares, tends rather to make prospective buyers cautious of dealing in a market so much at the mercy of American manipulation.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1914.	Dividend 1915.	Price March 28, 1916.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	7	—	£7 2 10
Charing Cross Ordinary	5	5	8⅛	—	7 13 10
do. do. do. 4½ Pref.	4½	4½	8⅛	—	6 18 6
Chelsea	5	4	8½	—	5 14 4
City of London	9	8	11⅛	—	6 14 9
do. do. 6 per cent. Pref.	6	6	10½	— ½	5 17 1
County of London	7	7	10⅝	—	6 18 4
do. 6 per cent. Pref.	6	6	10⅝	—	5 18 8
Kensington Ordinary	9	7	5⅛	—	6 18 4
London Electric	4	3	1	—	9 0 0
do. do. 6 per cent. Pref.	6	6	4⅛	—	7 5 5
Metropolitan	3½	3	2⅛	+ ⅛	8 4 8
do. 4½ per cent. Pref.	4½	4½	3	—	7 10 0
St. James' and Pall Mall	10	8	5⅞	—	8 18 10
South London	5	5	3	—	8 6 8
South Metropolitan Pref.	7	7	1⅛	—	6 14 0
Westminster Ordinary	9	7	5⅛	— ½	6 18 4

Telegraphs and Telephones.

	Dividend, 1914.			
Anglo-Am. Tel. Pref.	6	99	—	6 1 0
do. Def.	33/6	21⅛	— ⅛	7 17 6
Chile Telephone	8	6⅛	—	6 5 6
Cuba Sub. Ord.	5	7⅛	—	6 9 0
Eastern Extension	7	12⅛	—	*6 5 0
Eastern Tel. Ord.	7	12⅜	—	*6 4 6
Globe Tel. and T. Ord.	6	10⅜	—	*6 10 6
do. Pref.	6	10	—	6 0 0
Great Northern Tel.	22	34½	—	6 7 6
Indo-European	18	50	+ ½	6 10 0
Marconi	5	2⅛	+1/16	4 18 0
New York Tel. 4½	4½	100⅜	—	4 9 4
Oriental Telephone Ord.	10	1⅜	+1/16	5 14 3
United R. Plate Tel.	8	5⅛	—	*7 19 0
West India and Pan.	1	1⅛	—	9 10 6
Western Telegraph	7	12⅛	+ ⅛	*6 3 9

Home Rails.

Central London, Ord. Assented	4	67½	—	5 18 6
Metropolitan	1½	23⅛	+ ½	4 5 0
do. District	Nil	17⅛	+1½	Nil
Underground Electric Ordinary	Nil	1½	—	Nil
do. do. "A"	Nil	5/8	—	Nil
do. do. Income	6	81⅛	+1½	*8 8 8

Foreign Trams, &c.

Adelaide Sup. 6 per cent. Pref.	6	47	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½	3⅝	—	7 6 8
do. 2nd Pref.	5½	3⅝	—	8 3 0
do. 5 Deb.	5	78	—	6 8 2
Brazil Tractions	4	53	+ ⅛	6 12 1
Bombay Electric Pref.	6	10½	—	5 17 3
British Columbia Elec. Rly. Pfce.	5	53	—	9 8 8
do. do. Preferred	—	38	—	Nil
do. do. Deferred	—	34	—	Nil
do. do. Deb.	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	33	+3	Nil
do. 6 per cent. Bonds	—	35	—	Nil
Mexican Light Common	Nil	20	—	Nil
do. Pref.	Nil	32	−3	Nil
do. 1st Bonds	—	39	—	—

Manufacturing Companies.

Babcock & Wilcox	14	23	—	5 1 8
British Aluminium Ord.	5	23/6	—	4 5 0
British Insulated Ord.	15	11	—	7 19 1
British Westinghouse Pref.	7½	2	4/6	7 10 0
Callenders	15	11⅛	—	6 10 5
do. 5 Pref.	5	4⅛	—	5 17 3
Castner-Kellner	30	3⅛	—	6 8 0
Edison & Swan, £8 paid	Nil	7/-	—	Nil
do. do. fully paid	Nil	1⅛	—	Nil
do. do. 5 per cent. Deb.	5	60	—	8 6 8
Electric Construction	6	14/9	—	8 1 6
Gen. Elec. Pref.	6	9⅞	—	6 8 1
Henley	20	14½	+ ½	*7 15 0
do. 4½ Pref.	4½	4	—	5 12 6
India-Rubber	10	9½	+ ½	*12 0 7
Telegraph Con.	20	34	—	*7 19 0

* Allowance made for dividends being paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, March 29th.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Oxalic	per lb.	1/8	4d. inc.
a	Ammoniac Sal	,,	£70	..
a	Ammonia, Muriate (large crystal)	per ton	£51	..
a	Bisulphide of Carbon	,,	£23	..
a	Borax	,,	£28	..
a	Copper Sulphate	,,	£49	£1 inc.
a	Potash, Chlorate	per lb.	2/6	2d. inc.
a	,, Perchlorate	,,	2/-	..
a	Shellac	per cwt.	96/-	..
a	Sulphate of Magnesia	per ton	£18	..
a	Sulphur, Sublimed Flowers	,,	£14	..
a	,, Lump	,,	£9	..
a	Soda, Chlorate	per lb.	1/4½	..
a	,, Crystals	per ton	60/-	..
a	Sodium Bichromate, casks	per lb.	10d.	..
	METALS, &c.			
c	Brass (rolled metal 2" to 12" basis)	per lb.	1/4½ to 1/4½	..
c	,, Tubes (solid drawn)	,,	1/5 to 1/5½	..
c	,, Wire, basis	,,	1/4½ to 1/4⅔	..
c	Copper Tubes (solid drawn)	,,	1/6½ to 1/6⅔	..
g	,, Bars (best selected)	per ton	£148	..
g	,, Sheet	,,	£148	..
g	,, Rod	,,	£148	..
d	,, (Electrolytic) Bars	,,	£137	..
d	,, ,, Sheets	,,	£155	..
d	,, ,, Rods	,,	£144	..
d	,, ,, H.C. Wire	per lb.	1/5	..
f	Ebonite Rod	,,	8/-	..
f	,, Sheet	,,	2/6	..
n	German Silver Wire	,,	2/2	..
h	Gutta-percha, fine	,,	6/10	..
h	India-rubber, Para fine	,,	3/1½	½d. dec.
i	Iron Pig (Cleveland warrants)	per ton	88/9	3/3 inc.
l	,, Wire, galv. No. 8, P.O. qual.	,,	£32	..
g	Lead, English Pig	,,	£36	5s. inc.
g	Mercury	per bot.	£16 12 6 to £16 15	..
e	Mica (in original cases) small	per lb.	6d. to 8/-	..
e	,, ,, ,, medium	,,	8/6 to 6/-	..
e	,, ,, ,, large	,,	7/6 to 14/- & up.	..
d	Silicium Bronze Wire	per lb.	1/8½	..
r	Steel, Magnet, in bars	per ton	£35	..
g	Tin, Block (English)	,,	£204	£3 inc.
n	,, Wire, Nos. 1 to 16	per lb.	2/9	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

A High-Pressure Plant in Chile.—It was mentioned in this journal three years ago that a German company had received from the Chile Exploration Co. an order for the complete equipment of a power station at Tocopilla, Chile, of a capacity of 60,000 H.P. The power was to be transmitted by three-phase current at a pressure of 110,000 volts to the copper mines at Chuquicamata, where a transforming station for 30,000 H.P. was to be erected in order to yield the direct current necessary for the electrolytic production of copper. The undertaking, which is the first in South America with a pressure as high as mentioned, was to have been completed by the end of 1915, according to the contract. On the outbreak of the war, the greater portion of the plant was on the way in 12 German ships, which were compelled to make their way to the nearest ports in Brazil, Argentina and Chile. After many difficulties, it is stated that it was possible to tranship most of the plant to neutral vessels and convey it to its destination. One of the steamers was obliged to make for Antwerp whence, after the German occupation of that port, the machinery on board was returned to Germany, and it was shipped last year *via* a neutral port to Chile, after the American interests had succeeded in obtaining a permit from the English Government. Notwithstanding the transport difficulties, it is announced that the installation was brought into operation by the stipulated time—the end of 1915—and is working successfully.

The Petrograd Lighting Co. of 1886.—The fate of the Petrograd Electric Lighting Co. of 1886 has apparently not yet been decided, although the Town Council of Moscow, where the company also owns supply works, is continuing its efforts to bring about a liquidation on the alleged ground that the undertaking is under German control. According to the Swiss newspapers, the new Prime Minister of Russia recently informed the Moscow municipality that in view of the maintenance of customary working under Government supervision, it would be necessary first to prove that the activity of the company was prejudicial to the interests of the State, in order to secure liquidation, as only in this event could the winding-up be undertaken. In Swiss circles, which are large holders of share capital in the company, it is calculated that the dividend on the ordinary shares for 1915 will experience a moderate increase as compared with 1914, when a rate of 8 per cent. was declared, though its distribution was deferred.

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BALL BEARINGS FOR ELECTRIC MOTORS.

By T.E.C.H.

An electrical engineer will generally admit that he is not free from troubles due to faulty bearings, either owing to wear, or because the lubricant is insufficient, or else excessive, in which case trouble results when the lubricant comes in contact with the windings. These difficulties have existed from the earliest times, and, the writer thinks, will always obtain when the ordinary sliding type of bearing is used. The most costly item, and usual cause of in-

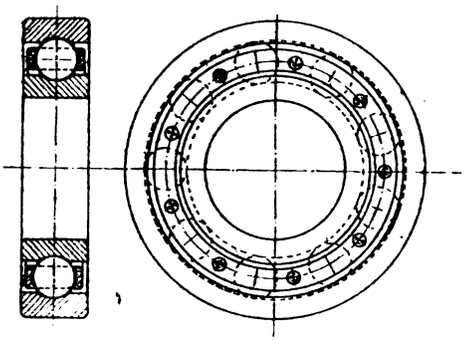

Fig. 1.—Radial Bearing.

efficiency, is the wear which must occur when surfaces under pressure rub against each other; while the wear is very often reduced by improved methods of lubrication, it cannot, it appears, be altogether removed, and although the cost of a new bearing is small, the damage done by an armature fouling the poles due to wear is very expensive, especially in the largest sizes.

Ball bearings can be considered free from this wear when not overloaded, and are, therefore, of value to the electrical engineer, enabling him to obtain the highest possible bearing efficiency. The following notes are intended to ensure a clearer understanding of such bearings and of the proper mode of mounting them.

Initial Cost.—The initial cost of the motor is reduced because:—(*a*) The air gap is very materially reduced, which results in a saving of copper; this reduction is not limited by bearing requirements; (*b*) the over-all length of the motor may be less;

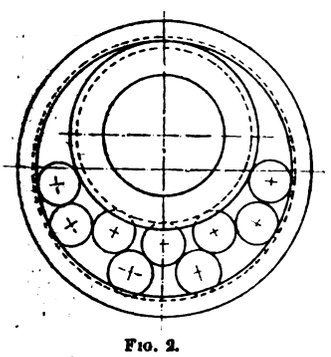

Fig. 2.

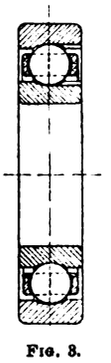

Fig. 3.

Fig. 2.—Radial Bearing, showing races placed eccentrically for assembly.

(Number of balls which can be assembled, small.)

Fig. 3.—Radial Bearing, showing cut-in races to enable a greater number of balls to be assembled.

(*c*) the end cover is a very simple casting, since it is not necessary to provide an oil well, which necessitates a complicated pattern and very careful moulding to prevent a large number of wasters being cast.

Design.—To enable the surface of the ball races to resist the stresses imposed by the rolling of the balls when under loads, the steel must have a very close structure and high elastic limit; this is obtained when the races are hardened throughout and then suitably tempered. At the present time most makers of good repute use a special chrome-steel alloy. Some of the early bearings were made by using a cheap steel, case-hardened, but with heavy loads failure resulted due to the surface of the steel not being supported sufficiently to enable it to offer adequate resistance to penetration or indentation by the balls, the smooth surface of the ball race being destroyed. To enable the surface of the ball path to resist penetration, the balls themselves must not be loaded above that which the ball path will withstand, or in other words, to obtain the highest load-carrying capacity the maximum number of balls must be used.

This requirement has resulted in many designs to obtain the maximum number of balls in a journal bearing of the type shown in fig. 1. Fig. 2 shows the races placed eccentrically, and fig. 3 shows a side recess in the races to enable a greater number to be assembled than is possible by placing the races eccentrically. Fig. 4 shows a later design of bearing, to obtain assembly in which the balls across an

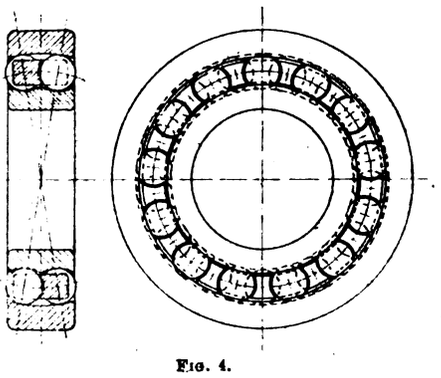

Fig. 4.

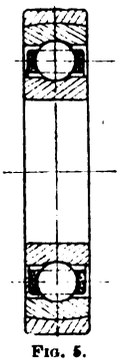

Fig. 5.

Fig. 4.—Radial Bearing. Maximum number of balls can be assembled.

Fig. 5.—Radial Bearing, with Radial Seating for Self-Alignment.

opposing diameter of the inner races upon which the balls are held by the cage are taken out; the cage is then passed into the outer race side-ways, and then swivelled across another diameter, and the missing balls are filled in.

Ball Contact.—The steel from which the balls are made will deform when under load, and therefore give a definite area of contact with the races; this should be the maximum possible without any sliding taking place, and also equal upon both races. With the design shown in fig. 1 the contact area of the ball with the outer race is greater than with the inner race, and therefore the stresses caused in the two races are different, for while the stress in the outer race is comparatively small, the stress in the inner

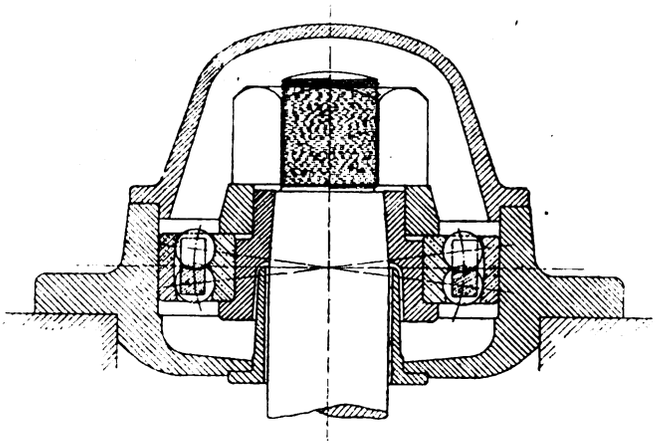

Fig. 6.—Mounting of Top Radial Bearing for Vertical Shaft.

race is the maximum. With the design shown in fig 3 the contact area between the balls and the two races should be the same, and is so when the diameter of the balls and the diameter of the ball path are correct.

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Alignment.—For those applications where there is no vibration, and the housing is of heavy design and accurately machined, the bearing shown in fig. 1 has proved very efficient, but where deflections and vibrations occur, it is advisable with this design to use a self-aligning seat or race as shown by fig. 5. This aligning difficulty is not present with the bearing shown in fig. 4, a frictionless self-alignment taking place by means of the balls rolling on the spherical inner surface of the outer race.

Fitting.—The inner race of a radial bearing should generally be a light driving fit on the shaft and held against a shoulder by means of a nut. This method is found efficient and prevents the inner race from creeping. Some makers prefer the inner race to be a heavy driving fit on the shaft and dispense with the nut and shoulder mentioned above, and for this purpose supply slack bearings; although for very small motors, and when great care is taken, this method may not cause trouble, this cannot be said for the large motors. The outer race generally should be a sliding fit in the housing, and no shake should be allowed, though sometimes a light tapping fit gives better results. When the bearings are mounted in a separate housing which is independent of the end cover, a considerable saving is effected when assembling, and grit and dirt are kept away from the bearings when the armature is disassembled for any purpose.

Lubrication.—Ball bearings require lubricating, and the lubricant used must be free from acid and alkali. Grit and dirt must be excluded from the bearings, and for this purpose felt washers are generally used. Oil-retaining sleeves are used for vertical shafts, as in fig. 6. The demand for reliable motors can only be met when efficient ball bearings are used, made from suitable steel, and to the required degree of accuracy.

Applications.—Fig. 6 shows the top bearing for a vertical shaft mounted in a suitably designed housing, embodying an oil-retaining sleeve. Fig. 7 shows the bottom bearing for the same vertical shaft; a thrust bearing to take the total vertical load is mounted in combination with a radial bearing similar to the one above. It will be noticed that the load passes from the shaft through the sleeve on to the thrust bearing, and does not pass through the inner race of the radial bearing, this being a point which is not always given its due share of attention.

Fig. 8 shows the mountings for a horizontal-shaft motor, the bearings of which are fitted in housings independent of the end cover. It will be noticed that only one of the radial bearings is held side-ways to keep the shaft in line; the length of the distance pieces marked A must be taken from the actual machine during the trial run when the armature has adjusted itself to the magnetic pull. The bearing which is fixed to keep the shaft in position sideways should be the one which has the least radial load to cope with, and which is nearly always the one furthest from the pulley end.

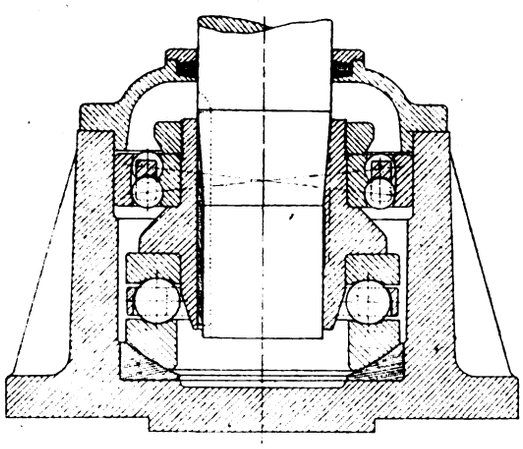

Fig. 7.—Mounting of Bottom Radial Bearings for Vertical Shaft.

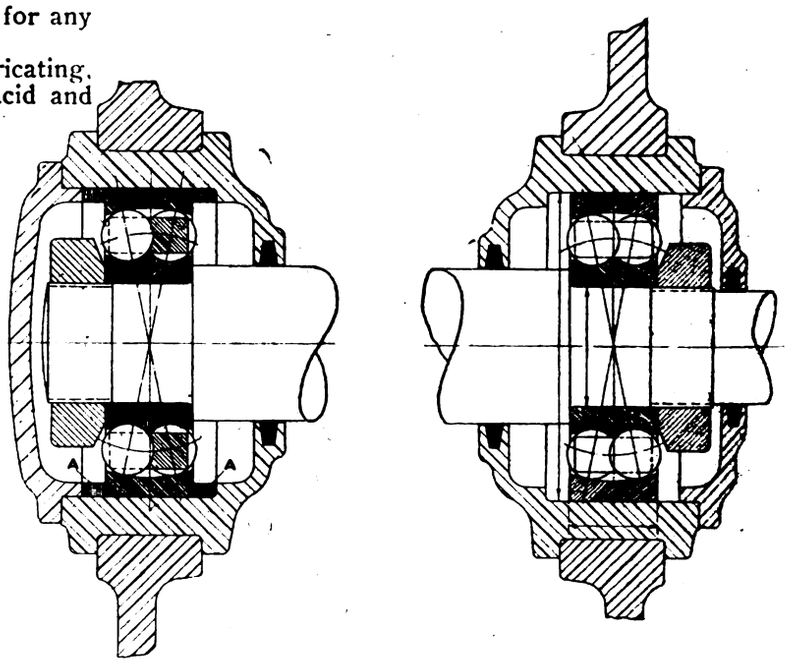

Fig. 8.—Mounting of Radial Bearings for Horizontal Shaft.

THE USE OF CONTINUOUS CURRENT FOR TERMINAL AND TRUNK-LINE ELECTRIFICATION.

By N. W. STORER.

(*Abstract of paper read before* The Institution of Electrical Engineers, *March 16th*, 1916.)

(*Concluded from page* 355.)

The use of field control usually involves the use of two additional switches for each motor where switches are used, unless two motors are connected permanently in series, when they can be controlled by the same number of switches as a single motor.

Much the same conditions prevail where the equipments are arranged for regenerative control. Where the motors are to be operated to give regeneration when connected all in parallel, it will be necessary to have a regulating apparatus for each motor, and consequently the additional control apparatus will be very considerable, requiring so much in fact as to make the regenerative control of very doubtful value.

That it is perfectly practicable to operate complicated control systems satisfactorily and reliably is shown by such examples as that of the New York, New Haven and Hartford A.C.-D.C. locomotives, which operate both from an 11,000-volt single-phase trolley and from the under-running 600-volt continuous-current third-rail of the New York Central system. The author has no desire to see that method of operation extended, but the control complications introduced by such an equipment are small compared with what would be involved in operating over three or four continuous-current voltages with full speed on three of them and with several different forms of contact devices.

The problem of supplying the power for auxiliary circuits on equipments receiving power at several different voltages is one of the most troublesome features to be considered, except where only two voltages are encountered, such as 600 and 1,200, which are very common in the United States. For the higher voltages it may be that the use of a storage battery, such as that provided on the 5,000-volt car equipment previously referred to, may prove to be the most satisfactory means. On this equipment a small-capacity storage battery, to which all the auxiliaries are connected, is included in the driving-motor circuit on the earthed side. The compressor can be so arranged that it will receive probably at least 90

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per cent. of its operating current directly from the main circuit without the current passing through the battery, which floats on the line and is thus of comparatively small capacity. This system has the advantage of always maintaining practically the same voltage for the auxiliaries regardless of the voltage on the line.

For locomotive use, where the auxiliaries require considerably greater power, it is quite feasible to use a motor-generator to supply power to the auxiliaries. The motor should be series wound, so as to secure the greater stability due to that type of winding. The great objection to this as well as in the remainder of the equipment to operating on several voltages, is the multiplicity of switches, change-overs, and main and control wiring and other details involved. It soon gets to the point where the ordinary car inspector cannot handle it.

Conclusion.—The logic of this paper points to the necessity for the early standardisation of some of the more important features connected with electrification. The benefits of standardisation would be immediately felt not only in the greater security of the railways in embarking on a project of electrification, but in the decreased cost of all apparatus connected with it.

A good plan would be to secure the fullest co-operation of all concerned, carefully canvass the entire subject, and make definite recommendations for standards. The initiative in such an important matter should be taken by the Institution, which numbers among its members all those who are necessary to decide such questions on their engineering merits. Its own prestige will go far towards making its recommendations into laws, but it would be well to secure the co-operation of all other organisations that are interested. All must approach the subject with an open mind so as to determine as nearly as possible what will be the best for all, and their decision should be accepted as final. Such things as the location of the contact rail for a third-rail system, and of a contact line for overhead systems, could be discussed and settled within a short time; also the question of voltage can be considered and decided before any further railways are electrified or extensions made to existing continuous-current systems.

Since the 600-volt system is so thoroughly established, and also so well suited to the requirements of terminal electrification, it should be continued as one of the standards, at least for the present. While it is probable that but little will be done towards electrification of entire railway systems in the next few years, one other voltage should be selected that will be suitable for such service and will at least serve to direct the aim of those companies about to electrify. This voltage should be high enough to permit the heaviest drafts of power required to be collected from the overhead conductor without exceeding the capacity of a single wire or a single collector, and to reduce the amount of copper in the feeder system to the lowest value consistent with reliable distribution. If the equipments are obliged to operate at full speed on 600 volts, it is practically useless to think of anything higher than 2,400 volts. A still higher voltage should be adopted if continuous current is to be used for trunk-line service with heavy trains.

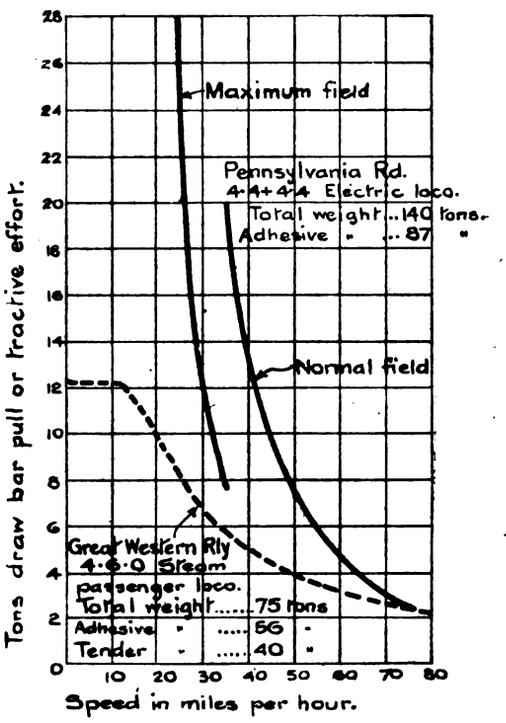
It is generally conceded that 1,500 volts is about the maximum voltage that can be economically used on the 4-pole railway motor. The type of motor used for the 5,000-volt equipment that has been mentioned previously offers a solution for the problem which makes a very considerable increase in line voltage appear not only possible, but easy in so far as commutation and commutation bars are concerned.* The first two motors of this type were tested with 7,000 volts on the line, *i.e.*, 3,500 volts on each motor, with very satisfactory commutation. The limit to the voltage will therefore be found elsewhere than in commutation. The question of insulating motor and control for such high voltages would also appear to be less serious than might have been expected; the sample equipment of four 100-H.P. motors has run over 15,000 miles in commercial service without a single defect in the high-voltage insulation, and the operation of the equipment has been highly satisfactory in every respect.

The author suggests that if possible the "through" lines should be differentiated from the purely suburban lines, and that the best voltage for the former should be adopted regardless of the latter; that an overhead contact wire in addition to the 600-volt third rail be placed over each track that requires full-speed operation for both equipments. While such a scheme has its disadvantages, they are negligible compared with the complication of equipments necessitated by the interchangeable operation on several different voltages.

Discussion in London.

Mr. O. H. Merz, who opened the discussion, regretted that the author was not there to take part in the meeting; he had always looked upon him as one of the most original railway engineers in the States, and he had many original ideas, as, for instance, the double armature motor for 5,000-volt direct-current work. Considering its advantages, it was surprising that more use had not been made of regeneration; until recently the only successful example of its use was on the Italian 3-phase railways. He thought there was no example of its use here on stopping services. The use of high voltage should simplify its adoption, because they would already have the dynamotor, which could be used for field excitation. The author urged them to standardise their electric railway work, and he thought most railwaymen would consider the 600-volt third-rail system as a standard for many years to come, but they must certainly also have a higher voltage if they undertook main line electrification. He did not think it could yet be decided whether the third rail or overhead wire would be adopted in main line work; in the States the long distances necessitated the use of at least 3,000 volts, which meant using the overhead system, and the system adopted in this country would depend on the higher voltage limit. No doubt the 1,200-volt construction used on the L. & Y. Railway would be good enough for 1,500 volts, but that did not seem high enough.

Mr. Roger Smith referred to the paper which he had read before the I.E.E. in 1914, in connection with which he had said that no electrical locomotive was in existence which would give 1,100 H.P. at any speed between 30 and 70 miles an hour, as was done by the main line steam locomotives in passenger service. The author, however, mentioned the Pennsylvania D.C. locomotives, which would develop 1,200 H.P. at any speed between 42 and 76 m.p.h., and up to 4,000 H.P. at lower speeds, which he suggested would be better than any steam locomotive. He (the speaker) pointed out that the



Curves of Draw-bar Pull (Steam Loco.) and Tractive Effort at Wheel Treads (Electric Loco.), submitted by Mr. Roger Smith.

Pennsylvania locomotive weighed about 145 tons, or twice as much as the steam locomotive, and in using it they had to haul about and pay for a machine which developed 4,000 H.P. in order to get 1,200 H.P. at high speed. For the goods locomotive, the series characteristic was admirable, and looking beyond the suburban service to goods working, field and regenerative control would be very valuable, but would probably involve the use of at least 20 switches for a four motor equipment. We were not in a position to settle the upper voltage limit for railway working. The 1,200-volt protected third rail on the L. & Y. Railway had given great satisfaction, working through the recent snow without a hitch. The snow formed an arch over the slot which preserved the vertical collecting face of the rail from wet, &c. It was important to note that nothing had been done to commit them to any voltage at all; they would have to decide first on the needs of suburban routes, and, later, on those of the main lines, and use equipments suited for use on both systems. There were districts in industrial areas where the tunnels would not admit of overhead wires. A 1,500-volt third rail system would work in well with a 3,000-volt overhead system, but he hoped that the switchgear for use on the two systems would not prove too complicated if used with regenerative and field control.

Mr. Lydall gave some data of speed range and tractive effort of 600 and 1,500-volt locomotives, from which it appeared that the desired electrical characteristic would not be so easily obtained on high as on low voltage. Referring to the necessity of interchanging electrical rolling stock and locomotives, he said no mention had been made of the Brighton Co.'s single-phase line, and suggested as a climax for future conditions a train equipped for running on two direct-current voltages and a single-phase current of high voltage. Very little information was available as to the extra cost of high-voltage train equipment, and it was a factor in the comparison. No doubt a 3,000-volt equipment would cost substantially more than one for 1,500 volts. He added that they could not decide yet on suitable standard voltages.

* A description of this system appeared in the Electrical Review of March 24th, 1916, p. 343.

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Mr. H. W. Firth said he was glad the author's attention had been drawn to the discussions on motor characteristics for railway working which took place at the Institution two years ago, and particularly to the wasteful methods involved. He would like to know whether he was really sanguine as to regenerative control on multiple unit trains; if his surmises as to the future were correct, then considerable economic improvements were in sight. They must do nothing in the matter of line voltage which would stop the interchange of locomotives and trains between different sections of railway. The author's views as to separate voltages would not commend themselves to railway men, as, unless it were possible to separate traffics, it would mean duplicating equipments. Most of the speakers seemed to accept 600 volts as suitable for suburban working, but that tied them practically to 1,200 volts as the upper limit, and it might be necessary to go higher later on. For instance, he saw no reason why 1,200 volts should not be adopted for the lower standard, but the time was not ripe for fixing the upper limit.

Dr. S. P. Smith said the author dealt with the characteristics of the series motor and showed its suitability for certain work, but the position was not quite clear when it came to larger outputs. He was afraid they would not get what they wanted for large locomotive work with field control, and they might have to aim for A.C. motor characteristics. Perhaps the single-phase series motor might solve some of the difficulties outlined by Mr. Roger Smith. He asked what would happen to a motor used continuously as generator (for regeneration) and as a motor for driving, with no opportunity of getting rid of heat, and yet restricted to the present limiting dimensions. American engineers had probably experienced the difficulties of varying voltages and systems, and he understood that the paper had been written as a warning against the use of more than two voltages.

Mr. H. M. Sayers said that the experimental work on regeneration had been mostly carried out on tramways in this country, and it had resulted in failure. One reason for this had been mentioned—the motor was in use always and had no time for rest. Further, a regenerative motor really required a shunt characteristic, and this was not very suitable for acceleration. But such a motor could be used by introducing between it and the wheel a speed-torque gear of satisfactory construction, and he understood that such a gear was available. This point was worth considering in connection with regenerative control and main line railway problems.

Mr. J. S. Peck, who read the paper in the absence of the author, replied briefly, agreeing that there had not been enough experience to fix standard voltages. He suggested, however, that it would be an advantage to fix some temporary standards on our present knowledge rather than go on on haphazard lines. He briefly outlined the basic method of regeneration, pointing out that many "frills" were being added, and expressed confidence in the ability of the modern motor to stand up to the extra strains due to regenerative working.

Discussion at Newcastle.

At a meeting of the Newcastle Local Section on March 13th, Mr. J. S. Peck, of Manchester, read an abstract of Mr. N. W. Storer's paper.

Mr. J. R. Beard thought the field-control system had its disadvantages. The normal condition of the motor was that some of the field was shunted, and that meant that so much of the copper was out of service, and consequently the motor had to be slightly larger to compensate for that. The section of the paper referring to regenerative control was the most interesting one, and on this question much work would be done in the near future; if regenerative control were used they certainly had much greater freedom in regard to the speed at which they braked. Speaking of standardisation of the third rail, he thought it was bound to be left over until they had had sufficient experience of the new third rail on the Lancashire and Yorkshire Railway.

Mr. W. G. Guns regarded the reference to regenerative control as the most interesting in the paper, but said the difficulty was to get a machine that would be suitable for both motor and generator. The difficulty was there overcome by providing additional shunt coils for use while the machine was generating; he thought it would be better to use the same coils.

Mr. O. Turnbull drew attention to the double-armature motor, and said the difficulty was the question of space; the motors were fitted to inches, and there was room for nothing else. As to regenerative control, he pointed out that the trouble there might be that there were not sufficient cars to absorb the regenerated current, and it would come back on the station. There were cases where the amount of current coming back was greater than that absorbed. Still, he thought the regeneration of energy would do a great deal to bring about the electrification of our lines.

Mr. T. Carter urged the importance of the question of standardisation, and thought the Institution should take up the point.

Mr. L. H. Carr said with regard to standardisation, that something might be done by the railways in conference, as had been done in part in connection with the third rail.

Mr. Peck briefly replied to the discussion.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

German Silver an Outgrown Superstition.

Mr. Thompson, in the *Journal* of the Institution of Electrical Engineers, sets forth many facts which bear on the use of German silver for resistance coils. The writer considers that any discussion of German silver as a material for resistance coils ought to be relegated along with the discussion of ancient ideas regarding the nature of a magnet. Since electrical engineering began to outgrow the telegraph stage, German silver as a material for resistance coils has been thoroughly discredited, and almost entirely given up. It is probably a fact that any alloy containing zinc is unfit to stand any sort of hard usage, such as exposure to the weather or the heating and cooling with exposure to the air incidental to the work ordinarily put on resistance coils. In the last 20 years alloys have been produced which answer almost every possible need of the electrical engineer for resistance coils. Many of these are of great value, and thoroughly well adapted for the particular purpose for which they are designed. These alloys should be better known. Very little experience is enough to indicate what material to use for a particular case. The writer does not know of any single use where German silver could be recommended.

If a definition of German silver should be wanted, here it is: "Brass with a percentage of nickel (very often 18 per cent., but sometimes more or less)."

Charles Wm.

Philadelphia, U.S.A.

Concerning Discounts.

Mr. Fisher's letter mentioning the T.L.A. discount sheet is interesting. He shows that, after getting out a complicated arrangement of discounts, the T.L.A. provide a sheet showing the equivalent simple discount. But why do the T.L.A. not use the simple equivalent discount right away?

We should howl with laughter if someone came from China and told us that the Chinese did business in this way. The whole system reminds one of an incident which is said to have occurred in a certain shipbuilding centre. Some neutral naval officers came across with regard to work being done for them. In the course of their visit they saw through the shipyard and inspected everything in the way of warship work that was being done for our own Navy. Then as they left the harbour they were carefully taken down into their cabins so that they might not see what was happening! Need one add that they were profoundly impressed by our method of preserving secrecy?

The Writer of the Article.

Cause of Flicker.

Confirming the opinion expressed in Mr. Long's letter, I remember about 15 years ago going from Bristol to investigate a flicker on the lights of a large passenger steamer in Southampton Docks. The effect of the flicker on the lights in the saloon was very noticeable when all lights were on. The defect was entirely cleared up by adjusting the valves of the engines.

This occurred so long ago that I have forgotten the name of the boat and even the name of the maker of the engines; but they were vertical engines direct-coupled to the dynamos.

H. Visger.

An Engineer's Wages.

We were interested to note "Experience's" letter in a recent issue of the Review under the above heading, and it would appear to us that "Experience" is one of the many disappointed men who, after the completion of their college training, are unable to obtain remunerative employment.

If "Experience" has not yet been able to solve his difficulties, we should recommend him to adopt the course which many men have found to be inevitable, and obtain a position as an apprentice in one of the many large engineering works, which would carry with it a remuneration of seven or eight shillings per week, experience, and plenty of hard work.

After the completion of his apprenticeship "Experience" may possibly be surprised to find that he is then able to meet his landlady's account with his own earnings.

Two-Phase.

Manchester, *March 21st*, 1916.

[Our two correspondents are quite right; a graduate from no matter what college has no claim to the title of engineer, and no right to expect an appointment in any such capacity, for there is one element in the training of an engineer which cannot be imparted by any teaching institution—*experience*. If our correspondent who, with unconscious irony, used that pseudonym, has been led to believe that when he has passed through his college course he is an engineer, he is the victim of a cruel deception.—Eds. Elec. Rev.]

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The Engineer in the Tropics.

In an article headed "The Engineer in the Tropics" in your issue of the 17th inst., the author makes at least one mistake. Towards the end of the article he says that "in India, Africa, and Malay States, white patrol jackets buttoned up to the chin are usually worn." Whether he is right about Africa and the Malay States I do not know, but in India certainly one seldom comes across this style of "get-up," except among the lower classes of Europeans (and then seldom) or travellers from "further East." Jackets cut to the same pattern as one's home clothes are *de rigueur*, and in the more civilised parts, *e.g.*, Calcutta, Bombay, &c., they must not be white, although the trousers may be. The coats should be either of light "holland" material, silk, or flannel, and the latter being slightly yellow provides the necessary contrast with the trousers. The trousers may be of the same material as the jacket, unless the latter is flannel. It is a small matter, but may as well be correct if mentioned at all. It is always best to buy clothes on arrival in the Tropics, and not at home, as then one gets the correct things for local wear. A man fitted out by a "colonial outfitter" is usually a source of amusement to everybody but himself. All he need take from home is a sun helmet and ordinary summer clothes.

The author of the article also recommends corrosive sublimate for wounds and scratches. It is true that this extremely poisonous substance cures "prickly heat" very quickly, but it has to be applied in *very* weak solution, and even then the result is usually very bad boils, due, presumably, to absorption of the poison into the system. Personally, I have given up this "cure," as I prefer the "prickly heat" to the boils. In any case, I have been advised by doctors that on no account must corrosive sublimate be used on or near open cuts or scratches, and chemists usually give the same warning. I am unable, therefore, to understand the recommendation in the article in question, and I certainly think a warning is necessary, although I profess no medical knowledge myself.

"Kole Hai."

Wiring Problems.

Apropos of the new wiring rules issued by the Institution of Electrical Engineers, where would you find a ruling for the following claims which were put to us in one day:—

No. 1. We tendered for the cabling in connection with a 15-H.P. motor, and in our specification we stated exactly the size and quality of the wires to be used. The cabling provided for nearly 25 per cent. overload, but the customer claimed that it did not comply with the rules, as his machine would give an overload of 50 per cent. for half an hour and 100 per cent. momentarily.

No. 2.—We were instructed to join up a 20-H.P. motor, but as the motor was only doing about 2 H.P. we were requested to provide for that load only.

Needless to say, we have settled both these matters satisfactorily to ourselves and the customers, but other views would be interesting.

L. E. Wilson.

Manchester, *March 24th*, 1916.

The B.O.E. and the C. & G.

Your journal is read by many students who will presently be answering examination questions on electrical engineering; and some of them now understand the serious inaccuracy of the old rule for getting greatest current from a battery, which is still obstinately adhered to by professors connected with the Board of Education and the City and Guilds of London Institute. These candidates may be wondering whether they would run any risk of losing marks if they employed my rule, and thereby got a correct answer that the examiners were not expecting; for both these institutions have either been giving full marks for wrong answers, or setting questions that are all specially suited for a rule that is known to be bad. You will, therefore, perhaps allow me to show the following way out of the difficulty.

Suppose the candidate is asked what arrangement of 20 1-volt and 1-ohm cells will send the greatest current through an external resistance of 13 ohms. With 10 in series and 2 in parallel the resistance of the battery would be 5 ohms; and with all in series it would be 20 ohms. Therefore, the greater of these resistances being the nearer to that of the external circuit, the old rule would tell him to put the cells all in series; and he should give this answer without any comment; for *the old rule will always be right when it indicates an arrangement with more resistance than the external circuit.*

But now, suppose that the external resistance had been 12 ohms, which is nearer to the smaller of the above two battery resistances. Here the old rule would tell him to put 10 in series, which would give a current of $10/(5+12)=10/17$; whereas my rule would tell him to put all in series, which would give a current of $20/(20+12)=10/16$, evidently an increase of exactly 6¼ per cent. (I have chosen a number of cells that is particularly favourable for the old rule; otherwise my rule might have given an increase of 20 per cent., 100 per cent., or anything you please.) Here the candidate should say something to the effect that *when the external resistance is between two consecutive battery resistances and nearer to the smaller one, both of them should be tried;* and he should then show that the greater current is obtained with all the cells in series. So long as he takes care not to mention my name or my pamphlet, I do not think it will be necessary for him to give a wrong answer in order to get full marks.

W. F. Dunton.

Newcastle-on-Tyne, *March 27th*, 1916.

[Mr. Dunton is aware that we regard the grouping of cells as of little importance in practice; but his letter raises a totally different and very serious question, for he suggests that the examiners of these two great educational authorities have been deliberately "loading the dice." That Mr. Dunton's argument with regard to the "old rule" is correct is indisputable; we feel sure, however, that the examiners, if they have erred, have done so through inadvertence and not of set purpose.—Eds. Elec. Rev.]

THE RÖNTGEN SOCIETY.

At the March meeting of the Röntgen Society, held at the Institution of Electrical Engineers, the discussion on the protection of the X-ray operator, adjourned from the previous meeting, was resumed.

Dr. W. Harwood Nutt said that several X-ray workers complained of headache and sleepiness after a short time in the X-ray room. In his opinion this was due, not to the ionisation of the atmosphere, but to the generation of ozone, and some experiments he had conducted showed that ozone was actually produced in the neighbourhood of the tube.

Mr. W. A. Schall put in a mild plea for the manufacturers of X-ray apparatus. He had no doubt that there was room for improvement, but until the manufacturer was definitely told what he must guard against he was in a difficult position. The manufacturer did not yet know what the medical man wanted. One authority would say that a covering of 2 mm. of 4.5 lead rubber was amply sufficient as a protection; another that it was not nearly enough. They had yet to find out what thickness of lead rubber was equal in opacity to the human tissue.

Dr. G. B. Batten referred to the enhanced danger of those X-ray workers who, in addition to working with the tube, had to do with chemical substances, such as developing agents. These would often precipitate an X-ray reaction which otherwise would have remained latent.

Major Wilson, of the Canadian Medical Service, said that the ideas of British manufacturers on the subject of X-ray protection were certainly below the standard which was deemed necessary with the heavy transformer outfits obtained from the United States and Canada. He believed, with a previous speaker, that the tired feeling was due to ozone, no matter whether generated from the terminals of the tube or those of the transformer itself.

Mr. T. Clarke made the surprising statement that he had worked for 20 years at X-rays without any protection whatever, and had never received any injury. He had employed a static machine, and in his opinion X-rays from a tube excited by a static machine were comparatively harmless, and were different in nature from those given by a tube excited by an induction coil.

Upon this point, Dr. Sidney Russ, in replying on the discussion, said that there was no reason why, if the potential difference between the electrodes was the same, there should not be identity betwen the rays thus differently produced.

The President of the Society, Mr. J. H. Gardiner, announced that the authorities of the National Physical Laboratory were prepared to examine and give a certificate upon protective materials which would enable both manufacturers and users of materials to know the absorption coefficient of the protective devices they supplied and used. He also stated that the Council of the Society had under consideration resolutions on the subject of the efficiency of X-ray apparatus from the point of view of safety, which would be submitted to the War Office and Admiralty.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SWEDEN.—The exportation of the following, among other articles, has been prohibited from Sweden:—

As from February 8th.—Driving and transmission belts of leather, rubber, gutta-percha or balata, even in combination with other materials.

As from March 1st.—Boots and shoes of tissue, with rubber soles; tungsten wire.

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RUSSIA.—In virtue of an Imperial Decree, dated January 7th, the Russian Minister of Finance, in conjunction with the Minister of Commerce, has been empowered temporarily, until the close of the war, to diminish or increase, in accordance with local conditions, the period fixed for the payment of Customs duties on goods (including postal parcels) received at Customs establishments, to issue regulations with regard to the warehousing of the same, and to determine the procedure and periods of sale of these goods, in cases of non-payment of the Customs or other duties.

FRANCE.—Owing to the inaccurate declaration of British goods imported into France, several cases of difficulties with the French Customs authorities have recently been brought to the notice of H.M. Consul-General in Paris, with a request from the firms concerned that an appeal against the fine imposed by the French authorities should be made through his intermediary. The Consul-General states that, in such cases, the inaccuracies are usually ascribed to inadvertence, and adds that, as a general rule, no satisfaction is to be obtained on this ground from the Customs authorities. He therefore calls attention to the necessity of furnishing full and accurate information to the person charged with the declaration of the goods to the French Customs, in order that the consignments may be correctly declared and trouble with the Customs authorities avoided.

The following note of some of the requirements of the Customs Regulations may be useful:—

Declarations must be presented in duplicate on printed forms in conformity with the approved model; they must indicate the nature, kind, and quality of the goods, the place whence imported, and their destination. In addition, the weight, or the measurement or number, or the value, of the goods must be shown according to whether the duty is leviable on the weight, measurement or number, or on the value. The marks and numbers of the bales, cases, casks, &c., are to be shown in the margins of the declarations, and if the origin of the goods or any other special circumstance entitles them to favourable tariff treatment, the fact must be stated.

AUSTRALIA.—An Australian Proclamation, dated December 22nd, prohibits the importation into the Commonwealth of electric or magnetic belts, or any belt, or any article of wearing apparel, or article for toilet use, or any appliance which is alleged or intended to produce a therapeutic effect by electric or magnetic influences, or by the presence of radio-active elements.

UNITED STATES OF AMERICA.—According to a decision recently given by the United States Board of Appraisers, wireless apparatus imported for use upon vessels owned by the United States or operated under American registry, when entered and installed under the prescribed conditions, is free of duty on importation into the United States.

SOUTH AFRICA.—The following Customs decision has recently been officially announced in the Union of South Africa:—

Washing machines driven by electrical power are dutiable under No. 193 of the Tariff at the general rate of 20 per cent. *ad val.*, the rebate allowed on goods manufactured in the United Kingdom or reciprocating British Colonies being 3 per cent. *ad val.*

NORWAY.—The exportation from Norway has been prohibited of copper oxide and copper protoxide, also of all manufactures of rubber, balata and gutta-percha (with the exception of driving and transmission belts of balata and gutta-percha).

EGYPT.—Revised Tariff valuations for use in assessing duties on certain metals imported into Egypt have been issued, with effect from February 1st to March 31st, 1916, or until denunciation, as follows:—

	Valuation per kilog. Millièmes.
Copper and brass sheets, round and bottoms	136
Copper sheets, plain	133
Copper sheets in rolls, bars, round and flat	133
Copper ingots	130
Copper wire	*ad valorem.*
Brass wire	,,
Brass sheets, plain, 24 by 48, 8 lb. to 5 lb. ...	,,
Tin ingots and bars	185
Lead sheets	38
Lead shot	39
Lead pipe	38
Lead, pig	38
Zinc sheets	117
Zinc ingots	117
Phosphor bronze	117
Antimony	130
Quicksilver	600

Duty is leviable on the valuations shown at the rate of 8 per cent. (1,000 millièmes = £E1 = £1 0s. 6d.)

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

3,680. "Electric lamps." F. Westwood. March 13th.

3,707. "Leakage protection device for electric cables." C. J. Beaver and E. A. Claremont. March 13th.

3,726. "Manufacture of electrically-welded link chains and cables." R. Green. March 13th.

3,736. "Semi-automatic telephone systems." Relay Automatic Telephone Co. & H. J. Herink. March 13th.

3,737. "Automatic and semi-automatic telephone systems." Relay Automatic Telephone Co. & H. J. Herink. March 13th.

3,739. "Coil supports for electrical apparatus." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 13th.

3,743. "Oscillators or vibrators for wireless telegraphy, &c." Compagni Wireless Control Syndicate & M. Compare. March 13th.

3,745. "Alternators for production of high-frequency electric oscillations." Soc. Francaise Radio-Electrique. March 13th. (France, March 13th, 1915.)

3,758. "Telephone exchange systems." A. E. Lundell. March 14th. (U.S.A., March 19th, 1915.)

3,769. "Electrical indicators, &c." F. R. Hobley & J. G. Hooper. March 14th.

3,777. "Apparatus for obtaining synchronous motions at a distance." W. Kingsland. March 14th.

3,780. "Tools for internally shaping telegraph insulators, &c." H. L. Doulton & W. Podmore. March 14th.

3,789. "Measuring instruments, relays, &c." Marconi's Wireless Telegraph Co. March 14th.

3,795. "Contact apparatus for electrical connection of magnetos." E. J. J. Salmson. March 14th.

3,796. "Interruption device and method of mounting cams for magnetos." E. J. J. Salmson. March 14th.

3,797. "Mount for magneto distributors." E. J. J. Salmson. March 14th.

3,798. "One-piece framing for magnetos." E. J. J. Salmson. March 14th.

3,806. "Means for the electrical repetition, determination, and distant control of movements, specially applicable to order-signalling systems." E. A. Graham & W. J. Rickets. March 14th.

3,817. "Explosion engines coupled to dynamo-electric machines." Soc. Anon. des Etablissements L. Blériot. March 14th. (France, April 19th, 1915.)

3,835. "Electric lamps." J. R. Clay. March 15th.

3,859. "Dynamo-electric machinery." H. F. Joel & J. H. St. H. Mawdsley. March 15th.

3,863. "Valve mechanism." British Thomson-Houston Co. March 15th.

3,869. "Stationary contacts for electric switches or circuit-breakers." F. B. Holt. March 15th.

3,896. "Magneto-electric machines for ignition in internal-combustion engines." M. S. Conner & A. R. Kahl. March 16th.

3,914. "Projection apparatus." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 16th.

3,922. "Automatically-operating switch for machines switching telephone systems, &c." J. G. Hackley & Western Electric Co. March 16th.

3,938. "Electric flashlamps." C. R. Hall. March 17th.

3,969. "Grapnels for raising submarine telegraph cables, &c." W. Hessman. March 17th.

3,976. "Electric cables." E. A. Bayles & British Insulated and Helsby Cables, Ltd. March 17th.

3,986. "Control systems of air-compressors." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 17th.

4,006. "Apparatus for testing electric circuits." E. Proksch. March 17th. (Austria, March 22nd, 1915.)

4,026. "Deflector for deflecting light in electric fittings." J. E. Randall. March 17th.

4,035. "Treating articles electrolytically." D. L. Honeyman & C. J. Lane. March 18th.

4,049. "Casings for electric batteries." British Ever-Ready Co. & A. H. Sheppard. March 18th.

4,067. "Magnetos." R. G. le Noir & C. C. W. Simpson. March 18th.

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8,349. Electric Plug and Socket Connectors. H. Matthaey & Co., G.m.b.H., and H. Eickmann. April 2nd. (April 2nd, 1913.)

23,380. Telegraph and like Signalling Systems. T. B. Dixon. December 1st (December 5th, 1913.)

1915.

3,490. Electric Switchgear. F. Waller. March 4th.

3,500. Automatic Electric Circuit Breakers. H. H. Groves & H. Brittain. March 4th.

3,505. Distribution or Fuse Boxes for Electric Circuits. F. B. Holt. March 4th.

4,895. Combined Electric Lighting and Starting Apparatus for Motor Vehicles. L. Duca, E. Naldini, C. Massavelli & L. Bellone. March 30th.

6,349. Ball and Socket Joints. British Thomson-Houston Co. (General Electric Co., U.S.A.). April 28th.

7,498. Upper Clip for Anchor Insulators of Conductor Rails for Electric Railways. H. Scott. May 19th.

7,680. Points or Switches for Tramways, Railways, and the like. Edgar Allen & Co. and C. Pigott. May 22nd.

9,628. Electric Welding and apparatus therefor. British Thomson-Houston Co. (General Electric Co., U.S.A.). July 1st.

10,709. Automatic Telegraph Transmitters. Eastern Telegraph Co. and B. E. Phillips. July 23rd.

10,809. Brakes and Stoppers for Wire Cables. T. Hall. July 26th.

17,412. Liquid-operated Electric Switches. W. H. Smith. December 13th.

1916.

2,028. Telegraph Repeating Instruments. T. B. Dixon. February 10th. December 5th, 1915. (Divided application on 23,380/14.) Patent No. 100,074. December 5th, 1913.

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NATIONAL INDUSTRIAL ORGANISATION.

FROM the observations which appeared in our issue of January 21st, under the title "National Business Organisation," it will have been gathered that we viewed with regret the division of the different forces which were engaged in endeavouring to form a powerful national industrial organisation. There were several separate movements on foot, each of them was fairly strongly backed by important industrial interests, all of them were making headway in their own circle or sphere, and the objects in view were, in the main, very similar. Was it desirable, when there was a practically universal recognition that a truly national organisation of impressive proportions and effective strength was one of the greatest industrial needs of the times, that these groups should continue their efforts independently? If want of co-operation among industrial interests had been a weakness in the past, why perpetuate the error by a division of the very forces which were aiming to remedy it? The air has been thick with new schemes and proposals of one kind and another all the while we have been at war, and their existence, the interest that they have evoked, and the support that they have received, have proved beyond doubt the desire of industry to concentrate its forces.

Probably all of these schemes have contributed some assistance in stimulating interest in the idea of associated and co-ordinated policy, but three of them stand out more prominently than the rest as demanding serious attention when the time is ripe for seeing whether an amalgamation of forces can be effected. The Institute of Industry is one; the second is a substantial organisation started in the Midlands by Mr. Dudley Docker; and the third is the Manchester scheme set on foot by Sir Charles Macara. With the first we have dealt pretty fully on several occasions; its little plaster exhibition building overlooking the Strand still stands as a monument to its earlier memory, though fast crumbling to decay, like some of its earlier ambitions. Our readers will have noted that we never have been able to treat this movement as being seriously representative of the great industries of the country; it has not been founded or engineered in a manner which called forth either our respect or our admiration. When, therefore, we were invited to take tea with the Court of Directors last week, on the occasion of the making of an "important announcement," the object of the gathering being "The creation of a national organisation *adequately representing British industrial interests*," we attended with some curiosity, little enthusiasm, and only just a slight modicum of hope. As the proceedings developed, however, our curiosity developed into a deep interest, and our enthusiasm and our hope both rose very high. We are in doubt as to which was *the* "important announcement," for there were several. One was to the effect that the Institute of Industry was willing to sacrifice its name; the other that any director would retire in order to strengthen the Association; and last, but not least, Mr. J. Taylor Peddie had placed his resignation in the hands of the directors, so that they might offer to those who wished to join forces with them the advantages of a central association free and unfettered by any existing agreement as to management. So be it! Mr. Nettlefold, in his control of the proceedings, impressed us with his unquestionable sincerity. He gave us clearly to understand that the Institute of Industry, as we have known it, is willing to sacrifice itself in order that there may be that consolidation of national resources which is a vital necessity.

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The way was thus opened for valuable discussion, and as representatives of the two important groups which have made no inconsiderable headway (Mr. Dudley Docker stated that his movement was supported by from 30 to 40 firms who were each willing to put down £1,000 apiece) were present, it was possible for practical suggestions to be advanced. Mr. Docker proposed that a conference should be held between the Institute of Industry, the Association with which he was concerned, and the Manchester group, and he expressed the opinion that from such a conference there might emerge a big association, which even the British Government would have to recognise. He suggested that they should all "come under one umbrella" (we think he meant a new one) in order to co-operate efficiently. We are pleased to state that the proposition was accepted by the chairman on behalf of the Institute; it was approved by Mr. F. R. Davenport, who, as a director of the Manchester movement, said he would recommend it to the Manchester group; and it was supported by Mr. A. W. Tait, who is not disinterested in electrical and financial affairs. We believe that the conference actually took place within a few hours after the suggestion was made, and we shall hope to hear in due course that an entirely new and central organisation will be speedily established, forming an "umbrella" which shall shelter all our national industries from the cold water of the politicians whom Mr. Dudley Docker and not a few others abominate.

Two of the principal essentials for such an organisation are, as Mr. Tait remarked, brains and money—both are required in the best quality and the largest quantity. We asked a couple of months ago whether it was suggested that industrial firms should pay their usual trade association subscriptions and find funds for the new institute or association as well. Mr. Docker's efforts have proved that, when once it is realised that a truly great organisation is in prospect, funds will flow in freely. Hundreds of associations which are in existence will doubtless desire to link up to such a body, because they will expect it to exert in combination such a powerful influence in matters of prime concern as individually or in smaller groups they could never hope to exert. Hundreds of wealthy industrial companies and firms would also be prepared substantially to support movements which are going to assist them in the expansion of their operations.

The matter of finance in such an organisation is an interesting one. Mr. Allcock, of Manchester, advanced a suggestion which is deserving of careful consideration. He urged that in their thought of, and regard for, great ideals, they should not overlook the fact that there were many sectional associations which were doing very useful work. The money for a new association might be obtained by linking these all up together. At present most of them intermix idealistic and practical efforts. A transfer of the idealistic duties from each of the national organisations might induce those sectional associations to contribute a percentage of their income (say 10 per cent.) to the national body, which, by its constitution and objects, would cover all those matters concerned with what may be termed national policy in relation to industry. The remainder of their incomes they would continue to expend upon the aforesaid useful practical work. He mentioned, to illustrate his suggestion, the willingness with which a firm of, say, engine-makers, would subscribe to the funds of their own association if they were convinced that a better market for their engines would be secured; but they would be averse to subscribing to funds which had ideals as their aim. This is, perhaps, a point of detail which may well be left to the judgment of the court of directors of the new association or federation, or whatever it may be called, but we repeat that it is well worthy of consideration if for no other reason than that it would permit existing associations to leave undone some things that at present absorb a good deal of their attention, and allow them to increase their own usefulness to the trades that they represent by concentrating on work of really practical value.

The Institute of Industry, it will be remembered, dropped "science" from its title. It may be that the new Federation of British Industries will find that it can consolidate its forces in the most profitable manner by going a step further. It may recognise that it will be unnecessary for it in any way to overlap the operations that are likely to ensue from the national organisation of science which is being proceeded with by the Royal Society. A great and effective scientific organisation of this character can render service to science, and those who affect it as a calling, by linking up all the scientific societies and institutions for combined effort in the national interests. And if beside this there were a great Federation of British Industries, there would be available two essential parts of one grand organisation which would strengthen our prestige and position throughout the world. This is surely an object for which all should labour, and if for its fruition the spirit of self-sacrifice has to be exercised—as we believe it must be—we are sure that no founder, and no Institute, will be permitted to remain as an obstruction in the path. It is useless shutting our eyes to the fact that certain of those who have a substantial stake in some of the present movements will require such a sacrifice. The chairman most gracefully and appropriately signified by his announcements that such an eventuality had been foreseen, and we believe that he and his court of directors will, as a result of conference and mature deliberation, come to the conclusion that it must be made.

The I.E.E. and its Council.

The Council's nominations for the vacancies which will occur in the offices of president, vice-presidents, honorary treasurer, and ordinary members of Council, on September 30th next, are now in the hands of members. The task of commenting upon this document is one of considerable difficulty, since it is regrettably easy to be suspected of invidiousness when any names are mentioned. We may, therefore, begin by saying whatever we can that is favourable, just to show that we are not content with expressing dissatisfaction only.

The addition of Mr. Chattock to the body of vice-presidents will, we think, be welcomed by everyone, especially in the great industrial district of which Birmingham is the centre, and in which the heads of lesser concerns affectionately allude to him as "The Chief."

With respect to the ordinary members of Council, we must observe that it does not appear to be at all representative of the large manufacturing concerns of the country. How are we to look for that co-operation and that co-ordination of interests which are so much talked of unless representatives of all these interests are included?

The central-station engineers were at one time conspicuous by their absence from the Council, but we saw the somewhat violent advent of Mr. H. F. Proctor, and now we see upon it Mr. Chamen, Mr. Chattock, Mr. Christie, Mr. Dickinson, Mr. Highfield, and Mr. Woodhouse, to mention only those who are now members.

Certain sides of the manufacturing industry are fairly well represented, and we welcome the nomination of Mr. Nisbett, who will not only tend to preserve the continuity of the Council with its predecessors, but whose firm is embarking upon more than cable-making, and so becoming somewhat more representative of manufacturing in general.

It is, however, with regard to the presidency that we must sound a note of warning.

Dr. Ferranti was made president, amid universal acclamation, for a second successive year, he being the first president to be honoured in this way. We all had hopes at that time of the carrying into practice of a certain "broader policy," and that we might go forward under gallant leadership to a conquest of industry by electricity and to a conquest of electricity by the British race. That these hopes proved largely illusory was hardly the fault of Dr. Ferranti.

Mr. Duddell's eminent services to electrical science had their natural result in a second year for

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him. We refrained from expressing any views on the question at the time of his re-election, for, as will be remembered, there was something of a set made against him, with which we did not desire to be identified. Sir John Snell did not occupy the chair for a second year, and we then hoped we had broken away from the new practice before it had become a custom.

We are sure that we shall not be accused of any feeling adverse to Mr. Sparks, when we say that we unfeignedly regret that it is proposed to elect him to the chair for a second year. We welcomed his accession to that dignity; we have admired his occupancy of the chair; his popularity is as unquestionable as it is well-deserved. We feel, however, that there are so many excellent men on the Council, whose arrival at the head of the profession is delayed by the course proposed, that it is our duty to protest against it.

We sincerely trust the practice will not become customary with the Institution. The gain, if any, to be obtained by the holding of the presidency for two successive years by any member, however distinguished, is not obvious, and it makes the pace too slow for those behind.

Cross-talk.

That technical phrases which are perfectly intelligible to technical men should nevertheless present perplexing problems to lawyers is not a matter for surprise, least of all when they relate to such abstruse phenomena as electrostatic and electromagnetic induction, which have no parallel in the experience of the layman; but it is a matter of considerable importance when it affects the construction of a specification or the performance of an installation, and this was well exemplified in a case which was heard recently at the Salford Hundred Court of Record. In this case the plaintiffs, Messrs. Pearson's (Electricians), Ltd., a Manchester firm of electrical contractors, sued for a balance of account due for an intercommunication telephone installation which was guaranteed against "cross-talk." The defendants claimed that the installation did not comply with the specification, inasmuch as conversations could be overheard by departments which had not been called; the instruments and cable were of the double-line type, and were properly installed, so that inductive effects were eliminated. but the defendants claimed that a secret service was required and promised, and thus the case depended entirely upon the definition of "cross-talk."

The managing director of the plaintiff company, a representative of the General Electric Co., Ltd., and Mr. L. E. Wilson, A.M.I.E.E., were called on behalf of the plaintiffs, and in response to a request of the judge for a clear definition, "cross-talk" was defined as "electric energy conveyed through space and not by contact or connection." A representative of Messrs. Siemens Bros. & Co., Ltd., who was called for the defendants, agreed with this definition, and therefore judgment followed for the plaintiffs.

Those who were concerned with the installation of intercommunication telephones in the last decade, when single-line circuits were in general use, will remember that as the number of stations increased the trouble from cross-talk became acute on any busy system, and in 1909 Mr. L. E. Wilson, in a short paper on "Telephones" which he read before the Manchester Local Section of the I.E.E., pointed out that while cheapness was thus attained, the consequence was the production of cross-talk, which depreciated the value of the system generally; he went on to point out that cross-talk was directly proportional to the potential of the line. Mr. K. B. Miller also, in his "American Telephone Practice," stated that when one circuit acted inductively on another so that conversations on one could be heard on the other, the phenomenon was termed "cross-talk," and was attributed chiefly to electromagnetic induction. Counsel for defendants endeavoured to show that the badinage of two comedians talking at one another was known as "cross-talk," with what relevance we are unable to imagine.

The moral to be drawn from this case is that manufacturers in their catalogues, and contractors in their tenders, should make it clearly understood that immunity from cross-talk does not mean that a line when in use cannot be tapped by a third party, or that a secret service is to be provided; such secret service can, of course, be given, at a price, but is not contemplated in the ordinary intercommunication installations. Even when the double-line system is installed, cross-talk may still be present if the combination is not properly connected up. Expert opinion is adverse to the use of single lines beyond ten stations, though unfortunately contractors are to be found who would not hesitate to go to thirty lines.

Electrical Trade in Australia.

In view of the new situation that is arising in the Australian Commonwealth in consequence of the very thorough policy adopted by the Government for limiting the activities of German and Austrian traders there both during and after the war, we took advantage of the opportunity presented by the presence in this country of Mr. G. T. Milne, H.M. Trade Commissioner for Australia, to interview that gentleman on the present position and the outlook electrically. It is, of course, of the first importance that British firms who are anxious to open up new business connections in that part of the world should closely analyse the statistics of Australian import trade, so that they may see what proportion of the trade in their particular lines is already in British hands. In some sections of the industry we have a substantial hold on the trade that is going, but the conditions are likely to be so much more favourable to our manufacturers in all lines henceforth that the proportion that has gone to enemy traders in the past will be ours if we are able to tackle the business in the right way; in addition, there will also always be new development work in progress. These two possibilities should afford considerable scope for British activity without rendering competition between British firms unduly keen. From our conversation with Mr. Milne respecting the outlook, we judge that he holds the conviction that Australia is a very fine field for the sale of electrical machinery, fittings, and appliances. The uses of electricity are rapidly extending there as everywhere else, and they will continue to do so, but so far as the British manufacturer is concerned, Mr. Milne emphasises the point that when dealing with public bodies in particular, it is impossible to do business without proper local representation. A new firm entering the field cannot expect to do business unless it has a live representative on the spot, and the best course to adopt before appointing such is to send out a responsible representative who knows the electrical trade thoroughly, especially on its commercial side, to make a survey of the whole field and see whether that field justifies the opening of a branch or merely the appointment of agents. Perhaps a number of our firms will undertake such surveys on co-operative lines?

American and Japanese competition is a factor to be reckoned with. During the war there has been a development of Japanese manufacturing activity —Japanese electric lamps, switches, insulators, glass, etc., and even complete installations, are on offer. Whereas Germany formerly took large orders for insulators on account of price, there is now local manufacturing in this department as well as Japanese tendering. Japanese travellers have been on the ground recently, and their activities are not likely

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to be reduced at present. The policy of the Commonwealth Government is, of course, to support local manufacturers first of all, British manufacturers next, and our Allies will naturally follow closely thereafter in respect of any preferential treatment. Nobody can tell at present what is to be the upshot of trade affairs in the Australian market, save that the German trader is not likely easily to get a look in. It may be predicted with reasonable confidence, however, that the spirited and thorough policy that has been applied in respect of the metal industries will bring local industrial changes, and one of these will involve the drawing of copper wire in Australia. Representatives going out from England are advised to study on the spot this question of local industries in its bearing upon their own contemplated schemes for opening out branches. Viewing our trade with the Commonwealth as a whole, we are assured that where matters have gone against us in the past it has frequently been due not to high prices, but to failure to give delivery up to time.

Lead.

There has not been much change in the general position of pig lead lately, although the price rose considerably further up to about £36 10s., a new high record, notwithstanding the recent Government prohibition of speculative dealings. Under the new regulation, pig lead is, of course, no longer a free market, so that the present state of comparative scarcity is having, if anything, the more effect upon the trend of prices whenever the demand assumes some importance. The view, at any rate, is generally expressed by dealers that the authorities would have been wiser by not interfering with the market. Offers of distant metal are now generally held back and consumers find more difficulty to "hedge in" against their forward requirements. Transactions are chiefly confined to prompt and near shipments. which tends to narrow down the range of values. The price of foreign lead now stands near £34 15s. usual London terms ex ship Thames, which is not much less than 100 per cent. above the normal figure in peace times, but so far as can be gathered, there is not room for a big fall in the price until the quantities diverted to this country are more commensurate with the size of the abnormally heavy current requirements, chiefly in connection with munition work. There is no indication of an improvement in the latter direction, for the present at any rate, while the situation is aggravated by a multitude of adverse circumstances. The chief of these is undoubtedly the pronounced spell of stringency which has been developing across the Atlantic, where values have been raised to a level equal to something like £40 a ton, which virtually precludes the possibility of contracts being arranged for shipment to this side.

There is now apparently a ready demand in America for all the metal which is being turned out in order to provide for the much larger domestic needs, while outstanding contracts have yet to be met for export, partly to Japan. The American position is now affected by the utterly paralized state of the mining industry of Mexico. Operations at the American Smelting and Refining Company's plants in Mexico have been entirely stopped, and there is no prospect of early resumption of working there.

As regards the European situation, indications do not hold out much hope of relief. Mining operations in Spain still leave much to be desired after the recent labour troubles, producers being severely handicapped by fuel scarcity and abnormally high costs. A large portion of the Spanish production has been for some time past finding its way direct to France, so that the quantities coming to this side continue small. A fair average tonnage is coming forth from Australia, but the arrivals continue considerably short of last year, and it is to be feared that market conditions will continue pretty tight over the next few months.

SHERRY'S SAWMILL AND TIMBER WORKS.

The saw mills and timber conversion and treating works, which are illustrated herewith, have been constructed and equipped for Mr. Sherry, at Homerton Bridge, Homerton, from the designs and under the superintendence of Mr. W. Worby Beaumont, M.Inst.C.E., M.I.E.E.

Mr. Sherry has another saw mill at Old Ford, and some time ago he contemplated remodelling that mill as to its power plant and as to its timber seasoning department; but on this he was advised, and finally decided to erect entirely new works at Homerton.

The Old Ford works were supplied with power from suction gas plant and some electric motors, and, on advice, it was intended to install a modern steam plant in the place of the suction gas engine. The engine, however, which was designed to comply with the circumstances of the old works, has instead been erected in the new works at Homerton.

These new works are of particular interest because of the remarkable economy which has been effected in the cost of power. They are situated on the Lea Navigation, on land which had been waste until recent times; the site has been leased from the London County Council, which authority has a large area thereabouts still unused.

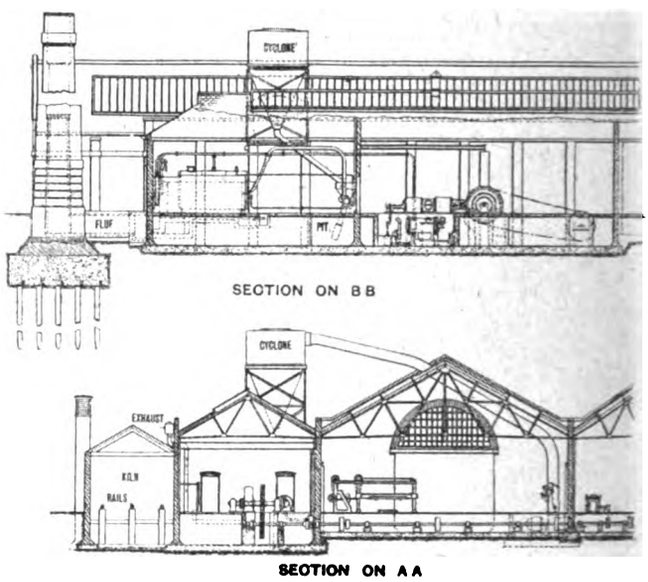

Fig. 1.—Longitudinal and Transverse Sections of the Sawmills (see fig. 2).

Mr. Sherry imports timber of various kinds on a large scale, and prepares it for the various prepared-timber users, especially the furniture and joinery trades. The preparation of the various woods, chiefly in the form of surfaced boards, light scantling stuff, and mouldings, produces a large quantity of sawdust and shavings, especially the short shavings from surfacing and moulding machines. About 26 tons of this sawdust and fine shavings was produced per week; a considerable quantity was formerly used for horse bedding, for which it was sold at a nominal price, but most of it is now used for power production by combustion in high-pressure superheated-steam generators, supplying steam to a compound condensing engine.

The general plan of the works is shown by fig. 2, whilst fig. 1 gives longitudinal and transverse sections of the mills. The sub-soil of the land on which the mills are built is a very varied composition of mud, silt, bog, gravel, clay, and shifting sand, and special precautions had to be observed in preparation for making foundations, especially in the case of the chimney.

All the foundations for the mill building and engine room are of wide-base concrete, heavily reinforced with strong expanded metal. Piling and heavy timber work had to be resorted to for the chimney

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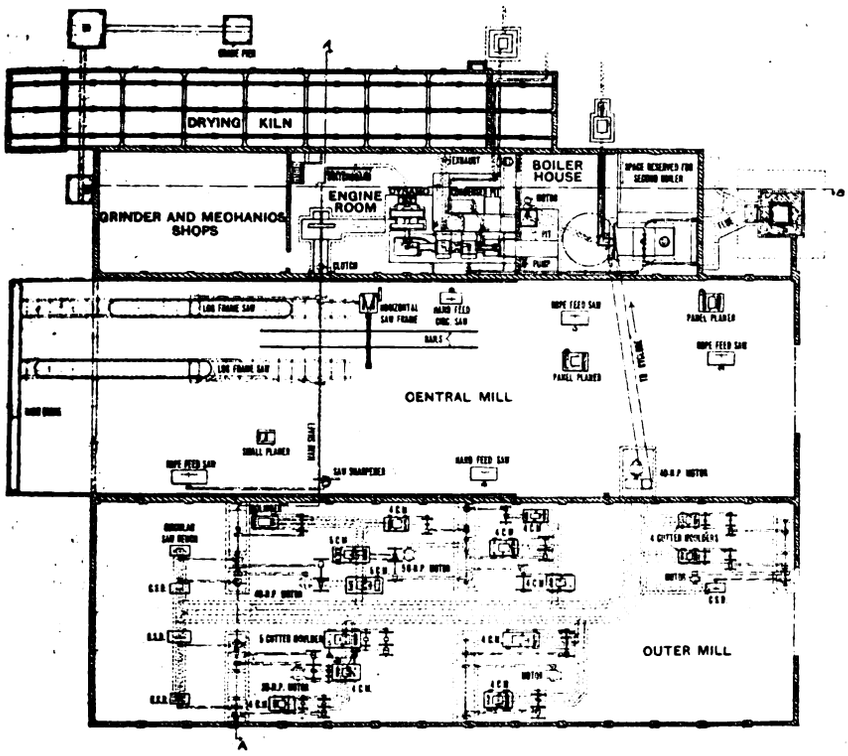

Fig. 2.—General Plan of Sherry's Sawmills.

foundation, which cut through into water-logged substrata below the level bed of the adjacent Lea navigation.

Adopting the experience and practice gained at other works by the same designer, the mill machinery is in part driven by direct rope drive to main shafting, and partly by electric motors to separate machines, or groups of machines, supplied with current from a continuous-current generator on the engine shaft.

The general plan, fig. 2, shows the two large mills, engine and boiler house, the gluing-up shop, and, alongside of the engine house, the drying kiln, which is about 30 ft. from the Lea Navigation Canal. A long jib crane commands the barges in the canal and the east end of the drying kiln, and the timber yard east of it. In the central mill there are several log frame saws, two of which are shown in position, and a number of other machines. In this same mill is the large exhausting fan, by which all the sawdust and surfacing-machine shavings are collected from the outer mill and delivered by a trunk 2½ ft. in diameter, as shown, into a large separator erected above the boiler house, from which they pass into a refuse pit therein. The positions of the present boiler and space for a second boiler (which is about to be installed), feed pumps, steam pipes, etc., are shown in the same plan, and in the adjoining engine room are seen the engine, dynamo, rope drive to main shaft in the central mill, switchboard, etc. The relative positions of these parts of the plant are further shown in the two sectional elevations taken on lines A A and B B of the plan.

The engine is of the tandem compound Paxman-Lenz type, with cylinders of 12 in. diameter and 21 in. stroke; the air pump is worked from the tail rod of the low-pressure cylinder. The engine works with steam at a pressure of 160 lb., superheated 200 deg. F., and runs at 200 R.P.M. The surface condenser arranged in the basement as shown is of large capacity, having in view the introduction of further steam and electric power. By arrangement with the Lea Conservancy, circulating water is taken from the Lea Canal and returned thereinto, and blow-off water from the boiler also finds its way into the canal from an interception pit.

Though not shown in the drawings, there is a large oil separator, as well as a steam separator and oil pumps, in the condenser pit. The boiler is of the Economic type, 14 ft. in length and 8 ft. 7 in. in diameter, with two furnaces specially arranged for firing with continuous air and refuse fuel supply from the cyclone separator, as before mentioned. The sawdust

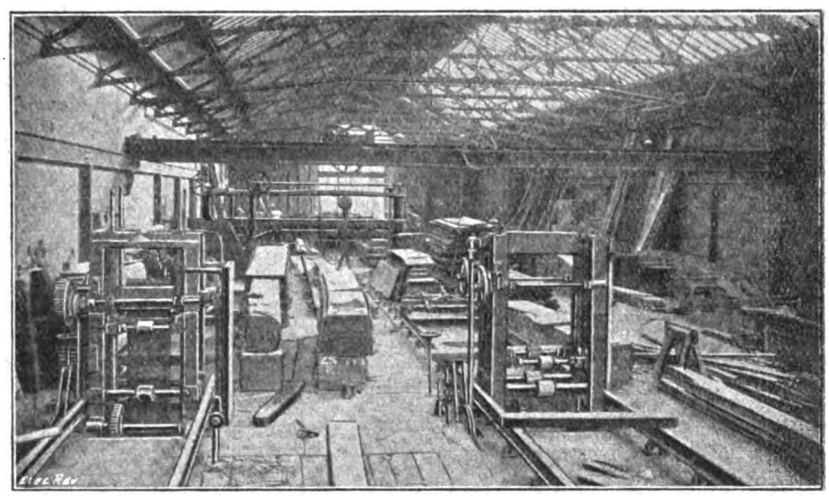

Fig. 3.—Central Mill, showing Log Frame Saws.

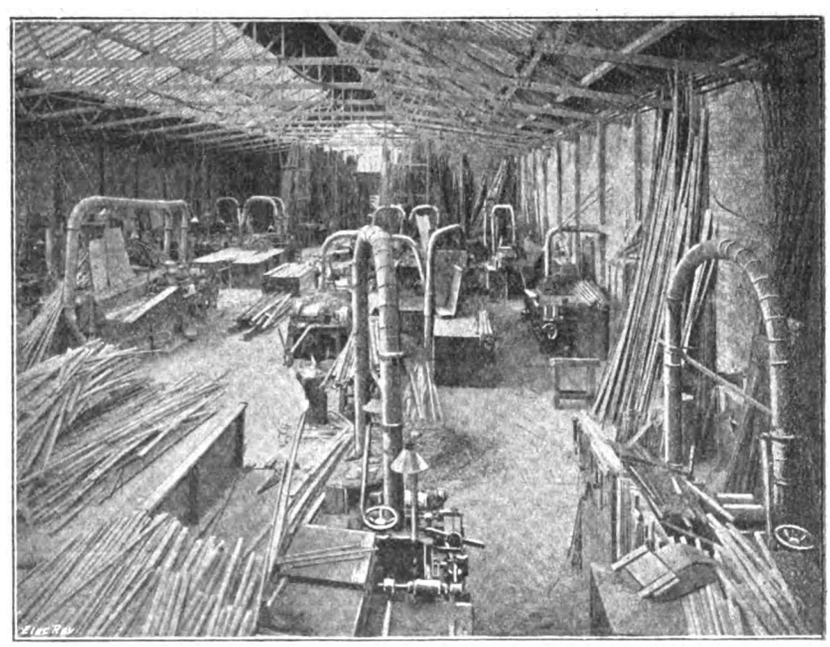

Fig. 4.—Outer Mill, showing Air-ducts for Collecting Refuse.

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and other refuse falls into the pit shown in the general plan, from which it is raised by an electric fan and delivered directly into the furnaces, the proportions of air and refuse being adjustable to the best relative values for complete combustion. Steam is taken from the superheater at the back of the combustion chamber.

The continuous-current generator on the engine shaft is of the General Electric Co.'s compound multipolar type, fitted with interpoles, and capable of an output of 160 KW. at 460 volts, as well as 25 per cent. overload for two hours, or 50 per cent. overload for an hour and a half.

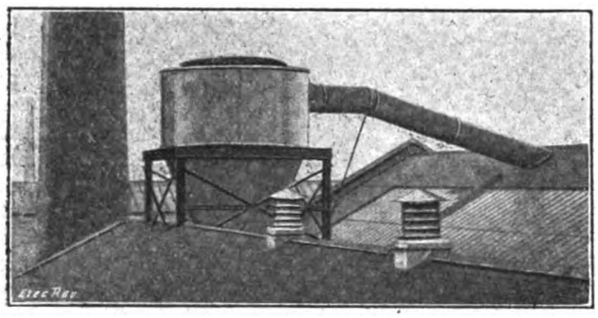

FIG. 5.—CYCLONE SEPARATOR.

Since the plant was tested on the completion of the works, a great deal of machinery has been added, but the following figures show that, with the load that existed at the time of testing, very remarkable economy was realised. When the original estimates were prepared with respect to fuel costs in Mr. Sherry's old works, which were then intended to be remodelled, and subsequently for these new mills, particular consideration was given to the type of refuse, which consisted chiefly, as mentioned, of sawdust and the short, small shavings of surfacing and moulding machines, and Mr. Sherry was promised that the new plant should give him all the power required for all purposes in the mill, including the provision of steam for the drying kiln (which is on the Erith system), for one-tenth of one pound of coke per H.P.-hour and all the wood refuse produced by the mill. In the result, however, no coke has ever been required, and less than three-fourths of the sawdust and other refuse produced is consumed.

GENERAL RESULTS OF TRIAL (AFTER PRELIMINARY TRIALS), NORMAL FULL LOAD.

Duration of Trial, 6 hours 54 minutes.

BOILER PERFORMANCE.

Total water evaporation	21,831 lb.
Evaporation per hour	3,164 lb.
Total wood refuse fuel	7,127 lb.
Fuel consumed per hour	1,032 lb.
Rate of combustion per sq. ft. of grate	28.7 lb.
Average steam pressure per sq. in.	158 lb.
Average steam temperature	578° F.
Average steam superheat	209° F.
Water evaporated per lb. wood refuse fuel	3.06 lb.
Equivalent evaporation from and at 212° F.	3.95 lb.
Guaranteed evaporation per lb. of fuel	3.6 lb.
Draught in flues close to boiler	0.6 in.

ENGINE AND DYNAMO.

Average steam chest pressure per sq. in.	148 lb.
Average steam chest temperature	508° F.
Average steam chest superheat	144° F.
Vacuum, engine gauge	24 in.
Vacuum, condenser gauge	27 in.
Total steam consumption	19,851 lb.
Total steam consumption per hour	2,877 lb.
Average indicated horse-power	270
Average kilowatts	150
Steam consumption lb. per KW.-hr.	18.1
Guaranteed steam consumption, lb. per KW.-hr.	18.33
Wood fuel consumption per B.TH.U. guaranteed	6.5 lb.
Combined efficiency, I.H.P./B.H.P.	79 p.c.

The highest dynamo temperature, after more than seven hours' run at full load, was 140° F. on the interpoles, representing a rise of 70° F. above the atmosphere.

The voltage regulation tests showed between no load and full load a rise of 1.75 per cent., and between no load and 25 per cent. overload 2.75 per cent., the dynamo running at constant speed, without regulation of the shunt rheostat.

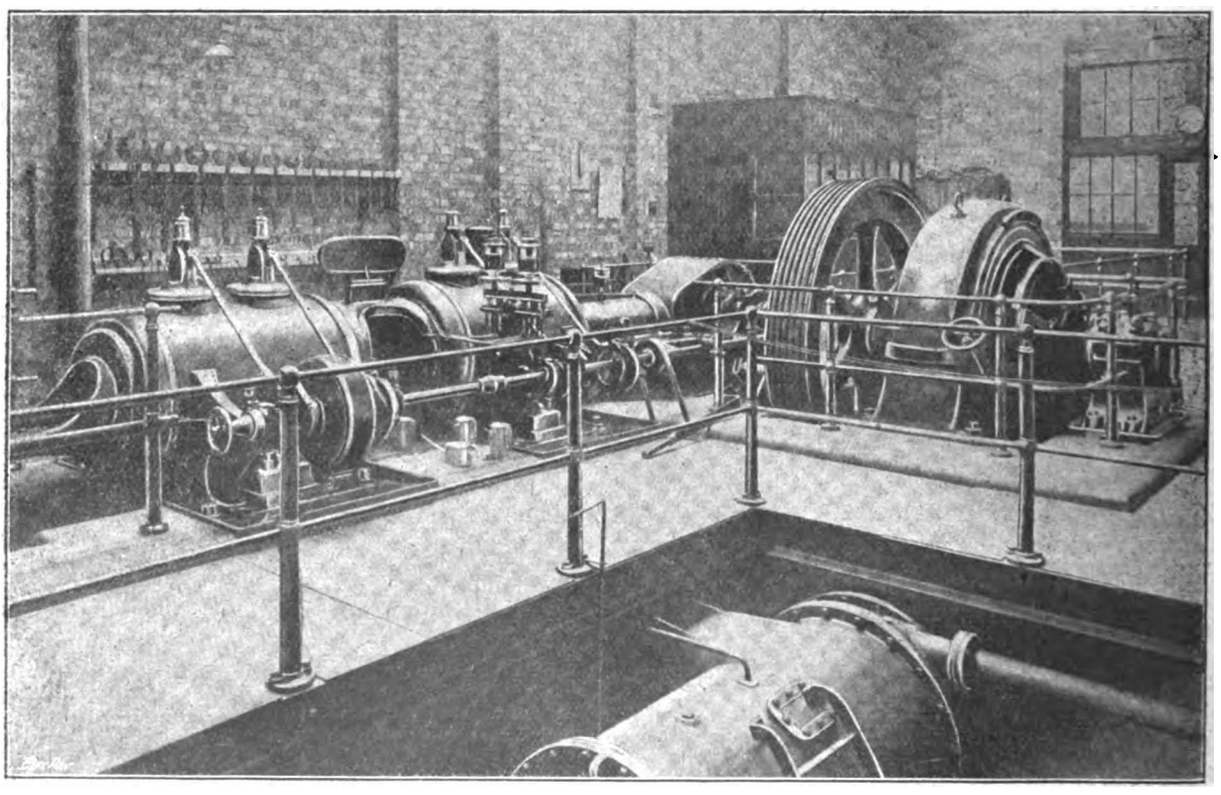

FIG. 6.—PAXMAN-G.F. CO. GENERATING PLANT.

The contractors for the different parts of the plant were:—Engines, boilers, etc., Messrs. Davey, Paxman & Co., Ltd.; 160-KW. generator, the General Electric Co., Ltd.; switchboard and distributing

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board, Messrs. Dorman & Smith, Ltd., and Messrs. Ward Bros.; pneumatic dust-collecting and delivery plant, including motor and fan, etc., Messrs. Matthews & Yates; engine and boiler foundations, and

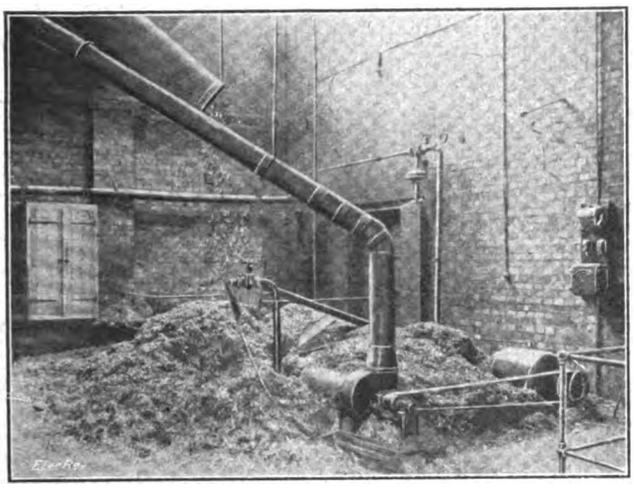

Fig. 7.—Electric Fan Feeding Boiler with Wood Refuse.

chimney shaft, Messrs. Neil & Co.; steel roof principals and wind gable ends, Messrs. David Rowell and Co.; heating apparatus in timber drying kiln, Erith's Engineering Co., Ltd.

LEGAL.

Read *v.* The Stella Conduit Co.

This case came before the Court of Appeal, composed of the Master of the Rolls, Lord Justice Phillimore, and Mr. Justice Sargant, upon the appeal of the plaintiffs from a judgment of Mr. Justice Joyce, in the Chancery Division, dismissing the action.

The plaintiffs brought the action against the defendants for an injunction, damages and ancillary relief for the alleged infringement of Letters Patent No. 18,375, of 1905, granted to Jas. William Brooks and Albert Edward Read, for "an improved means for connecting tubular electrical conduits together, and for connecting the said electrical conduits to their fittings," without screwing.

The case was reported in the Electrical Review of October 30th and November 20th, 1914.

Mr. Justice Joyce held that the gripping arrangement was a well-known and common one, and that there was no invention in the use of it in the patented appliance, and that the patent was invalid.

Mr. A. J. Walton, K.C., Mr. Colefax, K.C., and Sir Denham Warmington appeared in support of the appeal; and Mr. T. Terrill, K.C., and Mr. Arthur Gray for the respondent company.

At the conclusion of counsel's arguments on Thursday, March 30th, their Lordships reserved judgment.

Lund *v.* Hall.

Before Mr. Registrar Wild, in the City of London Court, on March 30th, a claim was made by Richard Lund, carrying on business as Lund Bros. & Co., electricians, against Messrs. A. Hall & Co., decorators, &c., Dulwich, for £1 9s., for work done and material supplied. The plaintiff's case was that he had done work upon the instructions of the defendant at St. Marylebone Infirmary, where the defendant was carrying out some work by contract, and his workmen had damaged some electric light fittings. The defendant denied giving the plaintiff any order, and said his workmen did not cause the damage in respect of which the plaintiff was seeking to charge. The case was adjourned for the plaintiff to produce further evidence, the Registrar remarking that it was oath against oath as the case then stood. When the case again came before the Court, the plaintiff called Mr. Brook, engineer of the St. Marylebone Infirmary, who said that some time last August some work was being done at the Infirmary by the defendant's men. In one of the wards the defendant's men injured the electric fittings, and it was in the defendant's contract to replace them. The defendant commissioned Messrs. Lund's men to replace the damaged fittings and to send the bill in to him. The work was done the following day. Cross-examined by the defendant, witness said it was the defendant's contract to take down the gas fittings. In the ward in which the electric fittings were damaged, he (witness) said he took down the gas fittings. In answer to the Registrar, witness said it was not in taking down the gas fittings that the damage was done; it was done by the defendant's men in washing off and whitening the walls and ceilings. The defendant said his men did not do the damage, and the engineer in question and the plaintiff were working together against him. The Registrar said that upon the evidence before him he must find that the defendant's men did the damage which the plaintiff had repaired. Judgment for the plaintiff, with an allowance of 5s. for the witness.

Baldry *v.* Sun Electrical Co., Ltd.

At the Lambeth County Court, before Judge Parry, on Monday, S. T. Baldry, aged 14 years, brought an action through his father, J. W. Baldry, engineer, of 65, Kirkwood Road, Peckham, S.E., under the Workmen's Compensation Act, for compensation for injuries, the respondents being the Sun Electrical Co., Ltd., of Charing Cross Road, W.

Applicant was employed by respondents as a learner in November, 1915. A piece of steel shaving was thrown and struck his eye. He did not see where it came from. He was taken to the Royal Eye Hospital, St. George's Circus, where his eye was removed, and he remained as a patient until February 1st.

Mr. Shakespeare, for the respondents, said the boys had nothing to do with the metals with the exception of brass. If boys were larking and an accident occurred, the Court of Appeal had decided that such accident did not arise out of, or in the course of, their employment, and therefore did not come within the scope of the Act.

Judge Parry said if that was so, they might as well shut out boys from the operations of the Act, as they were always larking. If the applicant had not been employed there he would not have met with the accident, and that, to his mind, meant arising out of, and in the course of, his employment. In view of the importance of the case, and the likelihood of an appeal, he reserved his judgment.

Lineman's Electric Shock.

Thos. Bannon, telegraphic lineman, claimed compensation at Tullamore Quarter Sessions against the Postmaster-General in respect of injuries received by his sustaining an electric shock while working at the summit of a ladder or pole and falling a distance of 18 ft. He was three months in hospital. On the suggestion of the County Court Judge, it was agreed that applicant should get half wages from December 31st to March 14th, and nominal compensation was given to keep his interests alive pending his resumption of work. Costs were also allowed.

Munitions Cases.

The Bolton Munitions Tribunal, on March 30th, heard cases against four employés of the Chloride Electrical Storage Co., who were said to have refused to work overtime on March 27th. The men said they should have a day's notice, but were not warned until the same day. They had not brought their tea with them. For the firm it was pointed out that notice was given on March 16th that overtime would be worked on March 17th and until further notice. In addition, there were instructions for foremen to provide tea for men called to work overtime at short notice. Three of the men were fined 1s., and the fourth man was cautioned.

The Warrington Munitions Court fined a firm of feeding-stuff manufacturers £10 and costs for employing men from a local controlled cable works without having obtained certificates of consent.

Notes from Canada.—Our Canadian correspondent writes:—"One of the most important occurrences in the electrical supply situation in the province of Ontario, is the recent arrangement made by the Provincial Government, to purchase at a cost of over £1,600,000 all the interests of the Trent Valley power companies, whose operations cover the territory lying east of Toronto along the shore of Lake Ontario. This means that the water-power rights and properties of these companies are purchased for the people, and that they will be put directly under the administration of the Hydro-Electric Power Commission of Ontario, and it also means that with the exception of the large generating companies on the Canadian side, at Niagara Falls, practically all the large power sites and projects are now owned by the people and controlled by the Commission. As was recently pointed out in these notes, the territory at present served by this Commission is almost as large as England, while its powers, extending over the whole province as they do, cover an area three and a half times as large as the British Isles. The Provincial Government has decided to approve of the power development scheme proposed by the Commission for the Niagara River, whereby an ultimate capacity of 600,000 H.P. will be made available. For this scheme turbines and generators in units of 50,000 KW. capacity are being considered. The development of the water-powers of British Columbia is receiving careful attention at present. Existing plants have a capacity of some 230,000 H.P., and there is said to be about twelve times this power available for use. The Edmonton Power Co. proposes to construct a dam across the Saskatchewan River at a point about 75 miles west of Edmonton. There will be a head of about 80 ft. An electric railway will be built from the city to the dam.

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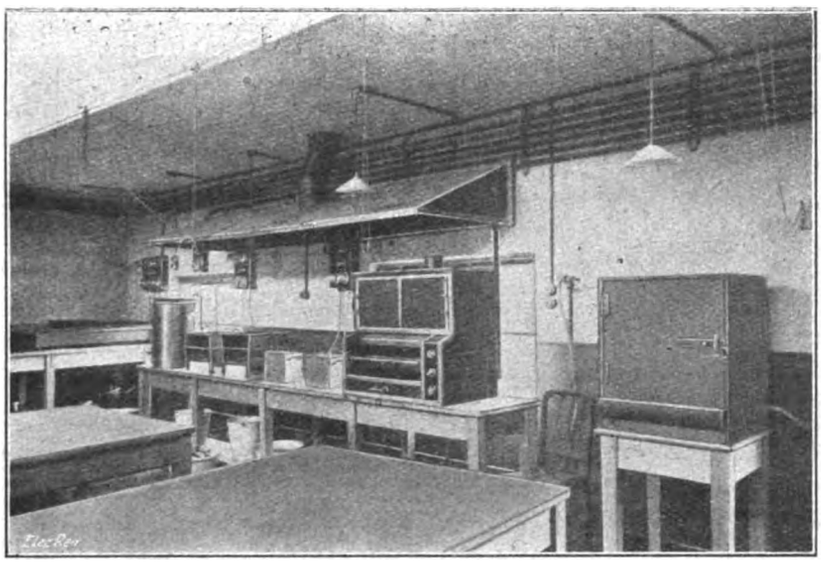
ELECTRIC COOKING AT SWAN & EDGAR'S.

THROUGH the courtesy of Messrs. Swan & Edgar, the well-known drapery firm whose premises are a familiar landmark in Piccadilly Circus, we were recently enabled to inspect the extensive electrical cooking equipment which has been installed within the last few months in connection with their staff catering department.



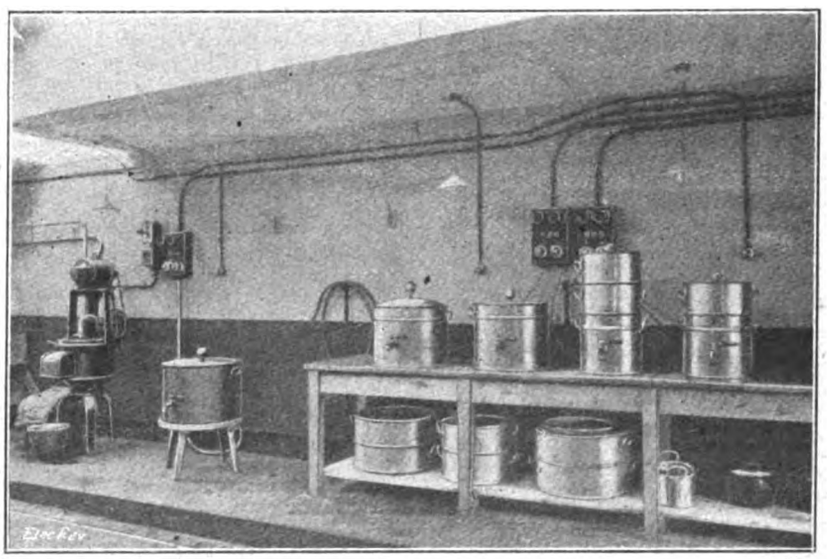
ELECTRIC STEAMER, GRILL, FISH FRYERS, &C., AT MESSRS. SWAN & EDGAR'S.

This installation has been carried out by Messrs. Locke and Soares, of 83-87, New Cavendish Street, W., the cooking equipment being supplied by the Jackson Electric Stove Co. and of their standard type.

The kitchen, which occupies a light and airy situation at the top of the building, is connected by service lifts with a servery on the floor below, where the extensive staff dining rooms are situated.

From the main switchboard in the basement, a special 220-volt 37/14 S.W.G. service is run to the top of the building to a 12-way D.P. 50-amp. per way glass fronted distribution board in the kitchen; the service is controlled by a 350-amp. Berry, Skinner D.P. switch and fuse, and a special meter. From the distribution board the circuits leading to the apparatus are carried round the walls, being run in solid-drawn heavy gauge screwed conduit, as is the case with the service leading up from the basement.

The apparatus installed includes two roasting ovens with double doors of the usual Jackson lagged type, each with a 7 KW. loading and three-heat control; a vegetable and pudding steamer of the cupboard type fitted with perforated shelves, &c.; a grill and hot cupboard, rated at 6 KW., of the standard Jackson type with three-heat control; two egg poachers for cooking 12 eggs at the same time; two fish fryers, with 9 KW. loading and three-heat control, and a 10-gallon water urn with a 6-KW. loading.

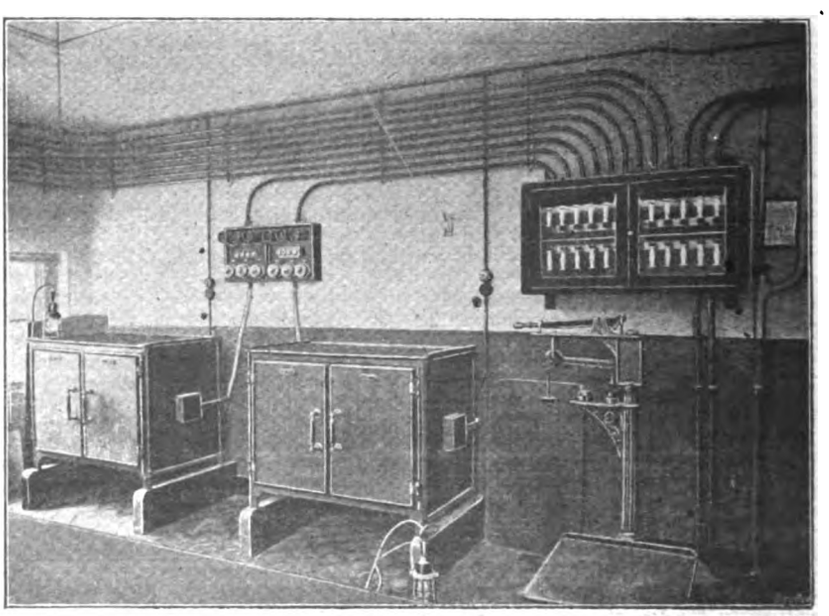


ELECTRIC BOILING EQUIPMENT AND MOTOR DRIVEN POTATO PEELER.

Arranged along the far side of the kitchen from the entrance are a small boiling hob consisting of four hot plates of 5·5 KW. rating and four boiling pans of three and six-gallon capacity with nests of steamers above and a total loading of 10 KW., these being arranged on a bench; a large stockpot of 3·5 KW. rating stands on the floor and beside it a Cornhill potato peeler, chain-driven by a ½ H.P. motor—a piece of apparatus which will deal with a sack of potatoes in a matter of minutes.

Each unit of cooking apparatus is controlled by Diamond H switches of the series-parallel or "on and off" pattern, with Zed fuses in circuit and provided with an indicating pilot light, these accessories being fitted on the wall adjacent to the apparatus controlled and coupled to the latter by armoured flexible cable. Practically all the apparatus is provided with three-heat control, and three apparatus—a 12-gallon steamer and two 10-gallon water boilers—have seven heat control. The servery is equipped with a 5-KW. hot cupboard and carving table, two water urns, one being of the immersion heater type and a milk and coffee urn, the controlling switchgear and pilot lights being grouped on one board.

The total installed loading of the cooking installation is approximately 75 KW., and the maximum working load has, we understand, reached 55 KW.; it provides, daily, 80 breakfasts, 360 dinners, 360 teas, and 80 suppers, or a total of, roughly, 880 meals for the staff, and, we should add



ELECTRIC OVENS AND KITCHEN DISTRIBUTION BOARD.

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is giving great satisfaction in use. The staff dining rooms, with adjacent sitting and smoking rooms, are dependent on electric heat, and five 3-KW. Belling fires and one of 2 KW. loading by the same maker have been installed for this purpose.

In conclusion, we are indebted to Messrs. Locke & Soares for the data published herewith.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Electric Capstan Control Gear.

The severe conditions of operation of electric capstans and winches call for extremely simple, robust and reliable control gear if satisfaction is to be given to the user.

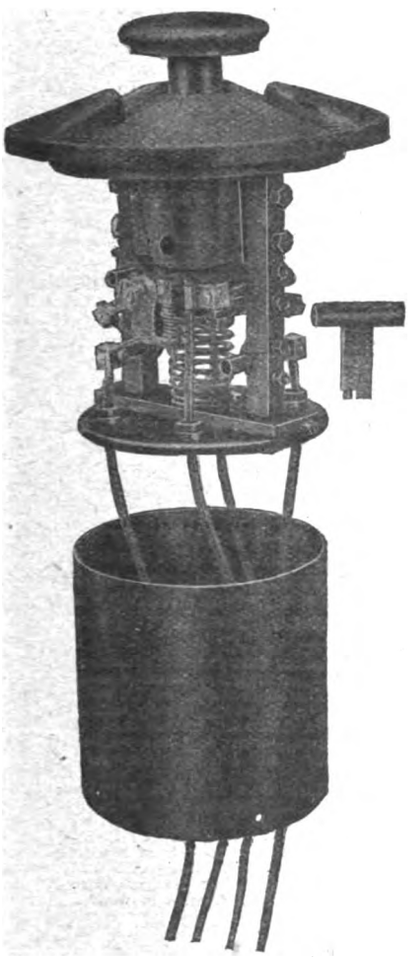

FIG. 1.—PEDAL SWITCH FOR ELECTRIC CAPSTAN.

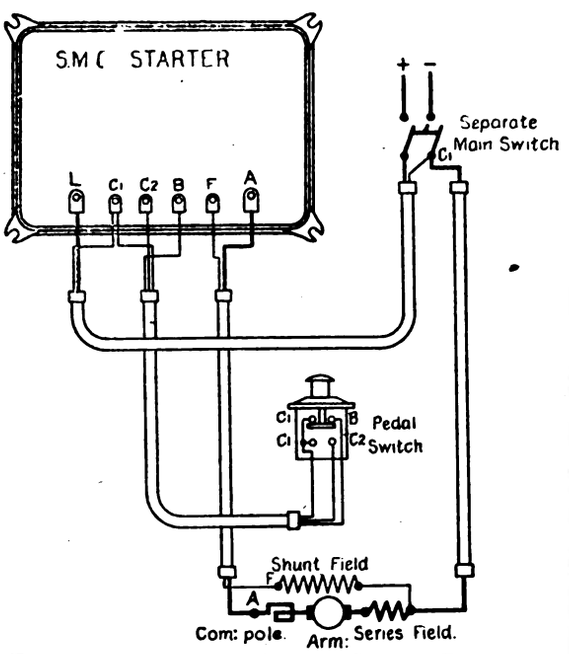

FIG. 3.—CONNECTIONS OF CAPSTAN CONTROL EQUIPMENT.

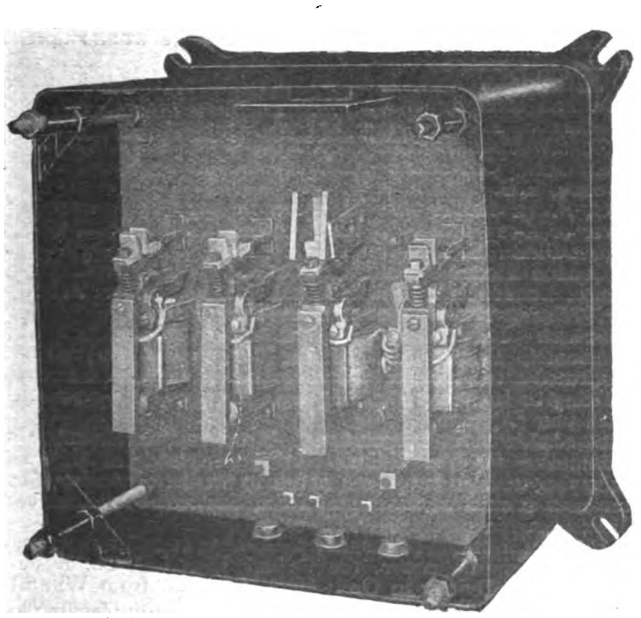

FIG. 2.—ACCELERATING UNIT FOR ELECTRIC CAPSTAN

In order to meet these requirements the BRITISH THOMSON-HOUSTON CO., LTD., of Rugby, has developed a special control gear, of the automatic fool-proof type, which comprises a pedal switch designed for use in a covered yard or on an exposed wharf, and an accelerating unit consisting of a series of electrically-operated contactors. The pedal switch does not carry the main current, but, when depressed, closes the operating coil circuit of the first, or shunt, contactor, causing it to close and complete the motor circuit through the starting resistance.

The remaining contactors close successively, cutting out resistance automatically at the proper time.

Fig. 1 illustrates a type P, form F, capstan pedal switch designed for exposed situations, while fig. 2 shows an accelerating unit—a standard S.M.C. starter, in a ventilated iron case. Tubular form resistance units are supplied in connection with the above.

Fig. 3 shows diagrammatically a capstan control equipment arrangement.

An overload relay can be fitted to the contactor panel, and special contacts are provided on the pedal switch, in such a case, to reset the relay.

Control equipments for reversible capstans are also supplied, operated by two mechanically interlocked pedal switches, one for each direction of motion; a special triple-pole contactor, fitted with magnetic blow-outs, is supplied for use with A.C. squirrel-cage motors, which can be connected direct to the line through such a contactor.

Belling Cooking Apparatus.

MESSRS. BELLING & CO., of Elmonton, N., have recently issued a leaflet dealing with their electric kitchen appliances, including

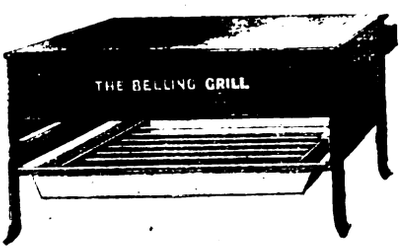

FIG. 4.—BELLING GRILLER-TOASTER.

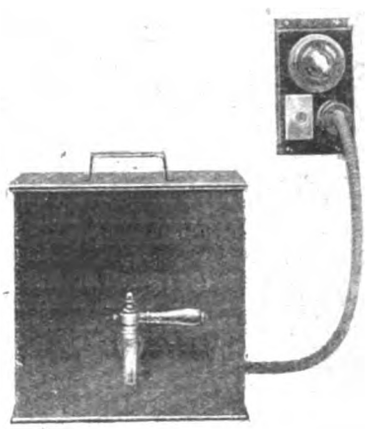

FIG. 5.—BELLING ELECTRIC WATER TANK

the Belling oven, griller-toasters, hot-plates, electric water-tank, &c. A recent introduction is a low-priced griller-toaster, fig. 4, to meet the needs of the small householder. The top is available for keeping things warm, while cooking is proceeding underneath, on the grill; a drip-pan and grid (10 in. × 8 in.) are provided, and three heating elements are fitted, giving a 1½-KW. loading, and 4 ft. of cable are supplied with the apparatus.

A large and more substantial apparatus of the same kind, with 3½-KW. loading, is also supplied.

Fig. 5 is a 2-gallon electric water-tank, made in polished copper, with removable lid. This has a 2 KW. loading, and is supplied with a control panel fitted with a three-heat switch, fuse, plug and socket, &c.

Indicating Crane Signal.

In large shops where cranes are continually moving back and forth, workmen naturally waste considerable time watching in what direction the cranes are moving. To reduce this waste a signalling system for indicating whether the cranes are moving forward or backward has been developed. The outfit consists of red and green lanterns mounted on both sides of the crane, the lamps of which are connected to the motor circuits. The red lanterns of one side and the green of the other side are connected to the same circuit, with the system so designed that when the crane moves in one direction one set of lamps is automatically lighted, and when the motor runs in the other direction the other set is lighted. Thus, when a person is in a certain position, and the red lantern is lighted, it indicates that the crane is approaching him, and if the green lantern is lighted, the crane is departing. When

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the crane is standing still, no lights are shown. The number of lanterns employed is optional—three on a side for each colour being generally used. When the cranes are equipped with indicating signals, it only takes a glance to determine definitely whether the crane is approaching or departing, the workmen knowing instantly whether they are in danger or not. The indicating signals are said to be very useful to operators of neighbouring cranes, minimising the possibility of collision, and enabling the operator to give practically all his attention to the floor level, since the signals come automatically within his vision with the approach of another crane, thus relieving him of strain, and greatly increasing the general safety. The device is being made by the NICHOLS-LINTERN CO., Cleveland, Ohio.—*Electrical World.*

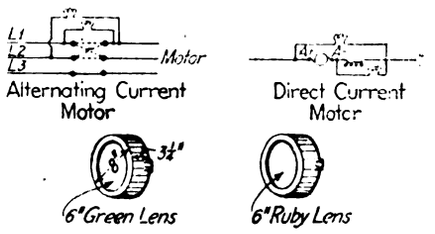

FIG. 6.—DIAGRAMS OF CONNECTIONS FOR CRANE SIGNAL.

WAR ITEMS.

Exemption Applications.—At a sitting of the Batley Tribunal last week, a local firm applied for exemption on behalf of an electrician and an engineer. The representative of the firm stated that the engineer was not the chief engineer, but it was thought that a concern such as that with which he was connected should be entitled to more than one engineer to attend to two large engines as well as dynamos and motors. He wished the members of the Tribunal could spare time to inspect the firm's plant in order to form an idea as to whether one or two men were required to run it. A member of the Tribunal suggested that the firm should secure somebody of non-military age to take the place of the engineer, but the applicant said the difficulty in doing that was that the older engineers knew very little about electricity. The number of men competent to deal with alternating current was extremely limited, and the applicant firm had both D.C and A.C. The Chairman intimated that the Tribunal were strongly opposed to granting any further time, but they would allow until April 15th. They thought that if the firm advertised they would be able to secure a suitable man.

Before the Doncaster Tribunal last week exemption was asked for on behalf of an electrician in the employ of the G.N.R. carriage and wagon works, who was engaged upon train lighting. The Railway Co. stated that the man could not be spared. Postponement until May 31st.

At Blackpool Appeal Tribunal, on March 30th, the general manager of the Tower supported the application for exemption of the electrical engineer and his chief assistant. They had 70 men serving, and had not appealed for a single man. Temporary exemption was granted until the end of October.

At the Durham County Appeal Tribunal, held at Darlington, an electrical engineer in business at Stockton asked for an extension. One partner was already in the Army, being chief electrical engineer in the Northern Command. At the beginning of the war they employed six men, all of whom had joined the Colours, save one who was engaged on munitions. An arrangement was made that whichever of the partners was first accepted for service, the other would remain and try to keep the business going. Appellant was the only one left in the business. He was not unwilling to serve. It was a question entirely of serious financial and business obligations. He asked for three months, and then, even at great sacrifice, he would follow his partner. The parents of the partners would have to sacrifice the money advanced to establish the business. Three months' extension, from March 14th.

At the Middlesbrough Tribunal, an electrician, trading as an electrical contractor, contended that, in view of his business he was a starred man. He had an invalid wife and child dependent on him, and the allowance which he would receive from the Government in the event of his joining the Army would be quite inadequate. Postponed until April 30th.

At the Portsmouth Tribunal, an electrician appealed on behalf of his apprentice aged 19, on the ground that he was indispensable, owing to the shortage of electricians, and to his being engaged in Government work. The case was adjourned so that the employer could apply to the Minister of Munitions for a ruling as to whether the occupation of an electrician is considered a starred one or not.

At the Erpingham Tribunal, Lord Suffield, through his agent, appealed for his electrician, aged 28, single, who has charge of a valuable electrical plant at Gunton Hall, and also of a gas plant. The claim was made on the ground that if the man had to go it would be a serious hardship to his employer, as he could not be replaced. Exemption was refused.

The Grantham Tribunal has granted conditional exemption, until July 1st, to two employés (switchboard attendants) of the Urban Electric Supply Co.

At Canterbury, on March 27th, Mr. Dashwood, electrical engineer, applied for exemption of an electrical wireman, who had six months of his apprenticeship to complete. Mr. Dashwood stated that he had already released six men, and applicant was the only man of military age left. The Military declined to regard the occupation as being on the reserved list. A month's exemption was granted.

The Wakefield Tribunal have granted varying periods of exemption—in the majority of cases total exemption so long as the men remained in their present employment—in respect of 52 employés of the Yorkshire (West Riding) Electric Tramway Co., who stated that the men were mostly skilled workmen employed at the tram depôt, and were absolutely indispensable to the proper working of the tramway system.

At Dukinfield, exemption was sought for two employés of the Tudor Accumulator Co., Ltd., whose works are Government controlled. The men stated that they were engaged on casting plates for miners' electric safety lamps. A representative of the firm stated, in answer to questions, that their hands were fully occupied, and it was not a fact that they were working the men only six hours per day. Ald. Garner (a Military representative): We are informed the firm could easily discharge fifty men at the present time without inconvenience. The firm's representative: I do not know where you could have got that information. It is incorrect. He added that the men were on work of national importance, and that the cases ought not to have come before the Tribunal at all, because the men were in a certified occupation. Temporary exemption was granted for two months.

At Rochdale, an electrical wiring contractor appealed, and stated that he would be of more service in a shell factory than in the Army, as he was a skilled turner and was willing to go on munitions. He had applied for work of this sort, but had not yet succeeded in getting any. The appeal was dismissed, but 14 days' grace was allowed so that applicant could finish work on hand.

A Publicity Man with the Forces.—The following is an extract from a letter received from Lieut. A. R. Courtenay, who, before taking up his commission, was acting publicity manager to the General Electric Co., Ltd. Writing, on active service with the Mechanical Transport (M.T.) A.S.C., from Alexandria, he says:—

"I am with a splendid Company. We run our own Pierrot Concert Party, which has become very famous, the zenith of our fame being reached recently when we gave a concert at The Alhambra Theatre in aid of the United Services Recreation Fund. A week before our name was practically unknown, but on the night of the show we had a record full-house and took over £100. Being responsible for the publicity work, I was thoroughly in my element. Within forty-eight hours of being told to 'carry on,' I had the town painted green with posters, nearly a thousand of which were distributed to all the principal shops in the town and district. These were backed by 5,000 small handbills and a large quantity of small invitation tickets. The stunt, however, was my troupe of Arab sandwichmen, a method of publicity which had never been seen before in Alexandria. I had 14 in all, divided into two groups, one group having the letters EMPTIES on their front board and a poster on their back, and the other group *vice versa*. Being quite unable to read English characters they did not at first appreciate the importance of keeping their places; hence the letters showed an inclination to wander at times, until I had drilled them. Chattering incessantly, they every now and again hailed a passing acquaintance, and at times I feared they would obstruct the traffic, as they attracted so much attention. Their appearance caused endless amusement, not only amongst themselves, but throughout the town generally. Considering there are no English compositors here, the printed matter was turned out very creditably."

Companies to be Wound Up.—In the latest list of companies ordered by the Board of Trade to be wound up the following appear:—

Veithardt & Hall, Ltd., 41, Eastcheap, London, E.C., iron and steel importers. Controller: A. J. Foster, 37, Wallbrook, E.C.

Gustav Rosenmann, 194-200, Bishopsgate, E.C., hardware merchant. Controller: N. W. Wild, 22-28, Broad Street Avenue, E.C.

C. F. H. Müller, 47, Red Lion Street, W.C., manufacturer of X-ray tubes. Controller: H. L. H. Hill, 2, Broad Street Place, E.C.

London Electron Works Co., Ltd., Regent's Dock, Limehouse, London, E., dealers in old tin. Controller: A. Taylor, Thames House, Queen Street Place, E.C.

French Industries.—The "Times" states that M. Clémentel, French Minister for Commerce, has recently instituted a technical organisation to deal with all questions relating to such industries as are not exclusively concerned with war purposes.

Swedish Export Prohibitions.—The Swedish Chamber of Commerce for the United Kingdom announces that the following articles have been added to the list of goods which are now prohibited for export from Sweden:—Calcium carbide, nitrogen carbide.—"Times."

Russian Electrical Companies.—Owing to military events, says a Petrograd paper, the Dvinsk Electrical Co. has removed from Dvinsk to Orel; Y. A. Shapiro, from Wilna to Petrograd; B. Petsh, Poland to Petrograd, Sampsonievsky Prosp. 84a; Titan, Poland, to Moscow, Pyalnitskaya 62.

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Thanks from the Front.—A correspondent with the British Expeditionary Force says:—"The "Electrical Review" continues to reach me regularly each week, and is very welcome too, I assure you. Mr. Carter's article in last week's issue on the resistance of a cube was very interesting. I manage to find time, during odd minutes, to wrestle with such problems, and to digest the various technical articles—in fact, there is not much of the paper that goes unread. The other day I happened across a man who, in normal times, is on the constructional staff of the Westinghouse Co. We had a brief chat, and he was quite pleased to have one or two back numbers of the "Review" that I was able to give him."

After-the-War Trade.—In reply to a Parliamentary question, Mr. Runciman says that the Government fully appreciates the importance of preserving and extending British trade in neutral markets. The subject will come under the consideration of the special committees which are being appointed to inquire into the position of certain important branches of British industry after the war. In addition, Mr. Ainscough, who has recently completed a commercial mission in China on behalf of the Board of Trade, has been closely in touch with important British firms trading with the Far East, and will be glad to receive further information as to their views.

Municipal Corporations and Enemy Companies.—The Blackpool and Eccles Corporations propose to follow the lead of Manchester by adopting standing orders to the effect that no contract shall be entered into with any person of German or Austrian nationality, and no contract shall be entered into with any firm or company whose subscribed capital (whether by way of shares or otherwise) is held or controlled to the extent of one-third or upwards by persons of German or Austrian nationality. Heywood Corporation G.P.C. has rejected a proposal in the same sense by ten votes to eight.

BUSINESS NOTES.

Dissolutions and Liquidations.—Adnil Electric Co., Ltd., Adnil Building, Artillery Lane, Bishopsgate, E.C.—The report of Mr. H. E. Burgess, Official Receiver, in this matter, has now been issued to the creditors and shareholders. The compulsory winding up order was made last October on the petition of a creditor, and accounts have been lodged showing liabilities £34,333, assets expected to produce £28,591, and a deficiency of £15,741 with regard to contributories.

According to the Official Receiver's report the company was registered on June 29th, 1909, as a private company, and was formed to carry on the business of electrical engineers and dealers in electrical appliances. It held the agency for this country for the Bergmann-Elektricitäts-Werke, of Berlin (hereinafter referred to as "the Bergmann Co"). The directors of the company were P. Berthold, J. Hissink and E. S. Morgan, all of the Bergmann Co. On the incorporation of the company, S. G. Leach and R. A. Marples were appointed joint general managers, but they were not directors. Although not strictly so in form, the company might be described as a reconstruction of Marples, Leach & Co., Ltd. (the "old company"). That business was founded in 1904 when it acquired the sole agency in this country for the Bergmann Co., and it was registered as a private company on April 6th, 1908. Debentures for £7,500 were issued, and on May 14th, 1909, the old company went into voluntary liquidation. The liabilities, in addition to the debentures, amounted to £24,408, of which £23,305 was due to the Bergmann Co. As a result of the liquidation the debentures were paid off in full, and the ordinary creditors received dividends amounting to 7s. 9d. in the £. The Bergmann Co. provided £9,001 out of a total of £9,520 required to pay the dividends referred to, and the transaction took the form of a payment as the purchase price of the stock. Mr. Leach explains that the reason why the Bergmann Co. appear as such large creditors is that on the liquidation they purchased the claims of all the English creditors, who thus received 20s. in the £, the loss of 12s. 3d. in the £ falling on the Bergmann Co.

After the incorporation of the Adnil Co. the question of the acquisition of the goodwill of the old company appears to have been considered, and resolutions are recorded in the minute-book, under date, Berlin, July 2nd, 1909: That Messrs. Marples & Leach should make arrangements with the Receiver for debenture-holders and/or liquidators of the old company to pay him, or them, for the transfer of any orders coming in a commission of 5 per cent. This arrangement to continue until superseded by any arrangement to purchase the goodwill. Berlin, August 18th, 1909: It was resolved to acquire the goodwill of the old company, the consideration to be such a sum as should represent the net profits made by the old company for the two years preceding the liquidation, &c. It does not appear from the books of the company that these resolutions were ever carried out; in fact, the only relevant entry in the books which the Official Receiver has been able to trace is an item of £45, which was credited on July 1st, 1910, not to the Receiver or liquidator of the old company, but to the Bergmann Co., in respect of the 5 per cent. commission referred to in the resolution of July 2nd, 1909, and debited to the goodwill account. But on June 30th, 1910, a goodwill account was opened, and a sum of £7,500 was debited to that account, and credited to the Bergmann Co., the figure being described as the loss in the liquidation of the old company, presumably the loss incurred by the Bergmann Co. Of the £7,500, £1,500 was subsequently transferred from goodwill account to fixtures, machinery, and tools account, thus reducing the goodwill to £6,000, and from that date there has always appeared in the books and accounts of the company an item of "goodwill £6 000" and a special credit to the Bergmann Co. of that amount. It was intended that this goodwill item should be written off from profits each year, but no reduction of it appears to have been made. It is not clear upon what grounds the Bergmann Co. thought themselves justified in putting upon the shoulders of the Adnil Co. the loss they had incurred in connection with the old company, for that appears to be the effect of the entries above described. There is no evidence that they had ever bought its goodwill; nor can it be suggested that the credit raised in their favour was in consideration of their allowing the Adnil Co. to use the stock which the Bergmann Co. had bought from the liquidator of the old company, for there is evidence that the stock was acquired by this company quite apart from the goodwill transaction, thus:—On June 28th, 1910, £7,096 was credited to the Bergmann Co.'s stock account, and debited to this company's goods account in respect of the stock purchased from the liquidator of the old company.

All the directors being in Germany the Official Receiver has had no opportunity of examining them, and his opinion is therefore based upon the facts as recorded in the books, but as at present advised he can see no grounds for any valid claim by the Bergmann Co. against the company in respect of the £6,000 before referred to, which is included in the unsecured debts now owing. This, however, is a matter which will have to be dealt with by the liquidator.

The nominal capital of the company is £10,000 in £1 shares, all of which have been issued, and are fully paid up. There are only three shareholders, the two signatories to the Memorandum and Articles of Association, who hold one share each, and the Bergmann Co., who are registered as the holders of 9,998 shares. Of the amount payable on the shares £1,000 was paid in cash by the Bergmann Co. in June, 1909, and £1,700 was paid to the company by the Receiver of the old company, but credited to the Bergmann Co., in September and October, 1909. The balance of £7,300 was paid by the Bergmann Co. on June 27th, 1911, but on the same day a cheque for £7,300 was paid to the Bergmann Co. on account of the amount due to them for goods supplied. No debentures were issued by the company. According to the accounts, which were audited annually by a firm of London chartered accountants, the results of the trading from the formation of the company were as follows:—Year ending June 30th, 1910, loss £178; June, 1911, loss £62; June, 1912, profit £639; June, 1913, profit £1,025; June, 1914, profit £245. In the year ending June 30th, 1913, a dividend at the rate of 5 per cent. per annum was paid, free of income-tax. No other dividends appear to have been paid. Shortly after the outbreak of war Messrs. Leach & Marples, the joint general managers, discovered that, owing to the company's German connection, the customers would no longer give any orders to the company, but many of them stated that they would have no objection to giving orders to Marples & Leach personally, upon their undertaking that no benefit from the orders should go to the Germans interested. There was a large stock on hand, and Marples & Leach thereupon began to take and carry out orders in the name of "Marples & Leach." The stock required to enable them to carry out these orders was taken from the company's stock, at stock book prices, and although in the absence of any directors it was impossible for them to enter into any written contract with regard to the matter, the arrangement they had in view was that they should pay the company one-third of the gross profit on such orders in respect of their use of the stock, offices, staff, &c. In cases where it was necessary to purchase material for the carrying out of these orders the company paid for it, and "Marples & Leach" used it on the terms above stated. They opened a separate bank account in the name of "Marples & Leach" in connection with the business so carried on, and paid all proceeds of such trading into the credit of that account. It was also arranged that for the protection of the company cheques on the "Marples & Leach" account should be countersigned by the company's auditor. At the date of the provisional winding-up order there was a sum of £4,887 standing to the credit of the "Marples & Leach" account, which was handed over to the Official Receiver. Mr. Marples left the company's service in June, 1915. An item "other liabilities, £1,216," shown in the statement of affairs, represents the claims of Messrs. Marples and Leach for a share of the gross profit above referred to. These claims will be dealt with by the liquidator.

In August, 1915, a proposal was made to the special manager by S. G. Leach for the purchase of the goodwill, stock, furniture and fittings of the business. The offer was considered at a meeting of the principal creditors of the company in this country, and an application was made to the Court, which made an order approving the sale to Mr. Leach. On October 12th, 1915, an agreement was entered into between the company and S. G. Leach and another for the sale to them of the goodwill, stock, furniture and fittings. The sum of £500 was paid on the signing of the agreement and the balance of the purchase price (about £3,390) is payable by monthly instalments for two years from December 1st, 1915. The book debts are not included in the sale. The failure of the company is directly attributable to the war. Mr. Leach states that the company had never done so well as in the early months of 1914. After war commenced, he and Mr. Marples did all they could to preserve it, but without avail, and in the absence of the

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directors they found it impossible to carry on the business any longer. The claims of the creditors are entirely on trade accounts, except £128 due for rent, and £6,000 shown by the books to be due to the Bergmann Co. on goodwill account. The total amount shown by the books as due to the Bergmann Co. is £27,706, including the £6,000 referred to. There is also £1,965 stated to be due to the Deutsche Telephone Werke G.m.b.H. of Berlin, which, the Official Receiver is informed, is not connected in any way with the Bergmann Co. As the result of the statutory meetings of creditors and contributories, reported in the ELECTRICAL REVIEW for March 3rd, the Court has appointed Mr. J. H. Stephens, of 6, Clement's Lane, Lombard Street, E.C., as liquidator of the company.

[We understand that the report which appeared in our issue of March 3rd, although strictly accurate, is likely to give a wrong impression. Mr. S. G. Leach ceased to be associated with the Adnil Co. in October last, when he formed an entirely new company under the title S. G. Leach & Co., Ltd, to take over the goodwill, fittings, fixtures and stock-in-trade of the Adnil Co., under agreement with the Official Receiver, thus securing for a company which is entirely British (capital, directors and staff), having no enemy interests whatever, either direct or indirect, the business which during the last seven years has been held by the Germans. We understand that somebody has been suggesting that the new firm are preserving the business for the benefit of the Germans, but we are assured that far from that being the case, the new concern in actual fact represents an effort to get back a business which was originally founded by Englishmen, but through force of circumstances, fell into the hands of the Germans.

In the above Statement of Affairs, it is mentioned that the old firm of Marples, Leach & Co., Ltd., paid a dividend of only 7s. 9d. in the £, but Mr. Leach calls our attention to the fact that all the British creditors were paid 20s. in the £, and this was the condition made by the shareholders of Marples, Leach & Co., Ltd., to the Bergmann Co., in surrendering their shares to them at the Marples, Leach & Co., Ltd., liquidation. Mr. Leach says: "It suited the Bergmann people to allow the liquidation to take 4-5 years to finish, and with one of their own servants—Mr. George Ambach—as co-liquidator, they were practically in the position to declare any dividend which pleased them. In this way the 7s. 9d. statement rather places the Marples, Leach & Co., Ltd. liquidation in a light which is not strictly accurate, nor fair to Marples & Leach. It is also to some extent affecting the new company which, of course, is now in no way connected with the Adnil Electric Co., Ltd., (in liquidation)."]

ELECTRO-STEEL FOUNDRIES, LTD., Darlaston.—A dividend of 20s. in the £ is payable at the office of the liquidator, Carey Street, W.C.

Book Notices.—"Technological Papers of the Bureau of Standards." Nos. 52, 54 and 55, "Electrolysis and its Mitigation"; No. 56, "Protection of Life and Property Against Lightning." Science Papers: No. 259, "A New Relation derived from Planck's Law"; No. 266, "Preparation of Pure Iron and Iron Carbon Alloys." "*Bulletin* of the Bureau of Standards." Vol. XII, No. 3. February 3rd. Washington: Government Printing Office.

"Whittaker's Arithmetic of Electrical Engineering." London: Whittaker & Co. Price 2s. net.

We have received a copy of No. 1 of a new sixpanny monthly journal, known as *The British Manufacturer*. Its object is to promote trade in the Empire and beyond, and it contains a number of articles which should interest those who are concerned with export trade matters.

"Electric Bells and Telephones." By B. E. Jones. London: Cassell & Co., Ltd. Price 1s. net.

"A Treatise on Electricity." By F. B. Pidduck. London: Cambridge University Press. Price 14s. net.

Thomas Alva Edison. By F. Rolt-Wheeler. London: Macmillan and Co., Ltd. Price 2s. net.—This is a "live" story about a "live" American, one of the most notable of those whose biographies are given in this series of "True Stories of Great Americans," which, by the way, includes Christopher Columbus. The subject is held up as "the typical American"—practical, enterprising, utilitarian, self-made, a glutton for work, inquiring to the last degree; like Newton, he was regarded as a dunce at school, and throughout his life mathematics has been his pet aversion. He had, however, an aptitude for making use of the acquirements of others, which was invaluable to him in the development of his great undertakings. But we do not propose to follow the author through the wonderful career of the great inventor; suffice it to say that the tale is told in a most interesting fashion, and is brought right up to date, for the last episode recorded in the book is the story of how Edison found a way of producing carbolic acid from American coal, in the spring of last year, when faced with the stoppage of supplies by the European War. The story of his life is a most fascinating one, and is here so admirably treated, that we can cordially recommend the book to our readers.

Bankruptcy Proceedings.—G. E. BONNER, electrical engineer, Palmers Green, Middlesex.—The adjourned public examination of this debtor was held at the Court House, Edmonton, on April 3rd, but no further questions were asked, the debtor merely signing his evidence.

New Russian Electrical Company.—The Erg Electrical Factories Co. is being formed for the manufacture and exploitation of electrical equipment; capital, 250,000 roubles. It will take over the business of Prince I. D. Avaloff & Co., Petrograd.

The Industrial Development of India.—In a Parliamentary reply to a question regarding the Commission to inquire into the economic resources of India, Mr. Chamberlain says, according to the *Times*:—"I understand that the Commission will be asked to report on the possibilities of further industrial development of India, and in particular, first, as to possible new openings for the profitable employment of Indian capital; and, secondly, whether the Government can usefully give encouragement by providing technical advice, by practical demonstrations in the case of particular industries, by financial assistance, or by any other means not incompatible with the existing fiscal policy of India."

Catalogues and Lists.—MESSRS. ROSE BROS., 25-27, Milton Street, London, E.C.—Temporary catalogue of electric pocket and hand lamps, scientific novelties, Fulmen educational working models, also of measuring instruments made by the Compagnie F.A.C. Da Dutilh, Paris.

MESSRS. FALK, STADELMANN & CO., LTD., 83-87, Farringdon Road, London, E.C.—Catalogue No. 409 (24 pages), giving illustrated particulars and prices of "Efesca" lanterns for half-watt and vacuum tungsten lamps for street, shop interior and exterior, and industrial lighting. Copies will be sent to any reader interested in the lighting of munition or other factories.

MESSRS. DRAKE & GORHAM, LTD., 66, Victoria Street, London, S.W.—Eight-page pamphlet (No. 240), giving illustrated particulars and prices of a number of vacuum cleaners—the "Santo," the "Econo," the "Little Briton," and the "Premier."

SWEDISH GENERAL ELECTRIC, LTD., Canada House, Kingsway, London, W.C.—April, 1916, stock lists of D.C. single-phase and polyphase motors and generators that are in London ready for delivery.

MESSRS. H. DUNOD & E. PINAT, 47 and 49, Quai des Grands-Augustins, Paris.—Summarised extract from their general catalogue of books, list of works recently published or reprinted, and prospectus of the "Agendas Dunod."

Trade Announcement.—MESSRS. EDWARD LE BAS AND CO., of Dock House, Billiter Street, E.C., have taken up the sole selling rights for Great Britain for "A.P.M." patent asbestos protected steel sheets, &c.

For Sale.—The Coventry Corporation Electricity Department has for disposal one 600-KW. McLaren-Siemens and one 600-KW. McLaren-British Westinghouse generating set. See our advertisement columns to-day.

LIGHTING AND POWER NOTES.

Atherton.—STREET LIGHTING.—The U.D.C. has decided to ask the South Lancs. Tramway Co. to arrange for the lighting of all the electric lamps on the tramway poles in the district, in order that the Council may obviate the need for lighting the gas lamps on tramway routes.

Bridlington.—PRICE REVISION.—The T.C. has decided to revise the electricity charges as from the June meter readings. For lighting the price will vary from 5½d. per unit for the first 500 units per quarter, to 4d. per unit for over 1,500 units. The heating and cooking rate will be 2d. to 1½d. per unit, according to amount.

Bo'ness.—PROPOSED LOAN.—The Public Works Loan Board has replied to the T.C., which asked for a loan of £14,500 for the proposed electricity works extension, that it is unable to accede to the request. Recently the Council submitted a proposal for a loan to various banks and insurance companies, but the replies were unfavourable, the parties approached having no funds at present in hand. The Council has an application pending before the Secretary for Scotland for sanction to a loan which it is apparently quite unable to procure.

Continental.—AUSTRIA-HUNGARY.—A census of electric machines has been ordered in Hungary, and all owners are required to declare their existing stocks of motors, electric machines and apparatus, in order that the latter may be requisitioned by the military authorities.

GERMANY.—Electricity supply is to be made a Government monopoly in Saxony, the Government intending, it is said, to lay before the Landtag a Bill to this effect. The State will undertake the distribution of electricity, hoping thus to obtain a new source of revenue. Municipal and private owners will be indemnified. The total cost of the purchase is estimated at 62,500,000 francs. In anticipation of the realisation of this scheme, the State has already purchased from the City of Leipzig the collieries owned by the latter at Lausitz and near Regis.—*L'Industrie Electrique.*

ITALY.—A new central station has been completed for the Volturno municipality. This is equipped with three 6,000-KW. three-phase transformers, for transforming energy received from Capo Volturno, and it further contains a stand-by generating plant, consisting of three 1,200-KW. Diesel engines, coupled to three-

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phase alternators and a smaller auxiliary 120-KW. Diesel set of the same type. The plant was supplied by the Italian Oerlikon Co. and Messrs. Sulzer Bros. The building will be much enlarged when the second Volturno waterfall is brought into use.

SWEDEN.—According to a return lately issued by the Swedish Water Power Association, new water-power utilisation plants to the extent of 28,000 H.P., exclusive of the Government works at Porjus and Alfkarleby, were last year completed in Sweden. The major portion of the new plants, 12,000 H.P., was in connection with the timber, wood pulp and paper industries; 9,000 H.P. was in connection with the iron and mining industries; 1,500 H.P. for the chemical industry; 500 H.P. for the textile industry, and 5,000 H.P. was divided over various other industries.

Derby.—PROPOSED LOANS.—The T.C. has applied to the L.G.B. for sanction to loans of £3,000 for motors, and £1,000 for mains, required for urgent service.

Dublin.—THE ELECTRICITY UNDERTAKING.—Writing in reply to strictures on the city electricity undertaking by the *Irish Independent*, Mr. J. J. O'Neill, chairman of the Dublin Electricity Supply Committee, denies that there was a deficit of £27,000 on the working for the nine months ended in December last, and asserts that, as a fact, there was a profit of about £3,000. As to the description of the refunding of cost of a new service by a prospective consumer as "extraordinary," he admits that it is not the ordinary arrangement in Belfast and in English cities, where, he says, the consumer has to pay at present the cost of the service and receives no refund, whereas in Dublin the cost is paid back to him in instalments which leave the Corporation without loss on the transaction. As it is not possible to raise any loan just now, the Committee adopted this method as most reasonable to the consumer.

The *Independant* says the Committee's report, signed by Mr. O'Neill, gives the total payment for the nine months to December 31st as £99,643, and the receipts as £72,673, and wishes to know, if the undertaking is conducted with the good results Mr. O'Neill attributes to it, "why the Committee refrained from submitting estimates for the coming year." The journal also asks why Mr. D'Alton's report to the Special Investigation Committee is not published officially.

STREET LIGHTING.—The Public Lighting Committee of the Corporation has been considering the best means of curtailing the expenditure on the street lighting during the next 12 months, the City Council having been obliged to reduce by £4,000 the amount to be provided for the purpose. The Committee has decided that the arrangement likely to cause the minimum of inconvenience to the public would be the complete discontinuance of the lighting of a proportion of the street lamps for the coming 12 months rather than the serious reduction of the lighting hours of all the lamps.—*Irish Times.*

East Ham.—The Finance Committee of the Corporation has had under consideration the question of increasing the price of energy used for public lighting, but has deferred the matter for the present.

Ilford.—LOAN SANCTION.—The L.G.B. has now sanctioned a loan to the U.D.C. of £870 to defray the cost of an electrical engine room at the refuse destructor.

Kingston-on-Thames.—REVISED TARIFF.—The Lighting Committee of the T.C. reports having further considered the mode of charging for the supply of energy, and states that it has adopted the following scale:—Lighting, first 3,000 units a year, 6½d. per unit; second 3,000, 6d.; third 3,000, 5½d.; fourth 3,000, 5d.; all over 12,000, 4½d. Basement lighting, first 3,000, 3½.; second 3,000, 2¾d.; all over 6,000, 2½d. Power, heating and cooking, first 10,000, 1¾d.; second 10,000, 1½d.; next 50,000, 1¼d.; second 50,000, 1⅛d.; all over 120,000, 1d. A transformer and automatic circuit breaker are to be obtained at a cost of £164.

Lancaster.—PRICE INCREASE.—The T.C. has decided to increase the price of electricity for lighting from 4¼d. to 4½d. per unit; for general motive power, from 2½d. to 2¾d. per unit; and for large consumers an increase from a third of a penny to a halfpenny per unit, in addition to the standing charges. The question of increasing the charge to the Tramway Committee is in abeyance.

Leicester.—YEAR'S WORKING.—The accounts for the year ended December 31st last show that 6,937,190 units were generated at the Aylestone Works, 5,214,419 units being sold, this including 3,029,391 units sold for power and lighting. The total revenue amounted to £46,257, a slight reduction on the previous year, while the total costs amounted to £26,881, some £3,200 increase on the previous year (when about 300,000 extra units, practically all for power, were sold). The gross profit, £19,376 was absorbed in meeting interest, sinking fund, and appropriations of £3,000 for a new boiler, &c., and £752 to reserve. The reserve fund in hand, in addition to the above, amounts to £10,911.

The Aylestone station supplied 1,312,400 units to the Lero station. The Lero station had an output from steam plant of 15,370,954 units, of which 1,324,698 units were required for station plant, 7,380,179 units were supplied to power consumers and the balance to the tramways undertaking. The power consumers supplied from the Lero plant numbered 260, with 9,100 H.P. of motors. The total costs of the Aylestone undertaking averaged 1·23d. per unit; the receipts were 2·13d. per unit, and the surplus (£3,752), after meeting interest, sinking fund, &c., was ·173d. per unit. The overall costs of the Lero station, including interest and sinking fund charges, were ·62d. per unit, and an average of ·84d. per unit was received for the power units sold, the surplus (on power supply only), after allowing for distribution, interest and sinking fund charges on cables, &c., being ·098d. per unit, or, roughly, £3,000, which is incorporated in the tramway accounts.

London.—At the City Corporation meeting, last week, a resolution was adopted instructing the Streets Committee to take the necessary steps to oppose the application of the Charing Cross Electricity Supply Co. to the B. of T. for consent to increase the maximum lighting rate. An amendment that it be referred back to the Streets Committee for reconsideration was rejected by one vote (82 to 81), and the original motion carried. In moving the amendment, the Chairman of the Streets Committee pointed out that the company was paying 60 per cent. more for coal, and that the costs of labour had considerably increased, and the Committee considered the increase fair and reasonable.

BETHNAL GREEN.—The Electricity Committee announces that considerable progress has been made with the work of laying cables, &c., in the borough, and it is hoped to be in a position to supply electricity in the western portion of the district in the course of a few weeks.

HOSPITAL LIGHTING.—The Children's Committee of the Metropolitan Asylums Board has reported upon the defective condition of the electric lighting installation at the Children's Infirmary. The institution is partly lighted by electricity and partly by gas; the electric installation is in an extremely bad condition, and considerable overhauling will have to be carried out. The total cost of the work is estimated by the Board's engineer-in-chief at £215. The matter has been referred to the Works Committee to be dealt with.

SOUTHWARK.—In January last, the B.C. referred back to the Electricity Committee the accounts of the undertaking for the 12 months ended March 31st, 1915, with a view to its submitting proposals for obviating future loss, and for effecting economy in the working of the station. At the meeting of the B.C., last week, the Committee reported having inquired into the deficit of £6,410 on the year's working, which it attributed to the unprecedented conditions prevailing consequent on the war. The Committee is satisfied that the number of hands now engaged is at its minimum, and, so far as the general management and conduct of the station is concerned, it can, at present, see no grounds for recommending any alteration. The Committee expects to benefit next year from the recent revision and increased charges to consumers for light and power.

ST. MARYLEBONE.—The estimated revenue of the electricity undertaking for the year ending March, 1917, is as follows:—From sales of electricity to consumers, £180,975; from public lighting, £14,970; meter rents, £7,800; sale of fittings, &c., £10,285; rent of properties, plant on hire, and sundry charges, £4,765, making a total of £218,795. The estimated expenditure is, for generation and distribution costs, management expenses, rates, taxes, &c., £81,110; allowances to employés, £5,050; maintenance and repairs to public lamps and repairs to properties, £3,800; sales department, £9,955; repayment of loans, £47,440; interest, £68,507, making a total of £215,862, and leaving an estimated credit balance on the year's working of £2,933. During the new year a short-term loan will be liquidated, resulting in a reduction of £4,581 in interest and sinking fund charges.

Maidenhead.—PRICE INCREASE, &C.—The T.C. has decided to increase the price of current for lighting by ½d. per unit, and for power by 10 per cent. A long dispute with the Diesel Engine Co., Ltd., who claimed a sum of £365, has been settled by payment to the liquidator of £128.

Malton.—PRICE INCREASE.—The Northern Counties Electric Supply Co. has informed the Urban Council that from April 10th the charge for electricity supplied to the Council will be increased by 20 per cent. The company has agreed to consider an application by the Council for an abatement in the lighting contract for the past year owing to restricted lighting.

Manchester.—The Electricity Committee has given permission to the city electrical engineer (Mr. S. L. Pearce) to advise the boroughs of Rochdale, Chesterfield, and Stafford, on their respective electricity undertakings.

Mr. Ross Clyne has given notice of intention to move a resolution at this week's meeting of the City Council, regretting that a request made to the Electricity Committee for large supplies of current by a firm proposing to establish works in Manchester, was not brought before the Committee as a whole, for consideration as to possible ways and means to meet the demand in question. The resolution proceeds to urge that in future all proposals, offers, or requests of like importance shall be properly submitted to the discretion of the Committee before acceptance or refusal.

Navan (Co. Meath).—At a meeting of the Guardians, Mr. J. Kelly referred to what he regarded as the Urban Council's undue delay with regard to the electric lighting scheme. It was now some years, he said, since a provisional order was obtained, and if it was not put in force in a few months, it would lapse.

Newport (I. of W.).—PRICE INCREASE.—The Electric Light Co. has informed consumers that the price of energy for lighting will be increased by 15 per cent., and for power by 10 per cent. after the current quarter.

Northwich.—PRICE INCREASE.—The Northwich Electric Supply Co., Ltd., has given notice that in consequence of the increased cost of materials and labour, the charges for electricity will be increased 10 per cent. from July 1st.

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Reigate.—Price Increase.—The T.C. has decided to increase by 15 per cent. the charges for lighting and power, and to raise the price for heating from 1d. to 1½d. per unit, plus 15 per cent., as from April 1st.

Salford.—Electric current is to be supplied free of charge to local hospitals under the control of the British Red Cross Society.

The Electricity Committee recommends the T.C. to authorise the cost of the proposed sub-station in the Greengate District to be defrayed out of moneys to be obtained from the sale of low-tension cables which will fall into disuse, the balance to be credited to capital account. The Committee proposes to enter into an agreement with the Peel-Conner Telephone Co., for the supply of energy for a period up to 10 years.

Stoke-on-Trent.—The T.C. has instructed the engineer to report as to the present plant in the power house, and upon what lines it is desirable that extensions shall be made, together with the probable cost.

Wirksworth.—Proposed E.L.—In reply to an inquiry from Mr. C. H. Best, of Bradford, as to the possibility of making preliminary arrangements for supplying the town with electric light and power, the U.D.C. has decided that it is undesirable to proceed with the matter at present.

Wimbledon.—Price Increase.—The T.C. has decided, as from April 1st, to increase the price of energy supplied in the borough, and at Merton and Maldens and Coombe by 10 per cent. A similar increase has been made for the hire of meters.

TRAMWAY and RAILWAY NOTES.

Dundee.—Year's Working.—The revenue from the Corporation tramways for the year shows an increase of £3,800, but the expenditure is greater by about the same amount.

Ilford.—Proposed Fare Revision.—In view of the increased running expenses, and the present prosperity of the town, the tramway manager has advised his Committee to consider the question of adopting the penny universal fare, and suggests that the scheme should be put into operation for the period of the war.

Leeds.—At a meeting of the City Council last week, Ald. C. H. Wilson (chairman of the Finance Committee) stated that the profits made on the tramway undertaking last year amounted to £91,000; £20,000 of this sum, however, represented money which would have been spent on track renewal but for the war, and £15,000 of it was to be put in reserve. He had anticipated that the profits from the tramways for the ensuing year would be £70,000, as against the Committee's estimate of £55,000, and if they could secure drivers for the cars there was little doubt that this year's figure would be exceeded at the end of the next 12 months, because, money being plentiful in the city, people would not walk.

Leicester.—Year's Working.—The total revenue of the tramway department for the year to December 31st last, was £188,520, as compared with £170,235 for the previous year. The working expenses, £122,142, increased by a less amount, leaving a gross balance of £66,733, as against £53,288 in 1914. After meeting interest, sinking fund charges, &c., and war allowances amounting to £7,412, the net balance remaining was £11,961, as against £11 221 in 1914, when war allowances were on a much smaller scale. It is recommended to appropriate £8,000 of the balance for rate relief, and £2,757 for reserve; the reserve fund in hand amounts to £92,797. During the year 40,440,158, being an increase of 2½ millions on the previous year, although the car-mileage, 3,899,939 miles, shows a reduction of 237,000 miles. The improved receipts were partly due to increased fares charged. At the end of the year 67 women conductors were employed on the cars.

Leyton.—The Tramways Committee recommends the carrying out of various repair, &c., works at the depôt, at a total cost of £160.

London.—The L.C.C. Housing Committee having proposed to make representations to the B. of T. on the inconvenience that would arise to the working classes from the closing of certain South London railway stations, the Highways Committee points out that the workmen's traffic at most of these stations is negligible, and that arrangements have been made by the tramway authorities to cope with any additional passengers resulting from the withdrawal of railway facilities.

Northampton.—The T.C. has been recommended to instruct the borough engineer to re-lay the curved tramway tracks in Mercer's Row and Abington Street.

U.S.A.—Extra-High-Pressure Turbines.—As previously mentioned in this journal, the Boston Elevated Railway has decided, in order to meet the growth of the load up to 1920, to install a 35,000-kw. steam turbine unit and to add 4,000-kw. rotary converters to its sub-station plant. The decision resulted from the relatively low first cost per kw. and superior economy of the large turbine over a 20,000-kw. unit which had been originally proposed. A feature of great interest is the decision to use a steam pressure of 600 lb., for which pressure future boiler plant will be built. The present South Boston plant operates on steam at 200 lb. pressure, and the new set will utilise the present boiler plant to commence with, being designed for the addition of probably six stages to the 16 stages considered necessary with the existing pressure. These extra stages will form either an extension of the turbine casing or a separate high-pressure section on the same shaft.

Regarding the use of high pressures, Messrs. Stone & Webster's engineers pointed out that the art of steam generation has reached a point where manufacturers consider it entirely practicable to build reliable equipment for operation at pressures ranging from 400 lb. to 600 lb., and that it seems probable that such equipment will be demanded by the best practice within a few years. The company cannot take advantage of these pressures yet, but the additional cost of a 35,000-kw. turbine designed for double the ordinary pressure is given as only about $15,000. The estimated saving of a 35,000-kw. unit over a 20,000-kw. unit, on a five-year period beginning 1917, using 200-lb. steam, based on 1,180,000,000 kw.-hours is $200,000, which covers the additional cost of the larger machine. The cost of adding the 35,000-kw. set, exclusive of engineering and fixed charges, will be $690,150, this including building, foundations, piping, exciter, ducts, an air-washer, switchgear, &c., as well as the turbine unit (which is figured at $315,000).

The South Boston station supplies 11 sub-stations, with 20 rotary converters, having an aggregate capacity of 41,000 kw. The 4,000-kw. rotary unit is to be adopted for future extensions in the central section of the city, since this not only reduces the cost and number of new sub-stations, but permits of the economical increase in capacity of existing sub-stations, whose 2,000-kw. machines can be used to advantage in the outlying districts.—*Elec. Railway Journal.*

Battery Car Operation.—The Cambridge and Indiana Railroad's 50-ft., 30-ton Edison battery car, during recent runs amounting to 738 miles, showed a total cost for platform labour and electric power, amounting to 13·9 cents per mile. Electrical energy cost $35·4 at 2 cents per kw.-hour. The company has just ordered another similar car, 35 ft. 8 in. long, equipped with 165 Edison A 10 cells and four Westinghouse motors.

TELEGRAPH and TELEPHONE NOTES.

Australia.—The Eastern and Associated Telegraph Companies will shortly open their own public office in Melbourne, Australia, which will be connected by special wire with their direct cable system.

Glasgow.—The special committee of the Corporation which deals with telephone affairs has recommended the T.C. to protest against the manner in which the charges for unlimited telephone service have been increased, without affording subscribers an opportunity to make representations against them, and to inform the P.M.G. that the Corporation reserves the right to take steps after the war, with a view to the modification of the charges and the amendment of the other conditions of service.

Norway.—At the end of June, 1914, the Government telegraphs and telephones possessed in the aggregate 220,443 km of wire and 22,674 km. of line; the bulk of the wire was installed for telephone subscribers' exchange connections, amounting to 129,690 km., while the trunk lines employed 67,713 km. The telephone system of Christiania claimed no less than 91,658 km. of wire, and the 72 State telephone exchanges had a total of 36 377 subscribers' stations. There were 104 million conversations during the year. Private telephone companies, numbering 330 in 1912, had 37,211 subscribers and transmitted 84 million messages, the revenue being over two million francs.—*Journal Télégraphique.*

Post Office Telegraphs and Telephones.—The report of the P.M.G. for 1914-15 was recently issued in the form of a blue-book. It states that the number of telegraph offices open at the end of March, 1915, was 14,222, an increase of 70; the number of telegrams handled was 91,179,000, an increase of over 4 millions, including over 3 million free Government telegrams more than in the previous year, and the receipts increased by £193,092 to £3,013,909. The military and naval traffic was extremely heavy, and Press telegrams increased by 6 per cent. The withdrawal of a large portion of the staff for military or naval service necessitated the employment of temporary staff, the training of additional operators, the recall of retired operators, and the use of the telephone in place of the Morse sounder at 7,350 sub-offices. The use of Creed high-speed printing telegraph machines set free a number of telegraphists, and a Western Electric multiplex was added on the London-Manchester route, on which the Murray instrument was already in use. Baudot working was extended, and the use of the Wheatstone was increased. The use of the telephone system for the dispatch and delivery of telegrams was found of great assistance, and the trunk telephone lines were also used for the delivery of urgent telegrams at night. The extended use of phantom telegraph circuits superposed on telephone trunk and junction circuits proved valuable. Foreign telegrams (apart from the cable companies' traffic) numbered 9,421,000, a decrease

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of over two millions. At the outbreak of war there were 2,158 licences in existence for private wireless stations on land, an increase of 195; no fresh licences were issued, and the existing stations were dismantled. At the end of July, 1914, 942 merchant ships carried wireless apparatus under licence from the P.M.G., an increase of 63 during the four months; in that period 26,145 radiotelegrams were dealt with at the P.O. Coast stations.

The number of telephones owned by the Post Office (apart from military and naval telephones) was 749,565, besides 46,782 private-wire stations. Nearly 10,000 emergency circuits were provided specially for Government departments. The exchange telephones in London numbered 253,486. The number of effective calls during the year was 815 millions, a decrease of 2·3 per cent. New exchanges opened numbered 232, making the total 3,052. Trunk calls increased by 6·89 per cent., and 570 additional trunk circuits were provided, or 40,727 miles of wire. At 34 towns the separate trunk and local exchanges were amalgamated, with advantage, and new underground telephone cables have been laid and brought into use. An accelerated trunk service was introduced between Bradford and Leeds. Automatic exchanges were working satisfactorily at the G.P.O., Accrington, Chepstow, Darlington, Epsom, Hereford, and Newport, and similar exchanges were being installed at Blackburn, Dudley, Grimsby, Leeds, Paisley, and Portsmouth. Only 357 exchanges now do not give a continuous service. The number of rural party lines (farmers' lines) was increased by 849 to 2,265. Some 7¼ million telegrams were sent by telephone, an increase of 13·4 per cent.

The mileage of wire in use was 3,071,867 miles, an increase of 6·4 per cent; of the total, 265,765 miles were used for telegraphs and 2,806,102 for telephones. Aerial wires aggregated 997,392 miles, underground 2,060,918 miles, and submarine 13,657 miles.

Urgent demands for stores for military and naval purposes were dealt with on the outbreak of war; in one case material weighing over 100 tons was assembled and dispatched within 24 hours of the receipt of the demand. Some 16,000 telegraph and telephone instruments were issued for naval or military purposes during the year. The whole of the initial equipment for the base and field post-offices of the Expeditionary Force, weighing about 10 tons, was dispatched within two hours of the receipt of instructions. Owing to the rise in price of foreign timber, 44,000 British-grown poles were ordered.

The financial results of the working of the telegraphs and telephones were briefly as follows:—

	Revenue.	Increase.	Expenditure.	Increase.
Telegraph ...	£3,407,326	£286,813 ...	£4,656,607	£324,352
Telephone ...	6,481,827	290,643 ...	6,588,869	636,796

The telegraphs showed a net loss of £1,249,281, and the telephones a net loss of £107,042.

Part of the deficiency on the telegraphs was due to the use of the Continental cables for war purposes, and to an expenditure of £98,884 in wages to employés serving with the Colours. Similarly the telephone cables to the Continent had been used for war purposes, and £80,802 was paid in respect of telephone employés serving with the Colours.

Uruguay.—The Government has obtained statutory powers to take control of the telegraph, telephone, and post-office services, and will entirely reorganise them as soon as arrangements can be made to take them over from the present owners.—*T. and T. Age.*

Wireless Inventions.—It is reported that Senator Marconi has been engaged upon research work in Italy, and has obtained results which concern the future practice of the whole science of wireless telegraphy and telephony; patents are being applied for. The inventions will probably be applied at once in Italy to military purposes, and it is expected that by these means results heretofore impossible will be obtained.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—May 1st. Two 300-kw. turbo-alternators, condensers, switchboard, &c., for the pumping station at Ryde, for the Metropolitan Board of Water Supply and Sewerage at Sydney.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-kw. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.*

May 24th. N.S.W. Government Railways and Tramways. 16/600-volt D.C. motors for tramway stores, Randwick.*

Adelaide.—April 12th. P.M.G. Ten to eleven miles of lead-covered cable.*

Melbourne.—April 11th. City Council. 533,000 arc lamp carbons. See "Official Notices" March 25th.

April 18th. P.M.G. 8,500 fuses.*

April 26th. Victorian Government Railways. Car-lighting material—cables, switches, fuses, &c.*

May 1st. City Council. Meters and maximum demand indicators. See "Official Notices" to-day.

May 10th. Victorian Government Railways. Motor-generator set and accessories for battery-charging of baggage trucks.*

May 17th. Victorian Government Railways. One 2-ton electrically-operated goods elevator for Jolimont car-shed.*

Tamworth (N.S.W.).—May 1st. Additional generating plant, switchboard, mains, &c., in connection with the municipal electricity undertaking. Specifications from Mr. V. G. Kable, Town Clerk, Council Chambers.

Salford.—April 17th. Electricity Committee. Switchgear for 5,000-kw. sub-station equipment. See "Official Notices" to-day.

Walthamstow.—April 26th. U.D.C. Water-softening plant for the Electricity Department. See "Official Notices" to-day.

Warrington.—April 11th. Electricity and Tramway Committee. Motors and transformers. See "Official Notices" March 31st.

April 26th. Electricity and Tramways Committee. Boiler plant and economiser. See "Official Notices" to-day.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Barrow.—The T.C. has accepted the following contracts for electricity supplies for 12 months:—

Copper wire, &c.—A. F. Goodwin & Co.
Insulating compound and bitumen.—Dussek Bitumen Co.
Switches, &c.—General Electric Co., Ltd.
Joint-boxes and switch cut-outs.—B.I. & Helsby Cables, Ltd.
Electricity meters.—Chamberlain & Hookham, Ltd.
Prepayment meters.—Ferranti, Ltd.
Metallic-filament (Osram) and tantalum lamps.—Drake & Gorham, Ltd.
Carbon-filament lamps (Pope's).—Pope's Electric Lamp Co., Ltd.
Earthenware pipes and troughs.—Doulton & Co., Ltd.
Electric motors.—Veritys, Ltd.
Meter boards.—E. Cust.
Bricks.—Furness Brick & Tile Co., Ltd.
Engine and crank-chamber oils.—Vacuum Oil Co., Ltd.
Cylinder and turbine oils.—Jas. Light & Sons, Ltd.
Ash-elevating plant, £919.—The New Conveyor Co.
Oil-eliminating plant (additions), £105.—Paterson Engineering Co.

Newport.—Messrs. Chamberlain & Hookham, Ltd., have received a contract for meters for the coming year for Newport.

Bexhill-on-Sea.—T.C. 500 tons of Shipley or Tibshelf peas coal, for the electricity works: Myers, Rose & Co., £1 8s. 9d. per ton.

Bolton.—The following tenders have been accepted by the Electricity Committee:—

Bolton Brick Co.—Trough covers.
J. & F. Webster.—Casings, &c.

Derby.—T.C. Coal for the electricity works: Derby Coal Co., Ltd., Hill & Poyser, T. Walker, and Brookhouse, Johnson, Ltd.

Dudley.—The Lighting Committee recommends the Corporation to accept the tender of the Earl of Dudley for a 12 months' supply of steam coal, at 22s. per ton.

Halifax.—The T.C. has been recommended to purchase from the Brompton & Kensington Accessories Co., Ltd., the electric cooker now on approval at the electricity works, and to accept the following tenders:—

Edison Accumulators, Ltd.—A standard 2-ton Edison chassis, complete with electrical tip body, for removing ashes from the electricity works, for £977.
Daimler Co., Ltd.—Two 2-ton Daimler chassis, for the Tramways Committee, £1,488.

Ilford.—Messrs. E. Foster & Co. are to supply one truck weekly, over a period of six months, of Hawkins' nutty slack, at 20s. 6d. per ton, to the Electricity Committee.

Kingston-on-Thames.—The Committee proposes to seal contracts with W. Cory & Sons, Ltd., and Usher & Co., for the supply of 500 tons of Lambton coal at 37s. 6d. per ton, and 300 tons Shipley ½-in. slack, at 22s. 6d. per ton respectively.

Lancaster.—Corporation Electricity and Tramways Committee. Tenders accepted for four motor-'buses: Edison Co. for the chassis, and Brush Co. for the bodies.

Leyton.—The tender of Messrs. Siemens Bros., Ltd., has been accepted by the U.D.C., at £172, for 2½ miles of service line cable (several sizes).

London.—The Metropolitan Water Board does not propose to enter into a periodical contract this year for the supply of electric lamps, wire, and accessories (sub-sections 1, 2 and 3). Instead, it has been suggested that the Works Committee should obtain tenders from time to time for the supply of such quantities as may be required during the period ending March 31st next.

The Metropolitan Asylums Board proposes to renew the contract with the Pritchett & Gold Co. for the maintenance of the electric battery at the Grove Hospital for a further period of five years, at £75 per annum.

L.C.C.—The Education Committee recommends that the chairman, vice-chairman and deputy-chairman of the Council, the chairman and vice-chairman of the Education Committee, and the chairman and vice-chairman of the Buildings Sub-Committee be authorised, during the Easter recess, 1916, to open the tenders received for installing electric light at the Southampton Street, Camberwell, L.C.C. school.

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The Asylums and Deficiency Committee has accepted the following tenders for the supply of the under-mentioned stores for three months :—

Electrical sundries.—A. F. Goodwin & Co.; General Electric Co., Ltd.; Cox-Walkers, Ltd.; Edison & Swan U.E.L. Co., Ltd.; G. MacLellan and Co.
Electric lamps.—Pope's Electric Lamp Co., Ltd.

Manchester.—The Electricity Committee has approved the following firms as sub-contractors in connection with the tender of M. Louis Prat (Paris) for induced-draught plant :—

Chimney.—E. Danks & Co. (Duxbury), Ltd.
Electrical materials.—Lancashire Dynamo & Motor Co., Ltd.
Foundation base.—Galli Bros.

Midland Railway Co.—The recent reference to a contract for Osram lamps placed with the General Electric Co., Ltd., by the Midland Railway Co., was not intended to indicate that the contract for the exclusive supply of metal-filament lamps was given to that company. The order only covers a portion of the railway's requirements.

Morden.—Joint Hospital Board. Electric light maintenance (not including armature and field coil failures): D. J. Macdonald, Hounslow, £22 for the year.

Salford.—The Tramways Committee has accepted the tender of Messrs. Scholey & Co., Ltd., for steel tramway tires, amounting to approximately £1,055. The Electricity Committee has accepted the tender of Messrs. Babcock & Wilcox, Ltd., for two water-tube boilers, &c., for £11,544.

The following tenders have been accepted by the Tramways Committee for supplies :—

Car accessories (electrical), insulating materials, &c.—W. McGeoch & Co., Ltd.; W. T. Henley's Telegraph Works, Ltd.; General Electric Co., Ltd.; L. Andrew & Co.; British Westinghouse Co.; Micanite and Insulators, Ltd.; North British Rubber Co., Ltd.; Griffiths Bros., Ltd. (insulating varnishes); C. Macintosh & Co., Ltd.; B.I. & Helsby Cables, Ltd. (P. and B. tape); Siemens Bros. Dynamo Works, Ltd.; Le Carbone; H. Norbury & Co.; Gabriel & Co., Ltd.; W. Boydell and Sons, Ltd.; J. Hall.
Car accessories (mechanical).—W. J. Ritchie & Co.; National Rail and Tramway Appliances Co., Ltd.; J. Needham & Sons, Ltd.; Anti-Attrition Metal Co., Ltd.; Brown, Bayley's Steel Works, Ltd. (steel tires).
Ears, frogs, pull-offs, &c.—B.I. & Helsby Cables, Ltd.; Watlington & Co., Ltd.; J. Hall; British Westinghouse Co., Ltd. (lightning arresters).
Special car accessories.—British Westinghouse Co., list prices.
Wire, solder, lead and tin.—B.I. & Helsby Cables, Ltd.; L. Andrew & Co.; R. Johnson, Clapham & Morris, Ltd.

The following tenders have been accepted by the Electricity Committee :—

British Westinghouse Co.—Two 1,000-kw. rotary converters, £5,590.
General Electric Co., Ltd.—One 500-kw. rotary converter, £1,580.
Babcock & Wilcox, Ltd.—Two water-tube boilers, £11,544.

York.—T.C. Coal for the electric light works: Mr. G. Cooper (Bentley Colliery Co.), at 16s. per ton.

FORTHCOMING EVENTS.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, April 7th. At 7.30 p.m. At the Literary and Philosophical Society, Westgate Road, Newcastle. Address on "The Business Side of Science: Its Part in the Coming Economic Crisis," by Mr. T. C. Elder.

Royal Institution of Great Britain.—Saturday, April 8th and 15th. At 3 p.m. At Albemarle Street, W. Lectures (V and VI) on "Radiations from Atoms and Electrons," by Prof. Sir J. J. Thomson.
Friday, April 14th. At 5.30 p.m. At Albemarle Street, W. Lecture on "The Genesis and Absorption of X-Rays," by Prof. Sir J. J. Thomson.

North of England Institute of Mining and Mechanical Engineers.—Saturday, April 8th. At 2 p.m. At the Wood Memorial Hall, Newcastle-on-Tyne. General meeting.

Salford Technical and Engineering Association.—Saturday, April 8th. At 7 p.m. At Royal Technical Institute. Lecture on "British Design Modern Cylindrical Grinding Machines, External and Internal," by Mr. T. R. Shaw.

Junior Institution of Engineers (Midland Section).—Tuesday, April 11th. At 7.30 p.m. At the Imperial Hotel, Temple Street, Birmingham. Paper on "Application of Chain Gear for Power Transmission," by Mr. C. Turtle.

Association of Engineers-in-Charge.—Wednesday, April 12th. At St. Bride's Institute, E.C. At 7.30 p.m. Paper on "Steam Turbines," by Mr. G. Stoney.

Dynamicables' Anniversary Meeting and Dinner.—Wednesday, April 12th. At 7.30 p.m. At the Trocadero Restaurant. Mr. C. P. Sparks in the chair.

Liverpool Engineering Society.—Wednesday, April 12th. At the Royal Institution, Colquitt Street. Paper on "Electric Power in Quarry Operation," by Mr. G. K. Paton.

Institution of Electrical Engineers.—Thursday, April 13th. At 8 p.m. At Victoria Embankment, W.C. Discussion on "The Present Position of Electricity Supply in the United Kingdom, and the steps to be taken to Improve and Strengthen it."

(**Newcastle Local Section**).—Monday, April 10th. At 7.30 p.m. At the Mining Institute. Paper on "The Nature of Electrical Insulation," by Mr. W. M. Thornton.

(**Scottish Local Section**).—Tuesday, April 11th. At 8 p.m. At 207, Bath Street, Glasgow. Paper on "Branches from E.H.T. Circuits," by Mr. D. M. MacLeod.

(**Yorkshire Local Section**).—Wednesday, April 12th. At 7 p.m. At the Philosophical Hall, Leeds. Paper on "Electric Heating: Its Present Position and Future Development," by Mr. G. Wilkinson.

Leeds Association of Engineers.—Thursday, April 13th. At 7.30 p.m. At 5, Park Lane. Annual meeting.

Institution of Mechanical Engineers.—Friday, April 14th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. General meeting.

NOTES.

Easter Holidays.—Owing to the Easter Holidays, the Electrical Review for Friday, April 21st, will be published on Wednesday, April 19th. All matter for both the editorial and advertisement pages for that issue should be in our hands at the earliest possible moment. A notice regarding the latest times for advertisements to be received, appears in our advertisement pages to-day.

Lost Time.—In the Belfast Munitions Court, two young electricians named Robert Sanderson and James Mawhirk were charged with absenting themselves from work. It was stated that during the nine weeks from January 20th to March 22nd, Sanderson lost 34 per cent. of his time and Mawhirk 33 per cent. Sanderson, who did not appear, was fined 40s., and Mawhirk 20s.

Electrical Output of U.S. Power Stations.—A table published in the *Electrical World* gives statistics relating to the output, load factor, &c., of the 36 largest electrical generating systems of the United States, which produce about 70 per cent. of the aggregate output of the country. The combined output of these companies in 1915 was 13,000 million kw.-hours, of which about two-thirds was generated by water-power. The Commonwealth Edison Co. produced 1,198 million units, with a load factor of 42·5 per cent. for the year. The Niagara Falls Power Co. produced 899 millions, with a load factor of 81·28 per cent., and three other companies exceeded 725 millions. The Hydraulic Power Co., which produced 695 millions, recorded the remarkable load factor of 91 per cent., the bulk of the energy being used in electro-chemical industries. Only two of the companies had an output of less than 100 million units.

London and Frankfort Metal Interests.—It is stated on good authority that, with the consent of the German and English Governments, a dissolution is to take place of the relations hitherto existing between the Metall Bank und Metallurgische Gesellschaft and the Metall Gesellschaft of Frankfort-on-Main, on the one hand, and Henry R. Merton & Co., Ltd., of London, on the other, in the sense that both sides will completely dispose of their mutual shareholdings. Certain formalities with English executors have to be settled before the transaction can be definitely completed. In this connection it is mentioned that of the ordinary shares in the London company the sum of £150,000 was in the possession of the Metall Bank and £180,000 in that of the Metall Gesellschaft, these having been disposed of in London, together with shares for £20,000 which were in private ownership. In return large blocks of shares in the Metall Gesellschaft, the Metall Bank and the Schweizerische Gesellschaft fur Metallwerke have been sold in Germany out of the holdings of persons who are closely associated with the firm of Henry Merton & Co. The sale price of the latter has ranged from 200 per cent. to 270 per cent. It is added that the incentive to the dissolution of relationship emanated from London.

I.M.E.A. Annual Meeting.—The 21st annual general and business meetings of the Municipal Electrical Association will be held at the Institution of Electrical Engineers, London (as headquarters), on June 22nd and 23rd next. The first day's proceedings include the reading of the presidential address by Mr. Alex. C. Cramb, Croydon, this year's president, followed by the reading and discussion of three papers as follows :—

"Boiler House Design," by Mr. W. W. Lackie, Glasgow.
"Area of Supply from an Economic Standpoint," by Mr. H. S. Ellis, South Shields.
"The Application of Electric Power to Agriculture," by Mr. W. T. Kerr, Hereford.

The second day's proceedings will be confined to the morning, when the annual business meeting will be held. No special arrangements will be made in regard to hotel accommodation or travelling facilities. The secretary is Mr. C. McArthur Butler, 28, Bedford Square, W.C., to whom communications should be addressed.

Petrograd Electricity Plans.—The Petrograd Town Council has appointed a special committee for establishing a basis for buying back the electrical concerns of the capital. The committee is working under the chairmanship of Town Councillor A. A. Voronoff, and is preparing a general plan for uniting various electrical concerns, having in view their reconstruction and further exploitation. It is also preparing an estimate and system of charges for current, and so on. It is said that the committee promises that electricity shall be much cheaper for the consumers than it was before. The estimated cost of the operations of the committee, which it is hoped will be closed in the year 1918, is about 548,000 roubles.

Tungsten Deposits in Burmah.—According to the *Mining and Engineering World*, the first serious attempts to develop the Wolfram deposits of the Indian Empire and Lower Burmah occurred about 5 years ago. During 1909-13 Lower Burmah produced over 5,000 tons of concentrates valued at nearly £400,000, and the present rate of production is about 2,000 tons. The methods adopted in mining are extremely primitive; open quarries, hand crushing of the ore are usual; the labourers are largely Chinese and Telegus. It is now announced that the Indian Government is taking energetic steps to stimulate the output.

Inquiries.—Firms that stamp out steriliser bodies are inquired for; also makers of paper rolls for recording voltmeters and makers of an assaying apparatus, using an electric current to deposit the metal under test.

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Institution and Lecture Notes.—Institution of Electrical Engineers.—The Committee of the Birmingham Local Section has had under very careful consideration the question of alien enemy membership, which is at present before the Institution, and, after a full discussion of the matter at two meetings, unanimously passed the following resolutions for transmission to the Council of the Institution :—

1. That the Council be requested to obtain powers to amend the Articles of Association to exclude from membership of the Institution any undesirable aliens or undesirable members of alien origin.

2. That, in view of the foregoing resolution, it is not considered necessary to proceed with the resolutions at present before the Institution.

The Committee has prepared the following list of officers to act during the Session 1916-17 :—

Chairman.—Col. J. F. Lister, R.E.

Vice-Chairmen.—S. T. Allen, N. B. Rosher.

Present Ordinary Members of Committee (remaining in office).—H. Foulds, C. C. Garrard, Ph.D., S. H. Holden, W. A. Jackson, Prof. G. Kapp, D.Eng., W. Marden, A. Pearson, B.A., W. E. Sumpner, D.Sc., F. Thursfield, J. M. Walshe.

Ordinary Members of Committee (new nominations).—*F. H. Clough, T. Plummer, E. O. Turner.*

Hon. Secretary.—J. D. Morgan.

The Committee's nominations are given in italics.

Additional nominations must reach the Hon. Secretary, at 13, Temple Street, not later than April 12th.

The annual general meeting of the Manchester Local Section was held on Tuesday last. The chairman (Mr. B. Welbourn) presided, and there was a good attendance of members.

The ballot for the election of chairman, hon. secretary, and Committee for the next session resulted as follows :—

Chairman.—Mr. A. E. McKenzie.

Vice-chairman.—Messrs. C. J. Beaver and A. P. M. Fleming.

Committee.—Profs. Field and Miles Walker, Dr. Cramp, Messrs. H. Allcock, A. G. Livesay, S. L. Pearce, J. S. Peck, H. A. Ratcliff, J. A. Robertson, H. D. Symonds, S. J. Watson, and Alderman Walker.

At the close of the meeting a lecture on "Recent Researches in X-Rays" was given by Prof. E. Rutherford, of the Manchester University.

The report states that the number of members at the close of the Session was 735, a slight increase over the figures for last year. The attendance has averaged slightly over 100 per meeting, which would be a good figure for ordinary times, and under present conditions must be considered exceptionally good. In the discussions upon the various papers, a very high general level has been attained, and an unusual number of new speakers has taken part.

Royal Institution.—The Day Lectures after Easter include the following :—Prof. T. M. Lowry, two lectures, "Optical Research and Chemical Progress"; Prof. W. H. Bragg, two lectures on X-Rays and Crystals : (1) "New Methods of Research"; (2) "First Results and their Applications" (the Tyndall Lectures); Prof. H. S. Foxwell, two lectures, "The Finance of the Great War : New Problems and New Solutions"; "How we Stand To-day, and What Lies Ahead." The Friday evening discourses will be resumed on May 5th, and will include the following :—Sir James Mackenzie Davidson, "Electrical Methods in Surgical Advance"; Prof. Charles G. Barkla, "X-Rays."

Junior Institution of Engineers.—The meeting at which a paper on "Speeding-up," by Mr. R. Rankin, is to be read, has been postponed from the 10th to the 18th April.

In an address before the Dublin Rotary Club, Sir John Griffith, late engineer to the Dublin Port and Docks Board, suggested the extension of the electrical equipment of the Port for the rapid discharge of vessels.

Fire Prevention.—The British Fire Prevention Committee's fire warnings, which have been issued since the outbreak of war, cover a number of matters that require the attention of the public with the object of reducing the ordinary fire waste and meeting the air raid danger. The public are advised to apply for the particular class of notice or warning that they desire. These are provided gratuitously. The warning for factories and works engaged on Government contracts is No. 16. For the air-raid danger, warnings Nos. 17A and 18A should be obtained. No warning notice is issued to any caller at the Committee's offices or testing-station, or upon any telephone message. Application must be made in writing, with a large stamped and addressed envelope enclosed for the reply, to the Registrar, The British Fire Prevention Committee, 8, Waterloo Place, London, S.W., and both the nature of the notice and the reference number of the warning (as given above) must be given.

Nickel-Chromium Patents in the U.S.A.—A list of the licensees under the Marsh patent, No. 811,859, for the use of nickel-chromium wire as a resistance element in electric heating apparatus, was published in the *Electrical World* of March 4th. The patent is owned by the Hoskins Manufacturing Co. and the General Electric Co.—the parties in the recent infringement case, reported in our issue of July 30th, 1915, in which the latter company was the loser. The General Electric Co. has acquired a third interest in the patent. An advance in the prices of heating appliances is anticipated. The owners do not intend to take proceedings against firms that have used infringing devices in the past, provided that they deal with the owners or their licensees in future, and do not deal in infringing devices. The Driver-Harris Wire Co., who manufacture nichrome wire, are in conference with the owners of the patent.

Fatalities.—At Failsworth last Friday an inquest was held into the death of Edward Capewell (48), who, together with another man, was employed at the works of Messrs. Ferranti, Ltd., Hollinwood. They were lifting a carboy of nitric acid from a trolley on to the floor when it burst and the liquid ran on to some brass castings and fired. Despite medical aid Capewell died later. The foreman, who was still suffering from the effects of the fumes, would not be able to attend the inquiry for some days. The inquest was adjourned.

An Openshaw electrical engineer, Arthur Fletcher, aged 45, employed at the Armstrong, Whitworth works was knocked down by a Manchester Corporation tramcar last week and killed. Verdict : "Accidental death."

Electrical Instrument Makers Wanted. — The Wireless Section of the Corps of Royal Engineers is open to recruit first-class instrument (electrical) makers. Conditions as to pay, terms of service, &c., can be obtained by application to Major A. Handley, R.E., St. Martin's Gate, Worcester. Applicants should state fully their training and experience, and say if they are eligible for service.

Volunteer Notes.—Engineering Institutions' V.E.C.—Orders for week commencing April 10th, 1916.—By Lieut.-Col. Clay, V.D., Commanding.

Monday, April 10th.—Sections 1 and 2, Technical; Sections 3 and 4, Squad and Platoon, Signalling Class and Recruits.

Tuesday, April 11th.—School of Arms, 6 to 7 p.m.

Thursday, April 13th.—Shooting for Sections 3 and 4.

Friday, April 14th.—Sections 3 and 4, Technical; Sections 1 and 2, Squad and Platoon, Signalling Class and Recruits.

Saturday, April 15th.—Adjutant's Instruction Class at 2.30 p.m.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, April 6th, 1916 :—

Battalion Parades.—Saturday.—The Battalion will Parade outside Baker Street Station at 2.30 p.m., and proceed by train to Wembley Park, for Battalion Drill, under the Commandant.

Sunday.—The Battalion will Parade at Liverpool Street Station (low level entrance, G.E.R.), at 9.30 a.m., and proceed by train for Entrenching duties.

Musketry.—There will be shooting at Bisley on Saturday next, 8th inst., and all day Sunday, 9th inst. Members proceeding to Bisley on Saturday, must Parade, in uniform, at 12.45 p.m., No. 6 Platform, Waterloo Station, and members going down on Sunday, at 9.45 a.m., No. 6 Platform.

The Acton Range will be open on Saturday, 8th inst., at 2 p.m.

Names (for both Ranges) must be forwarded to the Musketry Staff by first post Saturday morning.

A. G. Joiner, *Major and Adjutant*, O.B.C.

The Electrification of Fibres.—Arrangements are being made for setting on foot a thorough scientific investigation into the question of the electrification of fibres in the textile industry, a phenomenon which has given a great deal of trouble to manufacturers. The Textile Institute, at the instance of the Mill Managers' Association, has requested the Leeds University to take the research in hand, the cost being borne by the Institute, with the assistance of the manufacturers.

Registration of Firms.—With reference to the subject of our leading article of last week, we regret to state that in the House of Commons, last Friday, Mr. Lloyd George, in reply to Mr. Annan Bryce, said that as there was reason to believe that the Registration of Firms Bill would not be accepted as a non-contentious measure, the Government was not, as at present advised, prepared to proceed with the Bill in the Commons.

Electric Light Switching.—At the end of this month the results of the competition just closed will be published in this journal. Meanwhile, we are asked by Messrs. A. P. Lundberg and Sons to announce the fact that, owing to the success of this competition, a supplementary examination will be conducted shortly on the same sets of problems. Particulars will be issued to old and intending new competitors early this month. Those who have a copy of the February Examination Pamphlet should keep it by them ; those who have not, can obtain one on application within the next three weeks.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The L.C.C. Highways Committee recommends that, during the absence through illness of the chief officer of tramways, the deputy chief officer of tramways, Mr. J. K. Bruce, shall take the place of Mr. A.

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L. C. Fell as one of the representatives of the Council on the Rolling Stock and the Permanent Way and Building Conciliation Boards.

The Ilford Electricity Committee proposes to increase the salary of Mr. R. F. Windett, meter superintendent, to £145 a year.

On the occasion of his marriage with Miss H. Moon, Mr. Thos. Law, of the Rotherham Corporation Tramway staff, has been presented by the shed staff with a timepiece.

Coventry T.C. has adopted a recommendation of the Tramways Committee increasing the salary of the engineer and manager, Mr. T. R. Whitehead, from £500 to £600 per annum.

Certain rearrangements of the staff of the mains department of the Manchester Electricity Department have been made in consequence of the ill-health of Mr. L. R. Lee, mains engineer, and the Electricity Committee has decided to recommend the following increases of salaries:—Mr. J. Clarke, from £250 to £275 per annum; Mr. H. Hawkins, from £250 to £275 per annum; Mr. F. T. Fowler from £200 to £210; and Mr. A. J. Lovell from £185 to £200. The total advances amount to £75, which is the amount the mains engineer will relinquish from his salary of £475 per annum.

General.—Mr. C. J. Spencer, manager of the Bradford City Tramways, has been appointed Vice-Chairman of the Lord Mayor's Citizens' Contribution Committee, which is charged with the important duty of systematising the collection of funds from all classes of citizens in Bradford for the replenishment of the Lord Mayor's War Relief Fund. Mr. H. Moss, electrician, of Bradford, is on the same Committee as the representative of the local electrical engineers, together with Mr. Thos. Roles, the Bradford city electrical engineer.

Mr. William Wood, the senior partner in the firm of Scupham & Wood, Ltd., timber merchants and makers of electric blocks, Leeds, has just completed 60 years of service at the works. The local Press has interviewed Mr. Wood in connection with the celebration, and in the course of the article it is mentioned that some years ago Mr. Wood and his sons prepared to meet the demand for electric switch blocks, bell pushes, and casings, laying down a special plant therefor, with the result that when war broke out they were in a position to secure a good deal of the German trade. Mr. Wood expresses the opinion that the Germans will never get it back.

London Gazette notice.—Territorial Force, Royal Engineers, Tyne Electrical Engineers:—Second-Lieutenant H. G. White to be temporary captain; Second-Lieutenant (temporary Captain) H. G. White is seconded.

With reference to a notice which appeared in this column in our issue of March 10th regarding the arrangement existing between Mr. C. H. Best and Mr. Chas. Pullan, of Bradford, Mr. Pullan writes to say that, so far as the date mentioned is concerned, the announcement is premature. "Certain differences have arisen between Mr. Best and myself, but so far no definite dissolution of the existing arrangement between us has been signed. I would add that it is my intention to continue with village electric supply schemes in the future."

We regret that in our report last week of the speech delivered by Lord Vaux of Harrowden, at the Electrical Trades' Benevolent Institution annual meeting, reference was made to the death of Mr. E. G. Byng. This, of course, was an error, and should have read Mr. H. G. Byng.

Mr. W. B. Shirehampton, who was manager of the export department of Messrs. Veritys, Ltd., for many years, is shortly proceeding to Russia in the interests of a few electrical firms, and would be glad to hear from others who are interested in the development of this important market now and after the war. He will be in the country for several weeks. Further particulars may be obtained from Mr. Shirehampton at 75, Curtain Road, E.C.

Roll of Honour.—The death has occurred, at the Royal Infirmary, Aberdeen, of Private William Warner, of the 1st Battalion Gordon Highlanders, who was wounded in November, 1914, during severe fighting in the Ypres region. Prior to the war he was engaged at the Keighley Corporation electricity works.

Private F. Appleton, of the Buffs (East Kent Regiment), who has died of wounds received in action, was for seven years prior to the war engaged on the staff of the Isle of Thanet Tramway Co., Ltd.

Rifleman Alfred Dudley Tidey, of the Queen's Westminster Rifles, who has died after an operation at St. Mary's Cottage Hospital, Hampton, was, prior to his enlistment in August, 1914, engaged with the Pall Mall & St. James' Electric Light Co.

Rifleman F. Poe, of the Rifle Brigade, who was, prior to his enlistment, with the British Thomson-Houston Co., Ltd., of Rugby, is now reported killed in action. He had been missing since July 30th last, after a liquid fire attack at Hooge.

Private Frank Lynas, Royal Inniskilling Fusiliers, killed in action, was a Reserve man, and, prior to the war, was employed in the Belfast Corporation's electricity works.

Obituary.—Mr. T. Richards.—The death occurred last week of Mr. Thomas Richards, chairman of the Cleveland, Portishead & District Electric Supply Co., Ltd.

NEW COMPANIES REGISTERED.

Conner Magneto and Ignition, Ltd. (143,456).—Registered March 30th, by F. Samuelson, Midland Bank Chambers, 71a, Queen Victoria Street, E.C. Capital, £52,000 in 50,000 pref. shares of £1 each and 40,000 ord. shares of 1s. each. Objects: To adopt agreements (a) with the Peel Conner Telephone Works, Ltd., of 71a, Queen Victoria Street, E.C.; (b) with M. S. Conner relating to management; and (c) with M. S. Conner whereby certain shares are to be allotted to him for the consideration referred to therein, to carry on the business of proprietors and manufacturers of and dealers in aeroplanes, motors, motor and other carriages, vans, wagons, and other vehicles, all kinds of cycles and parts and accessories thereof, especially magnetos and other ignition apparatus, and electric lighting and starting appliances, carpenters, joiners, electricians, mechanical engineers, machinists, rubber manufacturers and merchants, dealers in mineral oils, motive power, traction, light and heat, instructors in motor traction, motor repairers and experts, &c. The subscribers (with one preference share each) are: F. Samuelson, 71a, Queen Victoria Street, E.C., solicitor; R. C. M. Poulter, 71a, Queen Victoria Street, E.C., solicitor. Private company. The first directors (to number not less than three or more than nine) are H. Hirst, 67, Queen Victoria Street, E.C.; J. Fraser, 31, Copthall Avenue, E.C.; and M. S. Conner (managing director), Peel Works, Adelphi, Salford. Qualification, 100 shares. Remuneration (except managing director) as fixed by the company. Registered office: Midland Bank Chambers, 71a, Queen Victoria Street, E.C.

Phonopore Construction Co., Ltd. (143,445).—This company was registered on March 29th, with a capital of £4,175 in 4,000 ordinary shares of £1 each and 3,500 founders' shares of 1s. each, to carry on the business of manufacturers of military telephonic and phonoporic instruments, munitions, and all articles used in the manufacture thereof or used in connection with warfare on land or sea, engineers, founders, &c., and to adopt an agreement with Justus Eck. The subscribers (with one share each) are: H. J. Eck, 10, Priory Road, Chiswick, W., engineer; T. H. Oswald, 5, Budge Row, E.C., engineer. Private company. The number of directors is not to be less than five or more than nine. Justus Eck shall be one of the first, and shall hold office permanently subject to holding 1,500 founders' shares. The New Phonopore Telephone Co., Ltd., shall be entitled during the continuance of a lease referred to in an agreement dated January 7th, 1916, between the company and Justus Eck, to be represented on the board by two directors; other directors to be appointed by the subscribers. Qualification of ordinary directors, £50. Remuneration as fixed by the company (£200 per annum extra for the chairman). Justus Eck is chairman. Registered office: 53-57, Park Street, Southwark, S.E.

Walter Robb, Ltd. (143,493).—This company was registered on March 31st, with a capital of £10,000 in £1 shares (9,000 "A" and 1,000 "B"), to take over the business of an electrical engineer carried on by Walter Robb at Wakefield, Yorks. The subscribers (with one "A" share each) are: W. Robb, 11, Drury Lane, Wakefield, electrical engineer; H. F. Buttenshaw, Walton, near Wakefield, electrical engineer. Private company. The number of directors is not to be less than two or more than three; the first are W. Robb (permanent) and H. F. Buttenshaw (with £416 and £208 per annum respectively as remuneration). Qualification, £500. Solicitor: J. Charlesworth, Wakefield. Registered by Jordan & Sons, Ltd., 116-17, Chancery Lane, W.C.

Associated Engineers, Ltd. (143,474).—This company was registered on March 31st, with a capital of £1,000 in £1 shares, to carry on the business of electrical, motor, and general engineers, founders, machinery, and part manufacturers, &c. The subscribers (with one share each) are: J. Rhodes, 153, Manningham Lane, Bradford, automobile engineer; J. R. Pepper, Moorhead Lane, Shipley, automobile engineer. Private company. The number of directors is not to be less than two or more than seven; the first are J. Rhodes, J. R. Pepper, and three others to be appointed by the subscribers. Qualification, 10 ordinary shares. Solicitor: W. Dunn. Secretary: A. E. Stringer. Registered office: Manor Row Chambers, 37, Manor Row, Bradford.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Banbury and District Electric Supply Co., Ltd.—A memorandum of satisfaction in full on February 5th, 1916, of debenture dated March 26th, 1913, securing £100, has been filed.

Orford Electric Light and Power Co., Ltd.—Issue on December 10th, 1912, of £20, and on March 17th, 1916, of £130, debentures, parts of a series of which particulars have already been filed.

Ramsden Green, Ltd.—Issue on March 21st, 1916, of £235 debentures, part of a series of which particulars have already been filed.

Isle of Thanet Electric Tramways and Lighting Co., Ltd.—Agreement, dated March 16th, 1916, to secure £1,000, and any sums which may become payable under a joint and several promissory note for £3,000, charged on the company's undertaking and property, present and future. Holder: Lord Arthur Butler, 7, Portman Square, W.

Runbaken Magneto Co., Ltd.—Particulars of £1,000 debentures, created February 11th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Lancashire Motor and Engineering Co., Ltd.—Mortgage dated March 6th, 1916, to secure £1,700, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: J. Craig and G. H. Wood, Mosley Street, Manchester.

CITY NOTES.

French Tramway Companies.

The gross receipts of the *Tramways de Bordeaux* reached £242,000 in 1915, as compared with £254,000 in the previous twelve months, and the net profits were £51,000 and £57,000 in the two years respectively. It is intended to pay a dividend of 8s. per share, as against 9s. in 1914.

The gross receipts of the *Compagnie des Tramways de Nice et du Littoral* declined from £170,000 in 1914 to £126,000 last year, and the gross profits from £49,000 to £36,000. As the net profits only amount to £3,700, it is not proposed to make any distribution, and dividends were also not paid either in 1913 or 1914.

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The Société des Tramways d'Amiens proposes to distribute £1 per share for 1915, as contrasted with 16s. in 1914, and £1 in 1913; the Société Versaillaise de Tramways Electriques et de Distribution d'Energié, £1 2s. per ordinary share for 1915, as in the previous year; the Tramways de Toulon, 7s. 2½d. per share, or 9 per cent., for 1915; and the Tramways du Var et du Gard, 7s. 2½d. per share, as in 1914.

The Compagnie Parisienne de Tramways earned £316,000 in 1915, as compared with £347,000 in the previous year, but after deducting working expenses and financial charges the net profits only amount to £8,000, as against £25,000 in 1914. The financial charges include £16,000 for the settlement of litigious accounts and £28,000 for the improvement of the permanent way and rolling stock, whereas the amount provided under the latter heading was only £17,000 in 1914 and £12,000 in 1913. It is not proposed to pay any dividend for the past year, as was also the case in 1914, but to place most of the balance to a special fund, and to carry a small sum forward.

The Société des Tramways de Rouen, where great activity prevails in connection with the traffic with England, experienced a recovery in 1915 from the fluctuations in the receipts and profits which occurred in the preceding year. The directors state that it was possible to provide a new workshop staff in place of the men called up for service and to resume the maintenance and repair of the rolling stock, which had to be neglected in the later months of 1914. The gross receipts were the largest on record, and the net profits amounted to £45,000, as contrasted with £42,000 and £48,000 in the two previous years respectively. A dividend at the rate of £1 4s. per share has been declared, this comparing with £1 and £1 6s. 4d. in 1914 and 1913 respectively.

British Westinghouse Electric and Manufacturing Co., Ltd.

The net profit for 1915 was £176,752, plus £8,121 brought forward, making £184,873. There is written off patents, goodwill, &c., £25,000; special depreciation of plant, machinery, &c., £35,241; additional reserve for employers' liability, £5,000; dividend of 7½ per cent. on the preference shares, £75,000; carrying forward, £44,632. There have been charged against revenue the usual expenses for maintenance of works, plant, &c., and in addition there has been applied to depreciation of the same items £87,150, which includes the special sum stated above (£35,241) to cover abnormal wear and tear of plant due to war conditions. Having regard to possible liabilities for taxation of excess profits under the Finance and Munitions of War Acts, it has been thought desirable to carry forward a much larger sum than usual. Last year the directors referred to the acquisition of certain controlling interests in the French Westinghouse Co., and they are glad to say that the business of that company shows signs of improvement. Annual meeting: April 6th.

Brompton and Kensington Electricity Supply Co., Ltd.

At the annual meeting, on Monday, the Chairman (Mr. H. R. Beeton), said that his anticipation that the year 1915 would be even less satisfactory than 1914 had, unfortunately, been fulfilled. Although their output had more than doubled in the past 13 years, their profits for last year were the lowest for any year in that period, and it had only been after considerable discussion, and some difference of opinion, that the Board had recommended the payment of the usual dividend of 10 per cent. The justification for such a course was to be sought in the fact that they had husbanded their resources in more prosperous years, so that to-day they had more than half of their capital represented by mains, with reserves of profits amounting to upwards of 60 per cent. of their capital invested in the business, with no debenture debt, and with 15 years of their tenure still to run. But, although they had restricted themselves to 10 per cent. dividend when it would sometimes have been possible to pay more, they could not, of course, maintain this rate if the scale of profits were to remain permanently at its present level. The present condition of things was mainly due to public restriction and private economy in lighting, and to increased cost of production consequent upon the war. Although a profitable return on the capital invested in the Accessories Co. with a view to encouraging the use of electricity for heating and cooking had been further postponed owing to the war, it was largely due to such expenditure that in their purely residential area they had virtually maintained their output in spite of restriction in lighting. The new turbo-generator, when installed, would give considerable economy in working to compensate them in some measure for increased cost of coal. Although the emergency legislation for limitation of price had tended to amelioration, they had not so far realised the full benefit promised under the Act, chiefly owing to disorganisation in production and shortage in transportation. The matter was, however, receiving the attention of a Committee of the Gas and Electricity Companies in conjunction with the Departments of Admiralty and Munitions, and it was hoped that some amendment would ensue. Although the progress of the Accessories Co. had been retarded by the war, its capital account had not been extended, and its revenue results showed an improvement, which was likely to grow. The Restaurant, which continued to serve as an excellent advertisement as well as an experimental laboratory, now enjoyed a custom which, in spite of the increased price of food, made it self-supporting. The show-room sales had been prejudiced by the prevailing shallowness of the public purse, and the stove department, whilst furnishing some important cooking installations, had been largely diverted to the production of munitions. The experience of the first three months of this year led him to conclude that the results of the present year would not be substantially worse than those of the past year, and if the coal position, which was undoubtedly precarious, was not aggravated, they might be rather better.

W. T. Glover and Co., Ltd.

Trading during 1915 resulted in a credit balance of £54,438, and £7,950 was brought forward. The following are deducted:—Directors' remuneration, &c., £1,035; 4½ per cent. interest on first mortgage debenture stock, £4,250; 5 per cent. interest on second mortgage debenture stock, £2,642; written off investments, £5,949; appropriation for payment to trustees of second mortgage debenture stock, £4,000; 5 per cent. preference dividend, £4,333; transfer to first mortgage debenture redemption fund, £2,500; dividend of 5 per cent., less income-tax, on ordinary shares, £4,977; transfer to reserve fund, £20,000; leaving £11,701 to be carried forward subject to payment of excess profit duty. With the above appropriations the redemption fund for the first mortgage debenture stock will stand at £40,500, that for the second ditto at £36,000, and the reserve fund at £50,000, making a total of £126,500. It will be appreciated that to provide the increased working capital to meet the present conditions, it is necessary to materially strengthen the company's reserves. During the year the works have been, and still are, largely engaged on the manufacture of cables, wires, &c., directly or indirectly for the prosecution of the war. Nine acres of land have been purchased for the general development of the company's business, which of late years has suffered by the works being greatly congested. A portion of this land is thought to be in excess of the company's probable requirements, and it is proposed to sell such portion to the Trafford Power & Light Supply (1902), Ltd., in whose welfare the company is largely interested. The directors ask for full power to transact business from time to time with that company, notwithstanding that they, or some of them, may be directors of that company. Annual meeting: April 10th.

The Berlin Elevated and Underground Railway.

The report for 1915 of the *Gesellschaft fur Elektrische Hoch und Untergrund Bahnen* states that a large decline in the passenger traffic occurred in the seven months ended with July, as compared with the equivalent period in the previous peace year, but a not inconsiderable increase took place in August and September, which had also continued into 1916. During the year the total number of passengers carried amounted to 69,542,277, as against 77,027,513 in 1914, and the expansion in the last five months was 4,352,000 in excess of the corresponding term in 1914. The working results were influenced by the large advances in wages and the cost of materials, and further reductions in the customary employés were caused through men being called to the Army, which, however, it was possible substantially to equalise by the engagement of women. The train mileage run was 2,123,476, as contrasted with 2,698,404 miles in 1914; the daily average number of persons carried was 190,527, and the average receipts per passenger amounted to 1.52d., as against 1.54d. in the preceding year. The accounts show the following figures:—

	1914.	1915.
Ordinary share capital	£2,600,000	£2,600,000
Preference shares	500,000	500,000
Loans	3,994,000	3,988,000
Gross receipts	418,000	394,000
Net profits	190,000	168,000
Dividend percentage on ord. shares	4½	4
Carried forward	31,000	17,000

The report states that work on the line from the "triangle" to the Nollendorf Platz and Wittenberg Platz was continued as far as the circumstances permitted.

Woking Electric Supply Co., Ltd.

The total revenue for 1915 was £20,331, and the working expenses were £10,649, leaving £9,681, plus £653 brought forward and £124 income-tax accumulations. The interest on debenture stock absorbs £2,514, interest on temporary loans £289, 6 per cent. preference dividend £2,999, and there is put to depreciation and renewals fund £1,750, £900 to reserve, 5 per cent. is paid on the ordinary shares, and £693 is being carried forward. The number of consumers increased from 2,021 to 2,101, and the lamps connected from 95,803 to 106,360, the net revenue advancing from £18,878 to £20,331. During 1915 there were issued £580 4½ per cent. debenture stock and £245 ordinary shares. Owing to the continuous growth of the business, issues of further debenture stock and ordinary shares were necessary. The annual meeting was held on March 25th.

Urban Electric Supply Co., Ltd.—The gross profit for 1915 was £68,513, as against £68,962 for 1914. The available balance is £21,889, out of which £12,500 is required for preference dividend and £9,389 is carried to reserve for depreciation.

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W. T. Henley's Telegraph Works Co., Ltd.

Mr. S. Gedge presided at the annual meeting on March 29th. He said that out of £10,000 set aside last year to provide for the dependents of the company's employés with the Forces, £4,333 had been spent, and he hoped that the balance would suffice for the purpose intended. The company had made a larger profit than in the previous year. They had not been able to accept all the private orders which they had been offered, but he hoped that they would not eventually lose those customers. They recommended a dividend and bonus of 25 per cent. for the year, or 5 per cent. more than was paid in the previous year. The company was excellently managed. The profit was about £41,000 more than that of the previous year. Ample provision had been made also for any claim which might be made in connection with the excess profits tax. They had over £139,000 in War Loan and other trustee securities at cost, less a reserve of £10,000. He had visited the works recently, both at Woolwich and Gravesend, and had seen the great improvements which had taken place during the year. At Woolwich they had suffered considerably from lack of space, and Mr. Hatton deserved great praise for the way in which he had overcome difficulties and had been able to meet requirements. At Gravesend they were in a different position, inasmuch as they had 12 acres to deal with, and could put up exactly what was required. Their workshops there were finer than any in the country, and they had now completed very fine dining-rooms for the workpeople with separate accommodation for both men and women, and these were lighted and heated by electricity, whilst they also cooked by electricity. Then, again, near by, in Union Street, they had opened a large warehouse for the purpose of their tire business. The Blomfield Street premises had been extended by taking in adjoining buildings, as the staff there now consisted of some 240 people. The Managing Director, Mr. George Sutton, M.I.E.E., who seconded the adoption of the report, said that the extraordinary course of events of the war had been reflected in their business. In addition to their special activities, other features of the year were the reduction in the demand, and their inability to meet the demand that did exist, for cables for the home and colonial commercial trade, and the greatly increased demand from neutral countries. As regarded the home trade and the reduction in the demand for cables for commercial purposes, there had been a great falling off in the usual home and colonial demand for wire and cables apart from cables required in connection with the war. Shareholders might think that they were also losing goodwill. He did not, however, think that they would do so. They would not suffer the loss of their orders because of inability to execute them through working in the national interests. In regard to the increased demand from neutral countries, to some extent that was due to the closing down of the German supply. In Germany and abroad, but not much in England, they had a great competitor. He thought that on the whole outside the British Colonies they had a larger trade in cables than English manufacturers, and therefore the closing down of the German trade had increased the demand on English manufacturers. The demand, however, had been very difficult to meet in consequence of the uncertainty of obtaining licences for export from the Government, and although they were able to locate their consignees, so that they knew that their cables would not find their way into an enemy country, there were no doubt other reasons which necessitated the stoppage of exports to neutral countries. They endeavoured not to commence the manufacture of cables until they had reasonable grounds to suppose that they would be able to dispatch them. The increase in the profit was due particularly to two causes. First, there was the strong financial position of the company. When the war started their position and credit were at a very high standard, and they used them, and continued to use them, to buy as freely as desirable those materials which were essential to meet the demand for their products which they expected would be upon them. Copper, rubber, and lead were the principal essentials, and their large forward purchases of these materials, which had risen so much in value, had brought considerable profits, as they had been made into cables, which were sold on the price of raw materials at the time the cables were ordered. There was, of course, another side to the picture. When raw materials fell in value, they were bound to be carrying a stock, more or less large, which involved them in a loss when sold in the form of cable. That was a contingency they always had with them, although it was now greater than usual, but the nature of their business necessitated always purchasing certain materials some months ahead of requirements, and their accounts always made provision, by means of contingent reserves, for the eventuality of loss on stocks. The second cause of the increased profit was increased turnover. They had added considerably to their plant in order to enable them to meet the demands which were made upon them, and owing to the uncertainty of their getting deliveries of small sizes of copper wire which they did not make, and which was required for urgent cables, they acquired for a cash payment a small factory in Yorkshire. The motor tire factory was more than paying its way. He could see the possibilities of an industry being built up there that might become as large as the electrical side. In regard to trade after the war, they did not know what the demand for their products would be, but they knew that the capacity for making insulated wires and cables in this country had enormously increased owing to the war demand. As they had put down new plant, they might be assured that other cable makers had done likewise, and there would be a severe struggle for the business to be had, which would probably mean the cutting of prices. They hoped that that might be avoided for the good of the industry generally, but with more machinery in the country than could be employed, it looked as though they might have a difficult time in front of them. They were not afraid, however, that Henley's would be unable to meet the position, for they possessed three first essentials of success—money, skill, and good organisation; and as they had successfully weathered storms in the past, they might look forward to the future with equanimity.

Madras Electric Tramways (1904), Ltd.

Mr. A. M. Quill, presiding at the annual meeting last week, said that for the first seven months of 1915 the traffic receipts were 6 per cent. less than for the corresponding period of 1914. During the last five months there was such a marked improvement in traffic that for the whole year there was an increase of 6.4 per cent. in traffic receipts and an increase in net receipts, and an advance of 5 per cent. in passengers carried. The special renewals of permanent way, which had been in hand for some years, had been practically completed. It was very satisfactory to be able to recommend an increase in the ordinary dividend. Recently a resolution was passed by the Madras Corporation praying the Government to increase the track rent paid by the company. If this petition were granted it would be a breach of faith. The fares were as low as in any part of the world, and much lower than they were entitled to charge under their Government Orders. The dividend on the shares could not be regarded as extravagant (5 per cent.), particularly as the average return since the company was incorporated was only 3.3 per cent. With regard to the negotiations with the Government regarding various extensions, referred to a year ago, the routes were approved by the Corporation and submitted to the Government for confirmation, but they still awaited the latter's decision.

City of London Electric Lighting Co., Ltd.

Mr. F. W. Reynolds, presiding at the annual meeting on March 22nd, said that Mr. Braithwaite, the chairman, was in America on very urgent business. The Marquess of Winchester was on active service. The capital expended during 1915 was about half the usual amount, and in 1916 it would be still less, as they were reducing expenditure in all directions. There was no object in giving a detailed comparison of revenue and working expenses, as in such abnormal times it could be of no real value. Everything that could be done to produce economical working was being done, and they hoped that there would be some limit to the rise in prices, which was so seriously affecting their business. Their chief difficulty was in regard to coal, the price of which was now 100 per cent. more than before the war, chiefly by reason of increased shipping rates, and supplies had at times been exceedingly difficult to obtain. For 1915, coal cost £14,000 more than for 1914, an increase of 40 per cent. There was no prospect of early relief, indeed, they must expect another and still larger increase during 1916. They were no believers in the policy of raising prices in such times as these until they had actually felt the effect of the increased cost of production and could claim that the time had come to ask consumers to take a further share of the burden. Both last year and this year shareholders had submitted voluntarily to a reduction of their income, before increasing the price of electricity. They had just given public notice of their intention to increase the price of electricity by 10 per cent. after the end of March. The balance for the year was about £16,000 less than last year. They were distributing £11,000 less in dividends, and providing the balance of £5,000 by reducing the carry-forward to £18,000. It had been pointed out at previous meetings that their liberal carry-forward constituted a dividend equalisation fund, and the present was a time when they might rightly draw upon that fund. The company had 168 members of its staff with the Forces; 1 had been killed and 9 wounded. None of their staff were pecuniary losers by going to the Front; all cases were carefully attended to by the managing directors, Mr. Bailey and Mr. Bull.

British Aluminium Co., Ltd.

Mr. A. W. Tait presided at the annual meeting last Friday. He said that the trading profits for the year, after making the provision for excess profits duty and adding interest and dividends on investments and deposits and the revenue derived from estates and transfer fees, was £312,546, an increase of £40,291. These results were the best which the company had shown since its incorporation in 1894. The conditions were, however, absolutely abnormal, and entirely due to the exceptional demand. He could not give particulars of the uses to which the metal was at present being put, and it was useless to speculate as to the probable conditions which would rule as regards the demand for the metal after the war. The recent uses and developments would go a long way to make up for any falling off there might be in the ordinary demand, due to the unavoidable and necessary period of recuperation required by all countries involved in the war. Further, there was no doubt that the experience gained during this war would open up a demand in certain directions in the future, which would considerably broaden the uses and applications of the metal.

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The sales had been approximately the same as those of the previous year, and this was accounted for not by any slackening in the demand, but owing to a shortage in the anticipated production, due to abnormal weather conditions in the West of Scotland and in Norway during the summer of last year. Prices for the metal showed substantial advances during the year; but these advances occurred particularly during the last six months, and as it had always been the practice to cover the requirements of their regular customers at fixed prices for the whole year, the average which was obtained was considerably below current prices at the end of the year. The costs of production had been very materially affected during the year, owing to the heavy increases in labour charges and the cost of raw materials, freights, insurances, and other expenses. Great difficulties had been experienced in obtaining the necessary supplies of raw materials and coal required by the various works, the principal difficulty being not so much the supply of the actual material as the obtaining of the necessary freighting facilities. The difficulties with regard to the supply of raw materials and labour and freight would undoubtedly exist until the termination of the war, and, in consequence, the costs of production were showing, and would continue to show, very material increases. The various works of the company had been fully employed during the year, and the additional plant for the manufacture of carbon electrodes was completed and put into operation before the close of the year. The erection of the new alumina works, which should have been completed by this time, had made slow progress, entirely due to the shortage of labour and materials, and it would be some months yet before those works could be put in operation. No further development work had been carried out on the Orsières power scheme, nor was this possible until after the war. The Martigny-Orsières Railway continued in operation for general traffic, but it did not contribute anything to their revenue. The depreciation reserve account had been increased to £250,000 by the appropriation of £50,000 from the profits of the year, and the reserve account had also been brought up to the same sum by the appropriation of £70,000 from the profits of the year. The necessity for making ample provision for reserves had been accentuated by the abnormal conditions, and it was advisable that their position should be strengthened, in order that they might be able to meet the peculiar and difficult times which would arise at the termination of the war, when ordinary commercial business had to be resumed in the markets of the world. Their competitors in neutral countries had naturally been considerably strengthening their position during these abnormal times, and, as their resources had not been depleted by the heavy taxation which was falling upon British industry, they would be in a position, if necessary or desirable, to create keen competition in international markets and also in the home market, unless some measure of protection was given by the Government. The results submitted were undoubtedly satisfactory, and amply justified the policy of the gradual building up of reserves which had been one of the main principles adopted by the present board of directors since the reorganisation of the company six years ago, and, looking back over those six years, the progress which the company had made in the time, and the position which it had established for itself, both commercially and financially, were good. However, this company, like all industrial enterprises, must be subject to the usual fluctuations which were the law of industry, and it was therefore incumbent upon the directors to see that the position of the company was strengthened, so that it could not only meet the demands of the extension of its activities, but that it might be able to live through any period of temporary depression with comparative equanimity.

Cleveland and Durham Electric Power, Ltd.

Mr. J. Falconer, M.P., presided at the annual meeting on Friday last. He said that the gross profits showed a decrease of £5,681, but that figure, owing to the exceptional way in which the company had been adversely affected by the war, did not afford any indication of the development of the business. If they took the business of the three combined companies, which was the only sound method of ascertaining what the true result of the business had been, for the years 1913-14-15, they found that the gross revenue had been as follows:—£131,933 in 1913, £141,482 in 1914, and £151,512 in 1915, increases of £10,000 in each of the two years since 1913, the pre-war year. In their case, differing from the experience of other of their companies, the result had been a serious diminution in the value of business done without any corresponding diminution of the amount of plant required to meet the demand. In all the mining districts—coal and iron alike—the output had been greatly reduced owing to the absence of men at the war. This had been further accentuated by the fact that in other businesses, such as the cement business, which they supplied, there had been substantial reductions in the demand for material produced. There had been practically no increase in the demand for current for the manufacture of munitions. The company's revenue had increased by £20,000 in the three years 1913-14-15; that was the natural development of the business. On the other hand, they had been seriously hit by the war in the matter of the cost of production. The figures for the past three years were:—1913, £91,839; 1914, £95,914; and 1915, £110,368. That increased cost was due to two causes. In the first place, the amount of current which they had generated in their waste heat stations had been seriously reduced by the fact that hematite iron had been largely substituted for Cleveland iron, and the result had been that the gases available for the waste heat stations had been much reduced. In 1915 the volume of energy delivered to them from waste heat stations had been reduced by about 15 million units as compared with the previous year. The consequence was that the energy they had supplied had come from the coal-fired plant at Grangetown. Thus, the coal bill was greatly enlarged, while prices had been very much in excess of those obtaining in normal times. In 1913 their coal bill was £845, whereas in 1915 it was £16,404, an increase of something over £15,000. This increase had had a serious effect upon their cost, and would continue to have an effect during the war. They must take this element into account in judging the trade condition of their business. The war had revealed to them the extraordinary value of the waste heat arrangement they had made. If the current had not been supplied to them through the waste heat stations it would have been impossible for the company to have lived through the period it had passed through, because it could not have paid for the coal (in the absence of waste heat stations) required for the consumers. They had never had to increase their night load, which would have given them additional revenue, nor had they been in a position to ask for increased prices. Their policy had been, in order to ensure financial stability, to have long-term agreements with their consumers, a policy which, he believed, was thoroughly sound for a company that had not a large reserve of capital behind it. In consequence of this, they had been compelled during the war to supply their consumers at the same prices as in normal times, notwithstanding that their costs had increased. It was, therefore, impossible for them to compare their conditions with those of other companies. They had for some time been satisfied that it was imperative, in order to obtain a fair return for their current, that they should stand out for a higher price, and they had also decided that their future policy should be to insist upon having a graduated scale of prices varying according to the price of coal. After the report had been seconded, M. A. Gemmell said that the halting and lame apology which the chairman had made was not satisfactory. It was not much consolation to hear that waste heat had failed them when they required it most, and when coal was dear. He suggested that there should be a Government inquiry into the position of the company. The report was adopted.

Liverpool District Lighting Co., Ltd.

At the annual meeting, held last week, the Chairman referred to the death of one director and the resignation of another, and added that Mr. Bromley Holmes, formerly city electrical engineer of Liverpool, had been appointed to the board. The accounts showed that they had done better than they expected. Restriction of lighting had caused a loss of 40,000 units and £859 revenue, but they had obtained Government contracts resulting in the sale of 108,000 units, so that the net increase was 68,000, the largest they had experienced, though, of course, they could not obtain the same price for large Government contracts as from other consumers. The result was a net increase of income of £168, but the increased cost of fuel, &c., was £560, leaving a net reduction of £392 in working profit. Fuel had further risen, and would affect the 1916 figures. To counteract this, they had followed the lead of the Liverpool Corporation and had increased their charges by 12½ per cent. all round. They were considering the question of coal storage, so as to provide for further reserves of fuel. The dividend for the year was 4 per cent.

Bell Telephone Co. of Canada.—The accounts for 1915 show gross earnings of $9,634,673, as compared with $9,599,026, and after deducting all charges, including $2,170,000 (against $2,010,000) for depreciation, the net revenue totalled $1,663,848, which compares with $1,650,837. The usual dividend of 8 per cent. has been paid, leaving a surplus of $223,848, increasing the total surplus to $1,249,139.—*Financial News.*

Falkirk and District Tramways Co., Ltd.—The *Financial News* states that the accounts to October 16th show an available sum, including £674 brought in, of £5,813. After providing for depreciation, &c., the directors declare a dividend of 6 per cent. for the year, as compared with 5 per cent. for each of the two preceding years, carrying forward £726.

Calcutta Electric Supply Corporation, Ltd.—The units sold to consumers during the four weeks ended February 25th were 1,362,833, compared with 990,763 in the corresponding four weeks of 1915.

STOCKS AND SHARES.

Tuesday Evening.

The Budget is out this Tuesday night, and the secrets which the Chancellor of the Exchequer has kept with commendable closeness now stand revealed to the expectant taxpayer. These mysteries exercised a slightly numbing effect upon investment business before they were made known, but

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had little influence upon prices, this being traceable more in the sentiment which prevailed than in quotations themselves. The Home Railway market has given way in the absence of further support coming forward to assist the buying movement of a fortnight ago. Once the Budget proposals are digested, investment business will return to the House, because there is literally any amount of money about; and the provinces, prospering like the proverbial bay tree, although for a different reason, send the bulk of their capital to London when they wish to employ it in Stock Exchange channels.

Amongst the electric lighting shares which went ex dividend last Friday are both classes of City of London and County of London shares. Metropolitans are again ⅛ up on the week, thanks, of course, to the expectation of what the new committee may be able to do by way of suggestion with a view to restoring the company to some, at least, of its past success. It is worth noticing that City and County preference have both returned to their par value of £10, at which the yield is 6 per cent. on the money. St. James' are ⅛ better, and the market as a whole shows firmness, due to a little inquiry for several of the best-class shares, and the discovery of the buyers that there are very few shareholders who wish to realise at the present time and prices.

Underground Electric income bonds have again risen 1⅛ to 83, being picked up by investors in the provinces who realise the attractions of a security upon which the interest is paid free of taxation when that tax is something to be seriously taken into account.

In which connection, may we observe that, with the income-tax fluctuating as it is at the present time—for even the latest proposals may not prove the limit of the burden which the war will impose in this way—it seems advisable to abandon our previous practice of estimating the yield with allowance for the tax, in those cases where dividends are paid free. Accordingly, we have reverted to the previous practice of working out all the returns on a "flat" scale, but have indicated by an asterisk those stocks and shares the dividends upon which are distributed free of tax. It requires but a simple calculation for the person interested to make this allowance according to the amount of income-tax current when he is working out the return.

Districts have gone back to 16¾, shedding most of their previous week's rise, but Metropolitans and Central Londons are steady. Tube railways stand to benefit from Zeppelin scares; and the ill-wind which brings the raiders may possibly profit proprietors of tube stocks.

The feature in telegraph markets is the further rise in the price of Marconis. A month ago the shares stood below 2, and to-day they are at 7s. 6d. higher, the reason for the improvement being the expectations of the amount which the Government is thought likely to pay the company for the use of its system since war broke out. Another bull point is the announcement that Senatore Marconi has invented a new development in wireless telegraphy, which bids fair to be of great importance, and which will be made public as soon as the formalities in connection with patent rights are concluded. American Marconis have hardened to 16s., and Canadians to 8s., the cheerful optimist maintaining that the latter will certainly go to 10s. before long.

Both the Globe Telegraph shares are ex dividend, but have recovered the deduction in each case. Eastern ordinary rose a point. The Anglo-American Telegraph stocks are a little lower.

The report of the British Westinghouse Co. did not entirely dissipate the disappointment felt with the retention of the dividend at 7½ per cent., and the price of the shares is dullish at 2. Electric Constructions at 15s. are a shade better. Telegraph Constructions rose 10s. to 34½. Manufacturing issues are good as a whole, such shares as Henleys, Callenders, British Insulated, and India-Rubber being more readily sold than bought, except when they come to market in connection with a deceased account.

The activity in rubber shares has died down in consequence of the interruption to communication with the provinces caused by the gale of last week. The lines are being mended, but even as late as this (Tuesday) evening, telegraphic and telephonic communications with the country outside London are erratic and uncertain. There is not much doing in copper shares. Prices of the popular companies move rather aimlessly, and business is of a meagre character.

Various of the American light and power shares have risen sharply during the past few days. Alabama Traction, Light and Power common gained 3 points at 24, and the bonds put on 2 at 67. Mississippi River Power shares advanced 4 to 20, and this group is in demand from people on the other side of the Atlantic. They, on their part, cannot sell shares here, in consequence of the physical possession restrictions imposed by the Treasury, so, as their transactions must all be purchases so far as London is concerned, the market moves only one way when there is anything doing in it on account of New York. Brazil Tractions, too, are better at 54½; and there has been a sensational rise in the shares of the City Services Co. Mexican issues are harder in tone; the only quotable alteration is a rise of 3 points—making 6 within the past fortnight—in the Tramway Co.'s 5 per cent. bonds.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1914.	Dividend 1915.	Price April 4, 1916.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	7	—	£7 2 10
Charing Cross Ordinary	5	5	8½	—	7 18 10
do. do. do. 4½ Pref.	4½	4½	8½	—	6 18 6
Chelsea	5	4	8½	—	5 14 4
City of London	9	8	11⅛ xd	—	6 17 9
do. do. 6 per cent. Pref.	6	6	10 xd	—	6 0 0
County of London	7	7	17⅛ xd	—	6 18 8
do. 6 per cent. Pref.	6	6	10 xd	—	6 0 0
Kensington Ordinary	9	7	5½	—	6 13 4
London Electric	4	3	1	—	9 0 0
do. do. 6 per cent. Pref.	6	6	4½	—	7 5 5
Metropolitan	3½	3	1⅛ xd	+ ⅛	6 * 4
do. 4½ per cent. Pref.	4½	4½	3	—	7 10 0
St. James' and Pall Mall	10	8	5¼	+ ¼	6 16 2
South London	5	5	2⅝	— ⅛	8 13 10
South Metropolitan Pref.	7	7	1⅞	—	6 14 0
Westminster Ordinary	9	7	5½	—	6 13 9

Telegraphs and Telephones.

	Dividend, 1914.			
Anglo-Am. Tel. Pref.	6	93½	— ½	6 1 10
do. Def.	33/6	21⅛	— ⅛	7 19 3
Chile Telephone	8	6⅝	—	6 5 6
Cuba Sub. Ord.	5	7⅜	—	6 9 9
Eastern Extension	7	12¾	—	*5 9 10
Eastern Tel. Ord.	7	129	—	*5 8 6
Globe Tel. and T. Ord.	6	10⅜ xd	+2/-	*5 15 8
do. Pref.	6	10 xd	+3/-	6 0 0
Great Northern Tel.	22	34½	—	6 7 6
Indo-European	18	50	—	6 10 0
Marconi	5	2⅛	+ 3/16	4 5 6
New York Tel. 4½	4½	100½	—	4 9 4
Oriental Telephone Ord.	10	1⅜	—	5 14 3
United R. Plate Tel.	8	5⅜	—	*7 19 0
West India and Pan.	1	1⅛	—	9 10 6
Western Telegraph	7	12⅛	—	*5 8 9

Home Rails.

Central London, Ord. Assented	4	67½	—	5 18 6
Metropolitan	1½	28½	—	4 6 0
do. District	Nil	16¾	— ¾	Nil
Underground Electric Ordinary	Nil	1⅛	—	Nil
do. do. "A"	Nil	5/8	—	Nil
do. do. Income	6	83	+1½	*7 4 7

Foreign Trams, &c.

Adelaide Sup. 6 per cent. Pref.	6	4¾	—	6 8 1
Anglo-Arg. Trams, First Pref.	5½	8¾	—	7 6 8
do. 2nd Pref.	5½	8⅝	—	6 8 0
do. 5 Deb.	5	78	—	6 8 2
Brazil Tractions	4	54½	+1½	6 8 6
Bombay Electric Pref.	6	10¾	—	5 17 3
British Columbia Elec. Rly. Pfce.	5	53	—	9 8 8
do. do. Preferred	—	38	—	Nil
do. do. Deferred	—	34	—	Nil
do. do. Deb.	4¼	61⅛ xd	—	6 18 8
Mexico Trams 5 per cent. Bonds	—	41	+3	Nil
do. 6 per cent. Bonds	—	85	—	Nil
Mexican Light Common	Nil	20	—	Nil
do. Pref.	Nil	32	—	Nil
do. 1st Bonds	—	89	—	—

Manufacturing Companies.

Babcock & Wilcox	14	2⅜	—	5 1 8
British Aluminium Ord.	5	23/4	—	4 6 0
British Insulated Ord.	15	103 xd	—	7 4 7
British Westinghouse Pref.	7½	2	—	7 10 0
Callenders	15	11½	—	6 10 5
do. 5 Pref.	5	4½	—	5 17 8
Castner-Kellner	20	2¾	—	6 8 0
Edison & Swan, £3 paid	Nil	¾-	—	Nil
do. do. fully paid	Nil	1½	—	Nil
do. do. 5 per cent. Deb.	5	57 xd	—	8 15 8
Electric Construction	6	15/-	+3d.	8 0 0
Gen. Elec. Pref.	6	9⅜	—	6 8 1
Henley	20	14¾	—	*6 15 7
do. 4½ Pref.	4½	4	—	6 13 6
India-Rubber	10	9½	—	*10 10 6
Telegraph Con.	20	84½	+ ⅛	*6 19 10

* Dividends paid free of income-tax.

Browett, Lindley and Co., Ltd.—According to the *Financial Times* the report for 1915 shows, after deducting £1,907 for interest, writing off £6,316 for depreciation, and making provision for tax and duty, a net profit of £14,010, to be deducted from the debit, which will then stand at £7,696. The directors submit a scheme for readjustment of capital.

Oldham, Ashton and Hyde Electric Tramway Co., Ltd.—The report for 1915 states (says the *Financial Times*) that the revenue amounts to £34,823 (£33,398 in 1914), and the expenditure (including £1,600 for debenture interest and £1,500 placed to provision for renewals account) amounts to £25,062 (compared with £26,024 in 1914), leaving a net profit of £9,761 (compared with £7,374), which, plus £1,021 brought forward, makes £10,782. The directors propose to place to reserve fund £3,000, to pay a dividend at the rate of 6 per cent. per annum on the ordinary shares, and to carry forward £2,282.

Marconi Wireless Telegraph Co. of America.—The gross earnings for 1915 were £141,000, against £150,600 in 1914; other income £21,000, against £30,000. £22,400 is placed to reserve, as compared with £24,400, carrying £35,400 forward, as against £29,800.

Shawinigan Water and Power Co.—A dividend at the rate of 1¾ per cent. for the quarter ended March 31st upon the common stock is announced.

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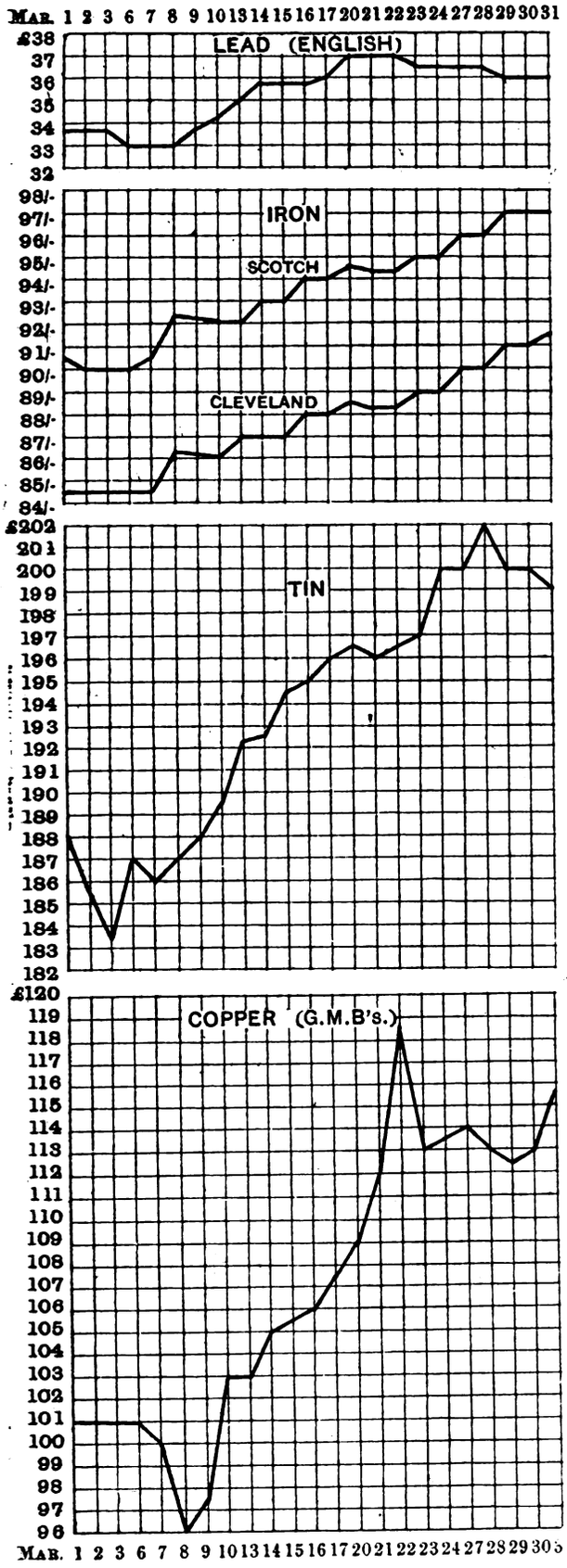
METAL MARKET.

Fluctuations in March.



Electrolytic Gas for Lighting and Heating.—In a recent issue of *Elettrotecnica*, Carlo Velardi advocates the use of hydrogen gas, obtained by electrolysis, for lighting and heating, in substitution for, or mixed with, coal gas. The difficulties attending its use, the chief of which is its distribution, are easily surmounted, while the advantages from its employment, especially in a country like Italy, abounding in hydro-electric energy, are great. Its utilisation for heating and cooking purposes, he contends, is easier of realisation than the replacement of coal gas by electricity.

THE HIRE AND MAINTENANCE OF CONTINUOUS-CURRENT MOTORS.

By HENRY JOSEPH, A.M.I.E.E.

(*Abstract of paper read before* The Institution of Electrical Engineers *at Leeds, March 8th*, 1916.)

The electricity-supply undertaking of which the author has charge supplies continuous current, principally for textile driving, in the town of Hawick, in Roxburghshire.

Table I shows the proportion of motors on hire at the end of 1914 in mills and for various industrial purposes.

TABLE I.

	No. of motors.	Total H.P.	Average H.P.
Consumers' own motors ...	162	966	6.0
Motors on hire-purchase ...	9	445	49.5
Motors on hire	105	643	6.1
Totals	276	2,054	7.5

Practically the whole of the above motors are maintained by the author's staff; and most of those owned by the consumers have been supplied through the company and the drive arranged under their supervision. Table II gives the present rates of hire for some of the sizes.

TABLE II.

H.P.	Quarterly rental. £ s. d.	H.P.	Quarterly rental. £ s. d.
¼	0 9 0	10	3 5 0
1	1 0 0	20	4 5 0
5	2 5 0	50	6 5 0

The hire rate includes the motor complete with pulley, starter, main switch, cut-outs, shunt regulator, and slide rails, if these are required, all fixed and connected up. The hirer pays for belting and the cost of mains from the service (or from the nearest available point of supply) to the motor and starter. The result is that practically the whole of the material is returnable on dismantling, and only the cost of labour is lost.

The rental covers the cost of all maintenance and renewals. New brushes are fitted when required, and no question as to whether the company is liable ever arises in the event of a breakdown. Damage occasionally occurs as the result of carelessness or negligence on the part of the hirer's employés, but it has not been considered good policy to raise the question of liability in such cases. They do not often occur, and the inconvenience caused to the user by a breakdown is quite sufficient incentive as a rule for him to urge his employés to treat the motor carefully.

It is to this policy, coupled with prompt attention to repairs, that the success of the hire system is largely due. Consequently consumers are quite willing to pay in most cases rentals which are admittedly high in comparison with the purchase price of the motors.

The company safeguards itself against loss due to a motor being hired for a short period and then returned, by inserting a clause in the hire agreement by which the hirer undertakes to pay an agreed sum to cover the cost of installation and removal in the event of a motor being returned before the expiration of a stated period.

Nearly all the hosiery mills, among them some of the largest in Scotland, hire their motors. They prefer to confine their attention to their business and to hand over the whole responsibility of their electric drive to the supply company.

Consumers possessing their own motors are encouraged to insure them against breakdown. In the event of a minor breakdown, a man is promptly on the spot to carry out repairs on site if possible. If the trouble cannot be quickly remedied another motor is fixed as quickly as possible. For mill work these are important considerations.

Since 1902 the average horse-power has increased from 3·2 to 6·1 H.P., and the capital cost has diminished from £14 to £6 per H.P. There has been a gradual increase in the percentage cost of maintenance due to the ageing of the bulk of the motors; this figure will probably settle down to an average of about 6 per cent. on the capital cost.

During the last five years the gross rentals amounted to about 18 per cent. of the capital outlay (about 25 per cent. is the average rental obtained on the total cost with new motors during this period), and the net rental was about 12 per cent., part of which is allocated to revenue and the balance set aside to a redemption fund for writing down the value of the motors when returned from hire.

About 27 motors are kept in stock, 40 starters, 12 shunt regulators, and 60 pulleys, besides a stock of every size and type of brush in use in the town, both on consumers' own and hired motors. There are over 40 of these, and they are each given a number, which is also painted in large figures on the motor frame. A card system is used to record the history of each motor.

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The company act as wiring contractors, and always have a staff of wiremen available. The permanent wiremen and mains staff are all trained for motor work, and one man in particular spends most of his time on motor repairs, and is as often as not in the works and readily available for emergency calls.

If a report of a breakdown is received, a man is sent out at once and reports by telephone if the failure is such that it cannot be repaired quickly on site. In that case he sets to work to get the faulty motor disconnected and removed from its bed. Particulars of the drive at the same time are ascertained at the works, and a suitable motor is selected from stock. A motor or horse lorry is ordered, preferably the former, and the motor is slung up and very little time lost in getting it on site.

Battens are taken to the job with it, and as the old bolt centres are probably wrong it may be necessary to screw the battens down with the old foundation bolts (if these are set in concrete), and coach-screw the motor down to them. Usually, however, motors are already fixed on battens wide enough to allow of considerable variation in bolt centres, so that little time is lost in fixing down another motor to them.

As a motor is often fixed in a room which can only be reached by taking it up two or three flights of stairs, a good deal of experience and some ingenuity is needed in handling it quickly and safely. Sometimes in the case of small motors, up to say 5 H.P., it is quickest to remove both end shields and take out the armature, when the motor can be carried up in pieces.

Pulleys are sometimes made to fit the shaft too tightly and are driven on hard; they are best shifted with a pair of screw pulley drawers. Keys are now always fitted with gib heads.

In may cases a small motor, up to say 5 H.P., can be changed in an hour and a half from the time of the breakdown, but possibly a more usual period from the notification of stoppage to the time a new motor is running is double this.

Large motors cannot be handled nearly so quickly, but by having men working simultaneously on the old and new motors while at the same time the pulley is being prepared, it is by no means impossible to change a 30–50-H.P. motor in 2½ to 3 hours.

The majority of stoppages are due to starter troubles, and of these the bulk are caused by burnt-out resistances or open-circuited hold-over coils, these fairly frequently failing at the leading-in wires. Most starter defects can be remedied, at any rate temporarily, on site. If not, a fresh starter is telephoned for. In the case of a large motor it is usually quicker to repair a fault on a field coil on site than to change the motor. It means removing one end, taking out the armature, and perhaps removing a pole-piece to get the coil out. By cutting away the outer tape before dismantling one can usually judge as to whether the trouble is sufficiently near the surface for a fairly quick repair to be possible. If the breakdown occurs in the afternoon a large motor is never changed for a field-coil repair unless it is a genuine burn-out.

In the case of armature faults it is often possible to make a temporary repair on site which will keep the motor running until a week-end. The commonest fault, especially in small armatures wound with fine-gauge conductors, is a break at the point where one of the ends bends away from the coil. One can frequently get over this in lap-wound armatures by soldering across the commutator lugs.

The surest way to keep down the cost of repairs is to educate one of the hirer's employés to keep the motor clean and the armature and field coils blown free from dust, to see that brushes do not wear down too far, and to keep a proper level of clean oil in the bearings. As a breakdown entails interruption of the user's business, he will usually see that one man is made responsible for a particular motor and that he gives it ten minutes or so of attention, say, once a week.

It was at one time thought that periodic inspection would lead to a diminution of breakdowns, but this, after being tried, was abandoned. It has been found more advantageous to risk a motor running till it fails than to inspect 20 or 30 motors on the chance of detecting one which needs attention.

When a hired motor needs general overhaul it is taken entirely to pieces, the commutator turned, the mica recessed and the armature and field coils varnished with a suitable insulating varnish. Bands are inspected, and if at all slack are replaced, and fresh whip-cord if necessary is wound on. Bearings are inspected and re-white-metalled if necessary, or, in the case of bushes, new ones fitted if required, or the old ones lined with white-metal. The brush-gear is taken to pieces and overhauled, and the frame thoroughly cleaned with petrol and finally painted. The colour is a grey, but the actual shade is changed each year, thus giving a rough guide as to how long a motor has run since the last overhaul. Finally, the machine is run for eight hours at full load driving another motor as a dynamo, and if satisfactory it is ready to be sent out again. It is believed that a motor sent out smartly painted and looking like new is likely to receive more careful attention than if issued in a shabby condition. There seems to be no doubt that the user takes a pride in keeping it in good condition.

When a rewind is necessary the repair is usually done at the works, the necessary coils being bought from the makers.

The question frequently arises whether in a particular case it pays to rewind rather than replace one or two faulty coils. It is very annoying after fitting a couple of coils to find that another has been damaged in lifting. It is still more provoking if the second failure does not occur until the armature has been belted and the motor re-assembled and tested. If the original faulty coils have been overheated to such an extent as to be useless as a guide to the condition of the rest, it is probably a good plan to scrap an additional coil and bend the wire to see if the cotton is perished and breaks easily. If so, it should certainly be rewound, because the coils which have to be lifted are almost certain to be damaged during the process.

Armatures should, of course, have a preliminary fall-of-potential test before the ends are sweated into the commutator. In connection with voltage-drop tests generally, the author would draw attention to what he believes is a fairly common error, namely, putting the current leads on opposite ends of a diameter or separated by an angle corresponding to the brush positions. If this is done and there are equalising connections, confusion is apt to arise, especially if, as is sometimes the case, one or more equalising wires are broken. If the current leads as well as the millivoltmeter leads are both applied to adjacent bars, the effect of possible trouble with equalising connections is eliminated.

One cannot lay too much stress on the importance of recessing the mica below the surface of the copper on the commutator. The saving in brushes is most marked, and in a few instances in particular it is little short of astonishing. Motors which have been known to consume a set of brushes in three weeks will go for twelve months without a single new one.

In 1914 the cost of carbon brushes per H.P. was 7d., and per motor 3s. 7d.

An effort has been made in recent years to adopt a standard motor, past experience having shown up a number of defects in various makes.

The principal points looked for are a liberal rating without undue weight and bulkiness, ease of dismantling, large bearings, and an accessible commutator. Suitable brush-gear is also a consideration. No brush-holder except of a positive radial type should be fitted to a motor. Old motors with obsolete brush-gear have been wonderfully improved by changing the holders.

Ball bearings should be avoided, for they are most unsatisfactory. Narrow pole gaps are also a great source of trouble. The small saving in efficiency is certainly outweighed by the greater risk of armature breakdown caused by a faulty bearing. Bearings inevitably wear; therefore such breakdowns are inseparable from motors with narrow air-gaps.

Price is the least consideration when one has to be responsible for the upkeep of the motors; hence cut prices and extra high speeds are avoided. On the other hand, very low-speed motors are unsuitable, on account of their size, for general hire work.

British motors are obtainable which fulfil most if not all of the above conditions.

It is unfortunately a fact that motor starters have not yet reached a very high state of perfection; the author has not yet been able to find one which combines a good resistance element with sound switchgear. Undoubtedly carbon with its negative temperature coefficient is the right material for starting a large motor. The largest motor on the author's mains is one of 250 H.P., which is started with a carbon resistance. This motor has a rope drive, and on the first contact takes 100 amperes. This current slowly increases and the motor begins to strain at the ropes until at about 160 amperes it slowly starts to move. Not only does such a start save unnecessary shock to the conductors of the motor, but it minimises the disturbance to the supply.

Starters are mounted on a wooden board plugged flat on the wall and covered with asbestos-cement sheet. All wires are carried on the face of the board and fixed neatly with cleats. Mains are also run on cleats, a short run of screwed tube only being used from the starter to the motor.

The author wherever possible prefers a belt drive to any other (except for heavy drives, where ropes are preferable).

Motors are preferably fixed on the floor, as they certainly receive more attention in this position. Occasionally there is no alternative but to mount them on brackets or hangers, or to hang them inverted from the ceiling.

For large motors, say over 50 H.P., which cannot be easily replaced at short notice, it is advisable to keep a spare armature and field coil. In the case of a large mill with a number of similar groups the author recommends the installation of duplicate motors as far as possible throughout, keeping one complete motor as a stand-by.

In opening the discussion, Mr. T. Roles (Bradford) stated that the prime cost of the motors—both A.C. and D.C.—at present hired out by the Bradford undertaking, was about £53,000, the largest machine being of 300 H.P., and the smallest ½ H.P. The Bradford hiring rates had never been increased or reduced since the hiring scheme was inaugurated, except in connection with some of the larger sizes of motors. He did not encourage consumers to adopt the hire system for motors of over 30 or 40 H.P. Quite a number of consumers in Bradford had bought their motors outright rather than continue to pay hire for them. He thought that the annual charge for hire should not be less than 15 per cent. on the total cost of the motor, slide rails, and starter, seeing that the rental had to cover repairs, maintenance, inspection, interest, and depreciation, and that, based on a 15 years' life, from 8 to 9 per cent. of the total cost would be required annually

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for interest and depreciation alone. Since 1906 hired motors had been depreciated yearly on the basis of 6 per cent. of their prime cost, and at the present day the hiring department was in a very satisfactory financial position. Brushes had to be paid for by the hirer, as had also the cost of any extraordinary damage which a motor might sustain. Practically all repairs were effected in the department's own works. He thought it very desirable that a hiring scheme should be in operation in connection with an electricity supply undertaking.

Mr. C. E. Allsopp (Bradford) said that in Bradford, for the year ended March, 1915, there were approximately 1,100 motors on hire, representing about 4,139 kw., out of a total number of 2,551 motors on circuit. At the present time the number of machines on hire was 1,262, representing 7,337 kw., an increase of 162 motors and 3,198 kw. in less than twelve months. They fixed plates on the motors stating that they were hired; this precaution was necessary in case of bankruptcy. The weight of the motors was also stamped clearly on the machines. In Bradford they found that a six-hour test was more than sufficient. He commented upon the necessity of having a highly efficient repair staff, and said that in Bradford they made their own coils readily at a very much lower cost than would be entailed by purchasing them from the makers. It was quite possible to standardise starters from 5 to 20 h.p. with interchangeable overload and no-volt coils, and he recommended "asbestin" covering for the coils in case of anything going wrong with the motor. Speaking from experience, he wished every machine they had at Bradford was fitted with ball bearings. By adopting ball bearings the air gap could be considerably lessened, with very good results. He had had considerable trouble with white-metal bearings; at Bradford they had had a number of machines running for years with both bearings, and he voted for the gun-metal mixture or the ball bearing.

Mr. R. H. Campion (Dewsbury) did not think it worth while to hire motors for cranes and hoists. With regard to ball bearings, he had found that the repairs in connection with them were very costly.

Mr. W. B. Woodhouse (Dewsbury) said that to make one charge cover all services seemed to him, from the commercial point of view, an ideal arrangement. He had come to the conclusion that 20 per cent. was a reasonable figure, but when this was put to the Yorkshireman he preferred to buy his motor rather than hire it. At the outset electric driving had been hampered by manufacturers, wiremen, and motor men all giving advice, the power user coming to the conclusion that it was an unsettled sort of business, and the engineers did not quite know what they were doing. The second portion of the paper was as valuable as the first, because it was good to know what troubles one met with, and how they should be dealt with.

Mr. W. M. Selvey (Sheffield) said that one of the most vital matters was the question of the size of motor. By putting in too large motors they got bad power factors and wattless currents.

Mr. W. Lang (Leeds) said that in Leeds, when the Corporation proposed going into this business, very strenuous objection was raised by motor manufacturers and electrical contractors.

The Chairman, Mr. H. H. Wright, said that the rates charged by the hiring company appeared to be exceedingly high as compared with those of corporations in the district, and that being so, he thought the profits of the company ought to be larger. He thought it best to arrange a minimum period of twelve months' hire, so that they knew exactly where they stood. He did not think it paid to insure motors with an insurance company, provided the machines were reasonably looked after; the insurance rentals against breakdown worked out at something like 5 or 6 per cent., and he knew many cases where there had not been any repairs for five or six years. He agreed with Mr. Allsopp in regard to bearings. At least 90 per cent. of breakdowns were due to oil getting on the windings. He considered it to be very important to have a clause inserted in the hiring agreement whereby, in case of the bankruptcy of the hirer, the landlord could not distrain upon the motor; the same thing would apply to a mortgagee of the property.

The Author, replying to various points raised in the discussion, said that at Hawick the power users did not want to be bothered at all with their drives, but turned the whole thing over to the company, with the result that they did not quibble about little matters. The company practically undertook to insure the whole of their drives, and provision was made for such contingencies as bankruptcy. His principal objection to ball bearings was that they could not be handled quickly; undoubtedly, if white-metal bearings let them down, they let them down badly, but they had not found much trouble from that cause in actual running. An objection to phosphor-bronze bearings was that when they seized, they seized badly. During the past five and a half years the drives at Hawick had got larger, particularly in the hosiery industry, with the result that one was continually changing the size of one's motors in the mills. At Hawick they had not had any trouble with contractors, because they had not any in the town, though they had had to make a firm of manufacturers feel rather uncomfortable when they attempted to quote prices representing 33⅓ per cent. off the proper charge, whilst his company were hiring motors out to customers at a higher figure.

THE USE OF CONTINUOUS CURRENT FOR TERMINAL AND TRUNK-LINE ELECTRIFICATION.

Discussion at Birmingham.

Mr. Storer's paper was read before the Birmingham Local Section of the Institution of Electrical Engineers on March 15th. An abstract of the paper was printed in the Electrical Review of March 24th and 31st.

Dr. C. C. Garrard said that the paper appeared to be largely a plea for standardisation of railway equipments in this country, and the suggestion was made that this matter should be taken in hand by the Institution of Electrical Engineers. Mr. Storer was of a somewhat sanguine temperament if he thought that this would be done. The Institution had not a standardisation committee or any other machinery whereby this and other problems could be dealt with. The American Institute of Electrical Engineers had such standing committees, and there was no doubt, to his mind, that the development of electrical engineering in this country was hindered by the failure of the Institution of Electrical Engineers to take the lead in such matters. The Engineering Standards Committee dealt with such a wide field that electrical engineering could only receive a small portion of its time and attention. These important electrical problems should be tackled by the Institution, which could put them into such shape that they could be presented to the Engineering Standards Committee as the considered view of the electrical profession. The Engineering Standards Committee would then see that the views expressed fitted in with those of other branches of engineering, and could eventually adopt them as a British standard specification. If this scheme could be arranged, he was sure progress would be greatly accelerated.

Mr. F. W. Carter said there was in some quarters, even now, a disposition to argue in favour of shunt or separately-excited motors, but, from an operator's point of view, the series motor was the only thing possible. He would like to have from the author a more explicit statement of the service conditions which he considered justified the use of field control. If s were the maximum permissible speed of the train, in miles per hour, d the diameter of the motor-driven wheels, in inches, x the ratio of gear reduction, and n the maximum speed of the armature in r.p.m., these quantities were connected by the following equation:—

$$sx \times 88 \times 12/\pi d = n.$$

The quantities s and d might be considered as being specified, whilst a maximum limit could be assigned to n by the designer. If, now, the motor were designed so as to use a larger gear reduction than that given by the above equation, the armature speed would sometimes pass beyond desirable limits, whilst if the gear reduction were less than that given by this equation the motor was not used to the limit of its mechanical capacity, and could be made more efficient or lighter or of greater capacity by reducing the number of armature bars, until the appropriate gear reduction satisfied the above equation. By starting the design with this equation, therefore, and deducing the number of armature bars in accordance with it, the most effective use was made of the active material. The above applied whether the motor was designed for operation with a single field or for field control. For a particular service, the comparison between motors must be based on the assumption of approximately similar characteristics on the normal fields; if it were desired to compare the operation of a particular motor with and without field control, it was necessary to use a greater gear reduction for the field-control motor; but from the discussion given above it would be clear that in this case either the field-control motor ran to a higher speed than was desirable, or the saturated-field motor could be improved by redesigning it so as to satisfy the equation given above; that was to say, the gear reduction was either too great in the field-control motor or too small in the other. The comparison between field-control and saturated field motors should not be made on the basis of using the same motor in the two cases, but on the basis of the best motor a designer could offer in the respective cases. Under these conditions the field-control motor would be somewhat heavier and more expensive than the saturated field motor. To sum up the advantages and disadvantages of field control, the advantages were as follows:—

1. There was a saving of energy, as explained by the author.
2. For locomotive-hauled trains there was an increase of flexibility, which was not only desirable but necessary in many cases.
3. For multiple-unit trains it frequently enabled an otherwise unsuitable motor to be employed by using it nearer to the limit of its mechanical capacity.
4. It enabled trains to meet special speed restrictions outside the ordinary schedules.

The disadvantages of field control when comparison was made on the basis discussed above were:—

1. The motors were heavier and more expensive.
2. They were slightly worse in operation on account of the weakened field.
3. The control equipment was heavier and more complicated. In many cases field control had not shown sufficient advantage over the ordinary series-parallel control to justify its use. At

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the same time, it was frequently a valuable feature of which advantageous use could be made. With regard to the author's conclusions, whilst standardisation was highly desirable from some points of view, he could hardly blame the railway companies if they were indisposed to admit this at the present time; the advantages of higher D.C. voltage were too recent to justify them in concluding that finality had been reached, and, in fact, the system using 5,000 volts was only of last year's development. It was pleasing to see that the author referred to the 600-volt system as not only being thoroughly established, but as being so well suited to the requirements of terminal electrification that it should be continued as one of the standards, at least for the present. This was the oldest system in use for operating railways, and there was always a disposition, when something newer appeared, to consider that it was superior to the older and necessarily superseded it. If, however, the question of electrifying such a system as the London underground railways came up at the present time, the sound considerations given by the author, where he said: "The determining factor in the entire question will, of course, be the cost, not only of the original installations, but the cost of operation and maintenance," would lead to the same solution as was arrived at by the Underground Railways Co. at the inception of their project. The author's final paragraph was important. In this country the main lines and the local lines were very largely distinct, and if one system of operation were considered best for local service and another system for main line service, the two systems would be largely concerned with separate tracks; if a different system of line conductors were considered desirable for the two classes of service, the few lines which it would be necessary to equip with both systems of line conductors would add little to the cost of the installation, as compared with the additional expense that would be incurred in adopting an unsuitable system of operation either for the main line work or for the local work, in order that a single system of operation might be employed throughout the railway.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Foreign Trade Successes.

You have frequently emphasised in the columns of your paper the necessity for the expansion of foreign trade, and therefore we think you will be interested in the following list of orders received by this firm from abroad during the last few weeks:—

Country.	Goods.	Value.
France	Switchgear and transformers	£15,000
Denmark	Transformers and meters	7,000
Holland	Transformers and switchgear (including 2-4,000 K.V.A.)	3,500
China	Meters	8,000
Russia	Instruments and meters	2,500
Spain	Meters	1,500
Australia	Meters	4,000
S. America	Meters	1,000
India	Meters	1,500
Other Countries ...	Meters	2,000
		£46,000

Ferranti, Ltd.

London, W.C., *April 1st*, 1916.

Canada and the Metric System.

No one who has had a scientific training can doubt the enormous advantage to British traders of changing to a decimal system, and the writer is in very hearty accord with the effort at present being made by the ELECTRICAL REVIEW to give prominence to this extremely important subject.

In order that the fullest possible benefit should be derivable from such a change, however, the whole of the British Empire should partake in it, and to that end it would be necessary to enlist the sympathies of the people of the Dominions. In the case of Australia, New Zealand, and South Africa this might not be so difficult; but Canada, owing to her proximity to, and intimate relations with, the United States, is in a different position, since it is not certain that Canada's big Southern neighbour would care to follow in the lead of the British Empire, and if she did it would make the task of British traders just that much harder, since the United States would have gained the same advantage in dealing with the world's markets. At the same time, this is not a very strong argument for keeping Canada out of line with the rest of the Empire, since her business men could more easily adapt themselves to the needs and requirements of the United States if the systems of weights and measures, &c., were different in the two countries than they can at present to those of some far-away country like Italy, Spain, or France, especially as there would be, in the former case, the supreme advantage of a common language.

Canada, like the United States, is in the rather awkward position which arises out of having adopted a decimal system only in a few directions, leaving others entirely unchanged.

The money, of course, is decimal, but articles are still sold in dozens, and to reckon out how much 2½ dozen buttons are worth at, say, 17 cents each, is quite an arithmetical feat for a former inhabitant of the Old Country, and, it is suspected, does not come any too easy even to a native.

Again, the measures of length are the same as at home, but the hundredweight is 100 lb., and the ton is 2,000, which latter are certainly improvements where decimal money is used, but the ounce is unchanged, making the reckoning of the cost of lb. with odd ounces an awkward item.

Cantuck.

[Our correspondent writes of existing conditions. But what of the future? What if the United States takes the initiative and adopts the metric system before we do? Already the medical work of the U.S. Army, Navy, and Public Health Service is carried on wholly in the metric system; so is that of the Bureau of Standards and other scientific departments; the system has been adopted in the Philippines and Porto Rico; scientific, engineering, and industrial organisations have urged Congress to take action; the U.S. Department of Commerce is in favour of it; and the movement is steadily gaining strength. If the United States decides to make the plunge, can the British Empire stay out in the cold?

Australia and New Zealand long ago advocated the adoption of the metric system throughout the Empire, and the Colonial Premiers in Imperial Conference have passed resolutions to the same effect. If we do not move soon, our rivals will—and then, as usual, we shall be "too late."—EDS. ELEC. REV.]

Cause of Flicker.

We note the suggestions made by your correspondent, Mr. J. W. Long, that the flicker in the light may be due to faulty valve setting causing unequal distribution of steam; also, that Mr. Bulsara should write to us for enlightenment and guidance. Concerning this, we have to say that, although at various times during the past 15 or 20 years a number of cases of flicker have come under our notice, in no case have we known the trouble to be traced to defective valve setting or to be remedied by readjusting the valves. We hardly see how the comparatively slight inequality due to a slide valve being out of position could produce such a result with the liberal proportion of fly-wheel effect and the fine degree of even turning there is with a high-speed steam engine, bearing in mind that in times past, at any rate, electric generators have been successfully operated by high-speed "single-acting" engines. If faulty valve setting or slight looseness in the valves could produce such an effect, complaints of flicker in the lights would be far more common than in our experience they are.

Belliss & Morcom, Ltd.

Birmingham, *April 3rd*, 1916.

Electricity in Agriculture.—Miss E. C. Dudgeon, of Lincluden House, Dumfries, has during the past few years carried out a number of interesting experiments in the growing of crops by means of electricity. The results she has attained in the case of potatoes were very marked. In 1912, the yield was 10 cwt. 3 qr. more per acre than without the electricity; in 1913, 13 cwt. 3 qr. more; and in 1914, 1 ton 3 cwt. more. Last year the oat crop was experimented with. From the very commencement of growth, the oats under electrical treatment showed a conspicuous difference, and they did not suffer from the prevailing drought to the same extent. When the crop was harvested there was a difference of 31 per cent in grain and 63 per cent in straw in favour of electrified oats. Miss Dudgeon considers that the experiments justify the following conclusions:—(1) That under the influence of the electric discharge the ingredients and the soil necessary to plant growth are rendered more soluble, and therefore more easy of assimilation; (2) that by the aid of electric current sap is enabled to flow more vigorously, and the formation of sugar and starch is increased; and (3) respiration absorption, and evaporation are accelerated, and by increased chemical activity in the plant its whole fabric is improved. With regard to the cost of electrical treatment of crops Miss Dudgeon considers there is no reason to doubt that the apparatus required, and its method of working, will come well within the means of any practical farmer who has a little knowledge of the subject, and that the increase of crop will repay with interest the outlay entailed.—*Aberdeen Journal.*

Russian Government Electricity Measure.—A Government conference has been held on the supply of electricity. It was shown that with the existing scarcity of fuel it was necessary to consider at once the means of assuring a supply of electrical energy which would aid in solving the motor difficulty. It is proposed to use liquid fuel (petroleum) in place of the coal that cannot be got. A project of law to this effect, already drafted and published, has been approved.

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TECHNICAL EDUCATION AND INDUSTRIAL RESEARCH.

Many wild statements have been made during the past 18 months on the subject of education, science, and research, and there have arisen schools of theorists with enthusiasm as their virtue and vagueness as their fatal defect. The national crisis has aroused them to well-meaning frenzy and secured a wide and sympathetic hearing for their proposals, particularly amongst those who, from previous ignorance, are unable to discern beneath the attractive surface of so many of these sweeping proposals a lack of definition and a failure to analyse the needs of the case, and correlate them with practical possibilities. Too many sovereign cures have been recommended with too little justification, and too much faith has been pinned on vague schemes for State aid and private organisation, whilst overlooking the fundamental importance of individual effort. Science has been regarded as a panacea for all ills, and there has been a tendency to forget that not only the general organisation and higher commands of the industrial army, but also the vast body of that army itself must receive attention. Those who begin life as manual workers must—with exceptions which are important in themselves, but almost negligible in point of numbers—remain manual workers to the end. In order that they may make the best of their opportunities and render the greatest good to productive industry, it is necessary that these workers receive suitable education during the critical years between the time they leave school and the time when their attitude towards industry and their position and prospects therein may be regarded as fairly definitely fixed. As pointed out by various speakers—Dr. W. Garnett and Mr. A. P. M. Fleming amongst them—at a recent discussion by the Circle of Scientific, Technical, and Trade Journalists, there is insufficient discrimination in our existing facilities for technical education between the needs of the leader of industry, the technical expert, the works manager, the foreman, and the skilled worker. Provision is already made more or less satisfactorily for the technical education of non-manual workers in the industrial army, but the needs of the manual worker are sadly neglected.

In this matter, which primarily affects juvenile workers, responsibility rests with manufacturers themselves, and, whilst Dr. Garnett emphasised the necessity for more practical education in schools, Mr. Fleming drew attention to the benefit accruing to workers and employers alike from works schools. Having investigated the problem, if only on the ground that it is a sound commercial proposition, the employer must provide the necessary training himself or make his voice heard in demanding that this kind of education be provided. In either case, the employer must contribute at least to the extent of granting juvenile workers class-time during working hours, for it is physically impossible that such workers should study hard and effectively during what should be their leisure hours.

Apart from the more or less specialised education of industrial workers, Dr. Garnett makes an urgent plea for the wider diffusion of popular science. Broad education of the general public, both at school and by popular lectures, would secure a more intelligent and sympathetic appreciation of industrial and scientific needs, conditions, and proposals; it would aid fathers in selecting a definite training and aim for their children; and it would bring home to legislators and capitalists the fact that every scientific discovery sooner or later finds its place in industry.

Following upon the question of education, which is its indispensable precursor, comes that of research. Purely scientific research should never be confused with industrial research; nor should either be regarded as of minor importance. Both are to be encouraged by every means at our disposal, but with this important distinction, that the pure scientist exploring unknown fields in search of knowledge for knowledge's sake cannot usefully be subjected to any organisation or restraint, whereas industrial research is mainly directed towards the solution of definite industrial problems, though it may yield incidental scientific discoveries. Numerous instances quoted by Mr. Fleming show, if further proof be needed, that industrial research on a large scale and well organised is always a commercial proposition. There are now upwards of 50 corporations in the United States having research laboratories costing annually from £20,000 to £100,000 each for maintenance. Recent advances in long-distance wireless telegraphy have been due largely to work in the Western Telegraph Co.'s research laboratories; the rustless sheet-iron of the American Rolling Mills Co. is a research laboratory product; a new industry for the manufacture of commodities from synthetic resins had its inception in the scientific work of the General Bakelite Co.; and half-a-dozen new factories have been started as the result of discoveries in Edison's laboratories since the outbreak of war. To quote Prof. Gregory, industrial research is primarily a commercial matter, and will be taken up by all our big firms directly they realise how profitable it is. The pure scientist, however, cannot be chained to any particular research, yet his work may be of far greater value than any industrial research. In Faraday's "magnetic spark" there originated every central station in the world to-day, and from Maxwell's electromagnetic theory of light there came the Marconi trans-Atlantic wireless stations.

Between the inception of a purely scientific investigation and its application to industry there lies generally a wide field demanding much patient labour before a track can be beaten across it. The first fact to be realised is that the several stages in the completed task are all equally important. Each must be encouraged—in spirit and by act—and the final fruits of labour must be distributed equitably between all the workers concerned. The original inventor or discoverer and the originator of the commercial application of his results should both share in the profits, and if the intermediate work has been aided by public funds it is only fair that the State should also participate in profits in order that further progress may be made in similar manner.

College laboratories may be more usefully employed than at present in the conducting of purely scientific research and in the performance of "scientific work to order"—the order being placed by industrial firms and ultimate profits being divided between the firm, the college, and the research worker. One of the most important functions of the Advisory Council for Research seems certainly to lie in organising, classifying, and supplementing existing facilities for research in public institutions, and in bringing manufacturers and scientific investigators into close association. It is in the preliminary stages of scientific investigation that college laboratories can be most usefully employed. There are some industries (*e.g.*, leather tanning and process-block making) in which the operations are the same for a single piece of work as for a thousand, but generally the college laboratory cannot undertake the commercialisation of scientific discoveries. Standardisation work and the testing of materials are provided for by the National Physical Laboratory, and appreciation of the sterling services rendered by this institution is extending rapidly.

There remains, however, a most important class of work, and one for which additional facilities must be provided in this country. These facilities should take the form of monotechnic institutes equipped for undertaking experimental work under commercial conditions, on a broader basis than the industrial research conducted by individual firms, and in the interests of all members of a particular trade or group of associated trades. Manufacturers would not be called upon to reveal secrets they already possessed or might thereafter discover, and they would certainly gain more than they would lose by sharing with others the knowledge acquired by combined industrial research. The cost of special trade research institutions could be met by a purely nominal levy on the capital of firms interested—for instance, an annual subscription of 0.1 per cent. on the capital invested in engineering works would yield about £300,000 per annum for research institutions and research workers—but in certain directions it would probably be expedient to provide State subsidies. There are, for instance, many researches of great importance to a large section of industry which fall outside the scope of pure science and are not of such a nature as to justify a single firm in undertaking the work at its own expense. It would, then, be equitable to credit the State with a proportion of the profits derived from the results of work conducted under subsidy. This could be done by State patents, or other means, and in the course of a few years fresh subsidies should be covered by research revenue. It would be necessary also to protect the interests of the research workers themselves and to provide against their disposing privately of information acquired during their investigations.

The danger particularly to be averted is that of relying too much on State organisation and aid, particularly at the present time, when technical education and research have still to be given really practical effect in this country. It cannot be emphasised too strongly that the main-spring of the movement is, and must be, the employer (particularly the manufacturer) himself. Manufacturers must abandon their policy of isolation, for there is no longer anything "splendid"—much less profitable—therein. Trade associations should be organised to secure suitable educational facilities for their employés (present and potential) and to make the best use of trained men supplied by trade schools and colleges. The question of the manual worker's education is one of extreme importance, and should be solved in detail by each employer, though his trade association could, and should, furnish much valuable assistance. The same trade associations should concern themselves with superintending the research work in which they are interested and in collecting and distributing information among their members. They should keep in close touch with the Advisory Council for Research, and should endeavour to frame their policy in conformity with arrangements made for industrial research as a whole, but, if State aid is not forthcoming promptly enough and in suitable manner and degree, it is the clear duty of trade associations to frame schemes for independent action. It is of the utmost importance that individual and concerted trade action be taken at the earliest possible moment, always, however, with a view to supplementing present and future central action on a national scale. It would be as foolish for trade associations to do otherwise than aid in building up a central national organisation, as it would be for the latter to take definitely effective measures without the co-operative help of individual trades. The intimate acquaintance of trade associations with the actual needs and conditions of the industries they represent is indispensable, and these mobile associations should set to work to define and supply their own needs as far as possible and to aid in building up an effective central organisation.

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FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

FRENCH WEST AFRICA.—New Customs Regulations have been established by a recent Presidential Decree. They are based on the Customs Legislation in force in France in so far as the latter can be adapted to the local necessities of the Colony, and deal in detail with the procedure to be followed in respect of the importation, exportation, transit, and warehousing of goods (including provisions as to the declaration of goods for Customs purposes), the procedure in cases of dispute as to the kind, quality, origin, or value of imported goods (*expertise*), &c. The complete text of the Regulations may be consulted at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

PERU.—A new Law, dated December 29th, makes provision for the increase of the Customs duties levied on certain goods imported into Peru.

The following goods, which have hitherto been on the free list, are to pay import duty at the rate of 10 per cent. *ad val.*: —Tin in bars and sheets; lead in bars or in unserviceable articles; steel cylindrical axles; liquid mercury; copper, brass, or bronze, in bars or sheets; asbestos or asbestos yarn, asbestos cement; steam boilers and feed pumps for same; passenger cars for railways or tramways, with any motor; locomobiles and locomotives with or without boilers; cranes.

Duty at the rate of 5 per cent. *ad val.* is payable on the undermentioned goods:—Steel bars; hoops of iron or steel; wire cables (hawsers); zinc in bars; iron sheets from 3 to 15 mm. thick; steel wire; round wire or wire resembling ribbon.

The following goods are to be subject to import duty at the specific rates shown:—

	Per kilog.
Machines of all kinds, hitherto free of duty, weighing up to 100 kilogs. (gross weight) ...	10 centavos.
Machines of all kinds, hitherto free of duty, weighing more than 100 up to 5,000 kilogs. (gross weight)	5 centavos.
Machines of all kinds, hitherto free of duty, weighing more than 5,000 kilogs. (gross weight)	2 centavos.

Among the goods that will continue to be admitted free of duty are irrigation pumps.

The Ministry of Hacienda is to fix, within 90 days from the promulgation of the Law, the specific rates of duty which are to be assessed as the equivalent of the 10 per cent. and 5 per cent. *ad. val.* rates mentioned above. For the purpose of converting these *ad val.* duties into specific rates, the prices current before the outbreak of the war are to be taken as the basis.

The Law also provides for the following, among other, modifications of the tariff of fees charged by Peruvian Consular Offices:—

The fee for the certification of the four copies of each invoice of goods shipped to Peru is increased from 1 per cent. to 2 per cent. of the value of the goods.

The charge (under No. 46 of the Consular Fee Tariff) for certification of the copies of ships' manifests is suppressed, and in substitution therefor the fee for the legalisation of signatures (2 soles) is to be levied for the visa of such documents.

For the certification of manifests for cargo that has to be transhipped, the fee for the legalisation of signatures is to take the place of the fee prescribed in No. 47 of the Tariff.

No. 48 of the Consular Fee Tariff, which provides for a fee of 50 centavos for the certification of the two copies of the general manifest, or of each one of the various manifests that, according to Article 113 of the Consular Regulations, must be presented by the captain of the vessel to which the merchandise has been transhipped, is to remain in force.

The Law further provides that a special duty of 20 centavos per 100 kilogs. (gross weight) is to be levied on all goods (with the exception of bulky goods which are cleared without entering into warehouse) imported through the *Callao* and *Mollendo* Custom Houses.

[Note.—The Peruvian sol (100 centavos) is equivalent to 2s., but for Consular Tariff purposes it is taken as 48d. sterling.]

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

4,096. "Electric contact keys, electric buzzers, &c." H. Rottenburg. March 20th.

4,109. "Joint for electric cable." E. A. Claremont & A. E. Tanner. March 20th.

4,110. "Manufacture of incandescent lamps." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 20th.

4,115. "Electric arc soldering." E. H. Jones. March 20th.

4,136. "Means for securing electric lamps, &c., in sockets." T. H. A. Brown. March 20th.

4,182. "Shaping wire." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 21st.

4,184. "Electrical condensers and condenser systems." W. A. Clark H. G. Longford, W. W. Longford, T. Morris & Sphinx Manufacturing Co. March 21st.

4,190. "Process for electrolysis of alkali chlorides." R. van Hasselt. March 21st.

4,193. "Sparking plugs for internal-combustion engines." W. P. Gilbart Griffiths, Gilbart & Co., and R. A. Griffiths. March 21st.

4,196. "Means for indicating state of adjustment or output of dynamo-electric machines." J. Stone & Co. (H. D. Rohman). March 21st.

4,240. "Electrical treatment of liquids and fluids and products resulting therefrom." J. E. Bloom. March 22nd.

4,247. "Electric transformers." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 22nd.

4,254. "Electric signalling apparatus." F. G. Baily. March 22nd.

4,279. "Electric flash lamps." Brass Flask & Capsule Co. and S. Peplow. March 22nd.

4,288. "Interrupters for magneto-electric machines." A. M. Allen & R. B. North. March 22nd.

4,295. "Inductances for wireless telegraphy, &c., and manufacture thereof." E. R. Clarke. March 23rd.

4,320. "Protective gear for electrical circuits." A. E. McColl. March 23rd.

4,321. "Means for protecting alternating-current generators and transformers." A. E. McColl. March 23rd.

4,334. "Locomotives." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 23rd.

4,337. "Automatic block-signal systems." National Safety Appliance Co. March 23rd. (U.S.A., June 30th, 1915.)

4,338. "Magnetic separators." F. Krupp Akt. Ges. Grusonwerk. March 23rd (Germany, October 22nd, 1915.)

4,342. "Electric light reflectors." C. H. Pitman & M. J. Railing. March 23rd.

4,343. "Means for controlling electric lighting of motor vehicles." W. Curtis. March 23rd.

4,347. "Telephone systems." T. Pettigrew. March 23rd.

4,348. "Arc projector lamps." J. Brockie. March 23rd.

4,363. "Application of tumbler switches to walls, &c." G. A. C. Thynne. March 24th.

4,373. "Trolley head for trams, &c." S. Henshaw. March 24th.

4,376. "Maximum-demand indicators for electricity, speed, and other registering apparatus." Chamberlain & Hookham and S. James. March 24th.

4,399. "Controlling mechanism for electric circuits." British Thomson-Houston Co. & W. L. Wise. March 24th.

4,402. "Telegraph machines." L. M. Potts. March 24th.

4,407. "Telegraphy." Muirhead & Co. and G. O. Squier. March 24th.

4,413. "Electric flash lamp attachments." British Ever-Ready Co. & T. Y. Unwin. March 24th.

4,453. "Leading-in conductors." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 25th.

4,467. "Magnetos." A. Guedatarian. March 25th.

PUBLISHED SPECIFICATIONS.

1914.

15,580. Connections for Electrical Condensers. H. Aland. June 29th. (June 28th, 1913.)

21,992. Method of Automatically Switching off Defective Sections of Electric Distributing Nets. M. Hochstadter. November 4th. (March 13th, 1915. Convention date not granted.)

24,074. Trolley Poles or Bows for Electrically-propelled Vehicles. G. Meyer. December 15th.

1915.

2,004. Lanterns for use with Gas, Electric, or other Lights. J. A. Chell. February 8th. (July 7th, 1915.)

3,329. Sanitary Telephone Mouthpieces. E. M. Jenkins. March 2nd.

3,410. Apparatus for Exhausting Lamp Bulbs and other Articles, and Testing the Vacuum therein. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 3rd.

3,420. Electric Impulse Transmitters, particularly adapted for Signalling purposes. A. Stern. March 3rd.

3,523. Electric Signalling Systems, particularly adaptable to Telephony. International Electric Co., H. E. R. Roose & R. G. le Noir. March 4th.

3,569. Method and Apparatus for the Electro-deposition of Metals. C. E. S. Bell & L. G. Scott. March 5th.

3,575. Electric Radiators. J. R. Quain. March 5th.

3,706. Electric Push Buttons. G. E. Roedding & E. B. Roedding. March 8th.

3,733. Electrical Switches. A. C. Wynne. March 9th.

3,953. Electric Furnaces. E. K. Scott & F. Howles. March 12th.

3,954. Wireless Telegraphy or Telephony. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. March 12th. (February 5th, 1915.)

4,600. Electric Heating Element for Kindling. R. K. Hearn. March 24th.

5,116. Gumming Machine for Gumming Telegraph Slip and the like. G. A. E. Purvis. April 3rd.

5,928. Ignition Magneto Driving Couplings. J. W. Montague. April 20th.

7,638. Control of Electric Motors. C. F. Brindley. May 21st.

8,421. Electric Incandescent Lamps. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 7th.

8,696. Sparking Plugs. H. G. Longford, W. Longford & W. A. Clark (trading as Sphinx Manufacturing Co.). June 12th. (Addition to 7,365/13.)

8,860. Electrical Resistances. A. H. Railing, C. C. Garrard & P. Greenhalgh. June 16th.

9,346. X-ray Devices. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 25th.

10,350. Electric Light Fittings. S. Fildes. July 16th.

10,370. Centrifugal Compressors. British Thomson-Houston Co. (General Electric Co., U.S.A.). July 16th.

10,421. Insulators. J. Roothaan & Ferranti, Ltd. July 17th.

11,457. Electric Distributing Systems. M. Hochstadter. August 9th.

11,511. Leclanché Cells and Methods of and Means for Resuscitating the same when apparently exhausted. J. T. Fahy & A. E. Otway. August 9th.

14,746. Electric Heating Apparatus. Automatic Telephone Manufacturing Co. & C. H. Archer. October 19th.

17,116. Electrical Table Lamp. J. Heiberg. December 6th. (January 9th, 1915.)

17,413. Electrical Apparatus for Heating Liquids. W. H. Smith. December 13th.

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ELECTRICAL REVIEW.

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4, Ludgate Hill, London, E.C.

THE CONSERVATION OF NATIONAL RESOURCES.

THOSE of our readers who study the technical Press of the United States are familiar with the importance which in recent years has been attached to the subject which forms the title of this article by our Western cousins. Not only has the waste of material resources such as timber and coal been freely denounced in that great country, which possesses such enormous reserves of these priceless treasures, but also the punishments which Nature remorselessly inflicts upon those who misuse the riches which she has lavished upon them in prodigal profusion, have been the subject of discussion—such as, for instance, the denudation of the land by rainfall when it has been unwisely divested of the protecting mantle of forest growth; and the wealth of water-power which is running to waste, while coal, oil, and gas are consumed at low efficiency, has received the attention of the leaders of the industrial world and of the Government.

If, in a time of profound peace, a country so lavishly endowed with natural resources should be gravely concerned as to the abuse of those treasures by its inhabitants, how much more urgent is our obligation to scrutinise minutely the manner in which the natural resources of these islands are utilised, at a time when the heaviest financial burdens ever laid upon a nation have to be borne by us, to ensure the triumph of our cause, and when we have to face the certain prospect of industrial competition of unprecedented severity in the years that will follow that consummation of our aims. Surely it is our duty to examine in every phase the methods of production and utilisation, especially of the fuel which constitutes by far the most important store of natural wealth in our possession—the factor to which is primarily owed our evolution from an agricultural community to the leading industrial nation in the world.

The subject has many times been dealt with in our columns, but never before has its importance been so pressing or its urgency so obvious as it has now become; and we are glad to know that leaders in the scientific and industrial spheres, such as Professor Bone and Sir R. A. S. Redmayne, are endeavouring to direct public attention to the question. The work of the former in the development of more economical methods of heating with gas is well known to our readers; the latter, H.M. Chief Inspector of Mines, is more immediately concerned with the extraction of our black diamonds from their age-old matrix, but in his presidential address to the Institution of Mining and Metallurgy last month he broadly reviewed the mineral resources of this country, unrivalled in their number and variety, and insisted upon the imperative necessity of the conservation of coal by the prevention of waste both in getting and in using it. With each of these operations the electrical engineer is intimately concerned.

As regards the extraction of the coal, the progress of electrification of the coal mines in the recent past has been so satisfactory that we need not dwell long upon this phase of the subject; not only is the adoption of electric lighting and power

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for ordinary purposes proceeding apace on all progressive properties, but also the number of electric haulages and electric coal-cutting machines in use is steadily increasing, and the use of electric power for main winders has passed the stage of experiment—in spite of the efforts of some faint-hearted electrical engineers who upheld the superior advantages of steam—and has established itself on the basis of proved merit. Not only do these methods reduce the consumption of fuel, but also they enable thinner seams to be worked to commercial profit and diminish the amount of coal abandoned in the pit or cut to waste.

But it is in connection with the use of coal that by far the greater scope for economy is found. Even if we ignore the fact that only at most about one-fifth of the energy contained in the coal can be utilised in steam engines, or one-third in the more costly gas engine, it is estimated that two-thirds of the coal consumed in industrial works is wasted owing to the employment of obsolete and inefficient methods and plant. Sir R. A. S. Redmayne refers to the appointment by the British Association of a strong committee to consider the whole question from a national standpoint, but considers that the matter is of so great importance that it should be undertaken by a State Commission provided with adequate funds and the whole-time services of able chemists. No electrical man will be surprised to learn that he comes to the conclusion which is reached by every engineer who studies this problem—that the more economical consumption of fuel for the production of energy depends upon the more extended employment of electric motive power, distributed from large generating stations in which the fuel is used most economically under the direction of highly skilled experts. *The centralisation of production and transmission lies at the very foundation of progress towards the conservation of our national stores of fuel.* This is no new doctrine; it is that taught by Ferranti, its first and most enthusiastic champion, and supported by such men as Insull, Merz, Pearce, Chattock, and other leaders in the electrical world. Wherever it has been carried into full effect, the results have proved its truth beyond all doubt. In this country, most unfortunately, the generation and distribution of electrical energy, with rare but instructive exceptions, is subdivided amongst innumerable undertakings of comparatively small dimensions and limited scope for development, thanks mainly to the craze for municipal ownership which for over 30 years has crippled the progress of the industry in this country, by maintaining a high cost of production and thus hindering the general adoption of electrical energy for all purposes, by preventing our manufacturers from developing the design and production of electrical plant on the grand scale in vogue abroad, and consequently by restricting the inflow of capital into an industry in which we for a time led the world. These facts are fully appreciated by Sir R. A. S. Redmayne, who points to the necessity of financial outlay on a large scale, and of legislative assistance to facilitate, if it cannot compel, the co-operation of municipal and private enterprise to carry the policy into effect. His views are in accordance with those which we have so long upheld in these columns, and we trust that the attention which is now being directed to the subject will bear fruit in the speedy liberation of the electricity supply industry from the toils by which it has hitherto been harassed.

Rubber.

Rather more conservative views have been of late ventilated in some quarters as to market prospects in crude rubber for the near future, which has been quite in keeping with the downward tendency in values within the last few weeks. Current prices, however, are still well above the lowest point reached at the end of January last, and the market looks like displaying more resisting power, while the demand throughout has continued on a fairly active scale. The price of spot fine plantation descriptions has dropped to a little under 3s. 4d. per lb., but the fact is worth noting that the fall has been accompanied by a decrease in the London stocks, thus indicating that the outlet has been stimulated at least to some extent at the lower level, while holders have evidently met the demand more freely. This policy has no doubt been prompted by the fact that very liberal quantities were already tendered against contracts maturing this month, which naturally tends to remove all apprehensions as to a renewal of tightness for some time to come. Not only are large quantities afloat, but consumers and importers on either side of the Atlantic undoubtedly hold fair stocks against urgent requirements that may arise in the course of this or next month. The remarkable strength of the position in the early part of this year was probably due in some degree to the rather oversold condition of the market at a time when the shipping situation was the subject of more particular uneasiness. There is now certainly less alacrity on the part of consumers to provide for their prospective needs pending further developments, but the postponement of orders in various directions means a slow accumulation of buying power later on. Recent heavy arrivals having synchronized with a reduction of the stocks and a fall in prices, precisely the reverse is liable to occur should anything happen to encourage the nursing of part of the future arrivals. While there is now a good supply of the commodity to meet all requirements in the home trade and for export, the outlook as regards shipping is not altogether free from anxiety. There have been delays to contend with in the arrivals, but no losses at sea lately with the exception of one boat last week, with only a limited quantity, however. The total shipped last month from the Federated Malay States amounted to 4,429 tons, this showing a reduction of about 800 tons against the previous month, and making an aggregate of 14,197 for the three months, which compares with 10,302 tons and 7,321 tons for the same period respectively in the previous two years. The fact deserves notice that the ratio of increase so far this year has been much greater than last year, thus testifying to the excellent progress of the plantation industry. The trade outlook across the Atlantic continues eminently satisfactory, and the continuance of a huge outlet there seems assured, which constitutes a big factor in the situation although the plantation output is steadily increasing.

Falling Trees and the Maintenance of Wires.

The blizzard which swept the country in the early days of the present month did considerable damage to electric wires and poles. Questions have already arisen as to who is liable for the damage caused to persons using the highway; and difficult problems are sure to arise as to who is liable to make good the damage caused by falling wires and poles, whether used for telegraph, telephone, or electric power. One such problem has already been brought to our attention by a correspondent. An engineer had undertaken to maintain and keep in repair certain poles and wires for a power company, and had given an indemnity in respect of all liability which might be incurred by the company owing to failure to maintain. A pole fell during the recent blizzard and damaged a cottage. The pole was new, well set up, and well stayed. If a claim is made by the cottage owner, can the engineer be sued on his indemnity? In the first place one has to consider whether the cottage owner has any right of action. This question depends upon a well-known principle that anyone who brings on to his land something

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which may in certain circumstances be a source of danger, cannot escape responsibility if it causes damage even as a result of the act of God. In the present instance the pole, bearing certain heavy wires, was presumably built on land of the company in such a position that if it fell it would injure the cottage. In such circumstances the company would be liable. On the contrary, if a tree growing on their land was blown down and did damage, they would not be liable, as to grow a tree is to make a natural use of land. But the fact that the company may be liable does not necessarily give them the right to sue on the indemnity. So far as appears from the facts stated by our correspondent the fall was not caused by the failure to maintain but by the blizzard—a very different matter. For all ordinary casualties resulting from the failure to maintain he would be liable, but not for the consequences of an unprecedented storm.

One Too Many.

The British Manufacturers' Association, which was formed a year ago, held a meeting at Cannon Street Hotel last week. What struck us as one of the most singular features of the gathering was the complete silence observed by the speakers concerning other efforts which are on foot to establish a great organisation of British manufacturers. There may have been very good reason for running separate movements up to a point, but, as we stated last week, if the manufacturing interests of the British nation are to deal effectively with the unique position which confronts us all, and are to carry weight with the Government and the public, they should act in union, bringing their great combined influence to bear through one strong representative organisation. Some of the speeches must have terribly bored the majority of those present. The Association has issued a booklet, "Better Times for Working People," for the education of the workers, and it has very definite ideas as to what the Government ought to do to prevent a great German "after-the-war dump." Some of its spokesmen are votaries of co-partnership, which English masters have been so slow to adopt, and which working people through their unions have so often treated with suspicion. The idea of convincing the worker that the interests of Capital are the interests of Labour too, and that both parties should therefore pull hard together, is excellent at any time, but surely for that sort of propaganda one hardly requires a "British Manufacturers' Association." Nor does one want another association to petition the Government to set up a Ministry of Commerce. If the new association was intended to serve the purpose of a sectional body to represent some particular trade, or some particular object, and were to connect up to whatever main body may emerge from the deliberations referred to in our leader of last week, it would be more welcome than it is in setting itself up under so ambitious a title as though it were the only pebble on the beach. One of the speakers, who is connected with the electrical trade, referred to the need that exists for one manufacturers' organisation which should be sufficiently powerful to stand against all opposing forces. One could only imagine that those responsible for the gathering were unaware of the important movements which have been making such substantial progress in recent months. To anybody who has closely followed the course of affairs, the proceedings were not impressive, the speeches were long-winded and unbusinesslike, and certainly many of the audience showed their interest by an early retirement. To be perfectly frank, our own opinion concerning the movement was that it was one too many. While it might fill a useful object if it were to represent particular trades, including leather, it is not needed for the electrical or engineering industries of the country.

THE EFFECT OF THE PRESENCE OF MOISTURE IN GAS COKE FUEL.

By PAKENHAM BEATTY, A.M.I.E.E., and A. F. SMITH.

The figures given in the following notes are based upon the results obtained in every-day practice during the consumption of 10,000 tons of gas-works coke, in the boiler house of a tramway power station in Buenos Aires.

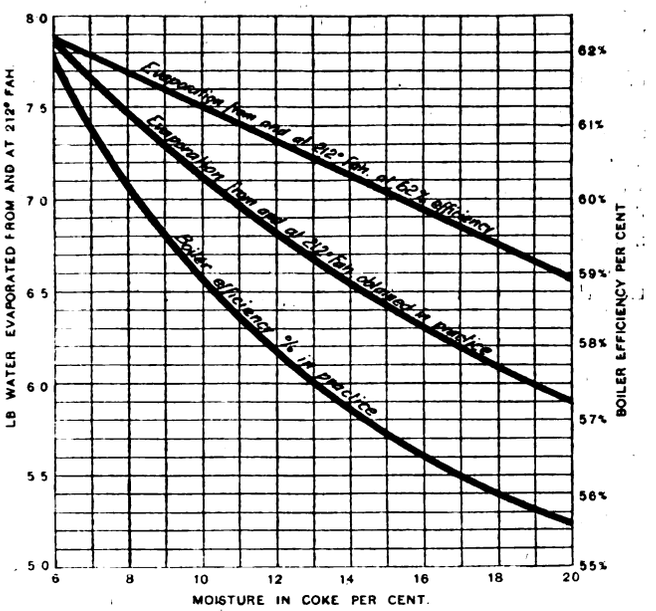
LB WATER EVAPORATED FROM AND AT 212° FAH
BOILER EFFICIENCY PER CENT
MOISTURE IN COKE PER CENT.
Evaporation from and at 212° Fah. at 62% efficiency
Evaporation from and at 212° Fah. obtained in practice
Boiler efficiency % in practice

Fig. 1.

Owing to the large stocks of coal it is usual to carry in Argentina, it was not until perhaps February of 1915 that the rise in the price of Welsh coal, following on the declaration of war by England, made itself felt. During February and March of 1915 Welsh coal, the normal price of which

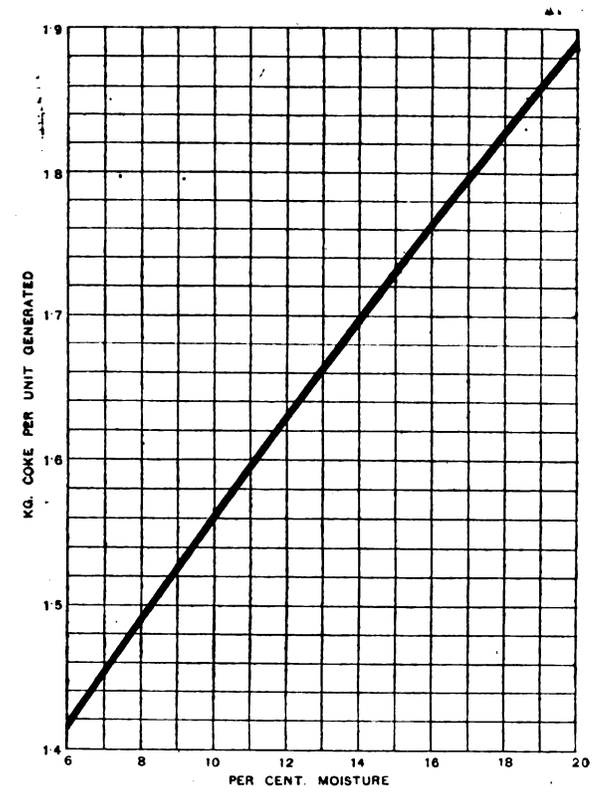

Fig. 2.

is about 33s. per ton c.i.f. Buenos Aires, rose to the unprecedented figure of 73s. per ton.

Only in June of 1915 were first-rate American coals such as Pocahontas, New River, and Georges Creek, obtainable

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at 45s. per ton c.i.f. and, although petroleum is actually found in Argentina and a supply from Mexico has also been available since the commencement of the war, in the case of large installations where the capital required for the necessary modifications and additions to the plant represented a considerable sum of money, difficulty was experienced in making contracts at a convenient price for such a length of time as would warrant the expenditure involved.

Apart from the appreciable amount sold for domestic purposes in Buenos Aires, gas coke is also largely used in lime kilns, but the general trade depression caused by the state of affairs in Europe reduced the consumption of this fuel to such an extent that it was placed within the reach of the power-house engineer.

The generating station mentioned in these notes consists of two separate plants. The first and older section contains five slow-speed horizontal reciprocating engines, coupled to direct-current generators, giving a total output of 4,500 KW., and nine Babcock & Wilcox marine-type hand-fired boilers, varying in size from 49 to 105 sq. ft. of grate area. The total heating surface of the battery of boilers is 24,710 sq. ft., and the total grate area 651 sq. ft.

The annual production in units is about 16,800,000, and the average total steam consumption per unit generated, including that required for all auxiliaries, works out at about 20·94 lb. A consumption per unit generated of 2·74 lb. of Welsh semi-anthracite coal, with a calorific value of about 14,000 B.TH.U. per lb., gives an annual boiler efficiency of about 62·5 per cent. The above figure includes the fuel for banking fires at night, which amounts to approximately 3 per cent. of the total coal used. When coal is employed, a maximum of 22·37 lb. per sq. ft. of grate area per hour is burned, while the average during the 24 hours is 15 lb.

The annual feeder load factor works out to 49 per cent.

The second, or more modern section, of the plant contains two turbo-alternators, each of 1,500-KW. capacity, and four Babcock & Wilcox land-type boilers, each of 76 sq. ft. grate area and 4,020 sq. ft. heating surface, fitted with under-feed mechanical stokers. Economisers are not installed in either boiler house, but exhaust-steam feed-water heaters are used.

Approximately, 10,750,000 units per annum are generated by the turbo-generators, one of which is always running continuously at nearly its normal load. The coal consumption in this case is about 1·975 lb. per unit, the steam consumption 17 lb., and the annual boiler efficiency 70 per cent.

An analysis of a representative sample of the gas coke used, made by Mr. A. Courtenay Luck, F.I.C.S., gives the following results :—

Elementary Analysis. (Sample dried completely at 110° C.)		Other Data.	
Carbon ...	88·15 per cent.	Sulphur ...	1·51 per cent.
Hydrogen ...	·94 ,,	Volatile matter lost on heating away from air	2·96 ,,
Ash	9·81 ,,	Calories per kilogram by Mahler bomb, dry fuel	7,589
Oxygen and nitrogen by difference ...	1·1 ,,	British thermal units	13,660
	100 00 per cent.		

The calorific value obtained by the Mahler bomb agrees fairly closely with the calorific value as calculated by formula from the elementary analysis.

The coke was burned under the marine-type hand-fired boilers, and the average results obtained during the consumption of 10,000 tons are set out below :—

Lb. per KW.-hour	3·675
Lb. of steam per lb. coke as fired	5·7
Lb. of steam per lb. coke from, and at, 212° F. ...	6·72
Boiler efficiency, per cent.	57·6
Ash, per cent.	13·5
Moisture, per cent.	13·0

The ash, on being weighed as taken out of the boiler house, after being quenched, was found to contain 20 per cent. of moisture. The best results obtained were with a large quantity of coke that contained 6 per cent. of moisture, when an average evaporation of 7·9 lb. of steam from, and at, 212° F. per lb. of fuel, was attained during trials extending over a month. After making the necessary deductions for the increased percentage of incombustible matter found in practice, and for the amount of water present, this evaporation corresponds to a boiler efficiency of 62 per cent.

Assuming it were possible to maintain a boiler efficiency of 62 per cent., the curve in fig. 1 was drawn showing the evaporation from, and at, 212° F. to be expected, taking into account both the increased percentage of incombustible matter in comparison with that set out in the analysis and the moisture present in the coke. As a result of subsequent trials, all extending over several days, a second or lower curve was constructed, showing the evaporation obtained in practice with varying percentages of moisture.

The loss of boiler efficiency due to the presence of moisture is also plotted on Curve No. 1. It will be noted that with 20 per cent. of moisture, about 55·6 per cent. efficiency is the highest that could be reached.

The curves in figs. 2 and 3 were plotted in order to show the enormous increase in fuel consumption per KW. produced due to the combined effect of the drop in efficiency and the losses expected from the presence of moisture. From Curve No. 3 it is apparent that a 10 per cent. rise in moisture over the normal, which was taken at 6 per cent., meant a 24 per cent. increase in the fuel bill.

In the case of all the evaporation performances in practice given above, the amount of fuel employed for banking fires is included, or, say, 3·5 per cent. of the total amount used.

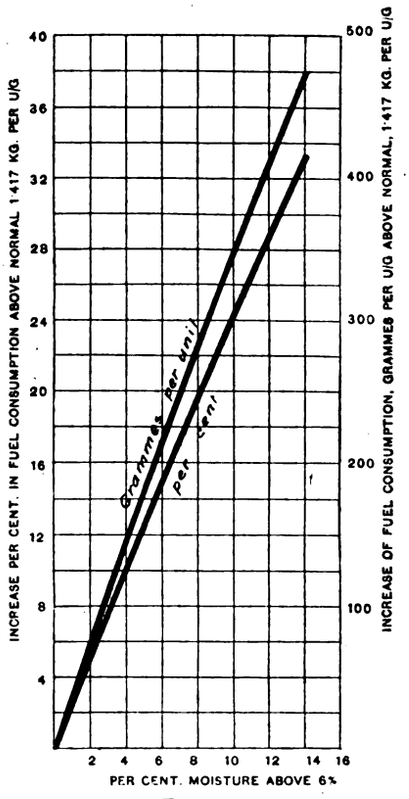
INCREASE PER CENT. IN FUEL CONSUMPTION ABOVE NORMAL 1·417 KG. PER U/G
INCREASE OF FUEL CONSUMPTION, GRAMMES PER U/G ABOVE NORMAL, 1·417 KG. PER U/G
Grammes per unit
per cent
PER CENT. MOISTURE ABOVE 6%

Fig. 3.

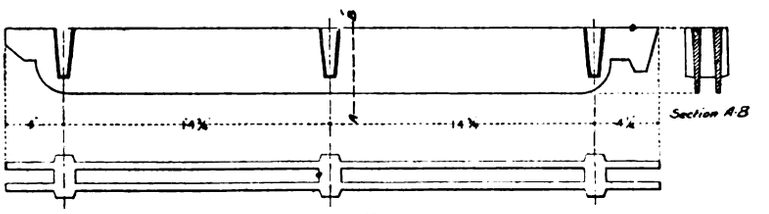

Fig. 4.

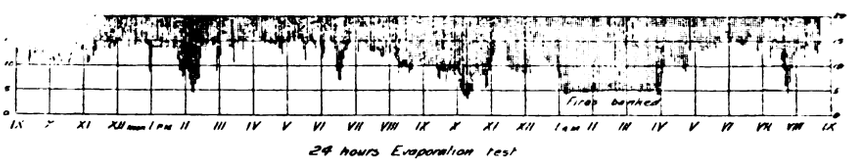

Fig. 5.—Percentage CO_2 Record.

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It should here be mentioned that the climatic conditions under which the fuel was burned were exceedingly unfavourable to such a hygroscopic substance as coke. The extremely high percentage of moisture was found during periods when heavy rains fell and the average relative humidity varied between 80 and 85 per cent. Six per cent. would, however, appear to be the minimum amount of moisture gas coke is likely to contain, even in dry weather. With this amount of moisture, 1 ton of coke occupied 2·45 cubic metres as against 1·1 cubic metres in the case of the Welsh coal usually burned. In other words, 1 ton of coke occupied about 2·25 times more space than Welsh coal, and the extra work entailed was the cause of some complaint from the stokers.

The highest rate at which coke containing 6 per cent. of moisture was burned reached 18 lb. per sq. ft. of grate area per hour, but when the moisture rose to 20 per cent., as much as 23 lb. per sq. ft. of grate area had to be consumed in order to keep pace with the load.

A sketch is given herewith of the type of fire-bar employed (fig. 4). As the ash-pits contain water-troughs, no difficulty was experienced at all in keeping the fire-bars cool. The ash formed was exceedingly troublesome to remove, forming a layer some 1½ in. thick over the fire-bars, that greatly hindered the passage of air through the fire.

In fig. 5 is given a CO_2 record that represents an average diagram. Frequent and careful tests made with an Orsat set only served to confirm the high percentage of CO_2, and failed to detect the slightest trace of CO.

As it was possible to keep the amount of coke burned per sq. ft. of grate area per hour down to about 15 lb., except during the short peak load in the evenings, it was not considered necessary to go to the expense of fitting forced-draught apparatus. All attempts to use coke in the automatic stokers ended in failure, owing to the burning of the bars and other parts of the stokers.

Extended trials made with coke breeze gave the following mediocre results, chiefly due to the extremely high percentage of ash that necessitated frequent supplementary cleaning of the fires by hand, on account of the impossibility of dealing, by means of the usual mechanical cleaning devices fitted, with this unusual quantity of incombustible material.

Lb. breeze per KW.-hour	3·196
Lb. steam per lb. breeze as fired	5·319
Lb. steam per lb. of breeze from, and at, 212° F. ...	6·282
Boiler efficiency, per cent.	55
Ash, per cent.	17
Moisture, per cent.	13

An analysis of the coke breeze is given below :—

Elementary Analysis. (Sample dried completely at 110° C.)			
Carbon	83·1 per cent.	Sulphur ...	1·15 per cent.
Hydrogen ...	1·02 „	Volatile matter lost on heating away from air	2·60 „
Ash	15·2 „	Calories per kilogram by Mahler bomb	7,318
Oxygen and nitrogen by difference ...	0·68 „	B.Th.U. per lb.	13,170
	100·00 per cent.		

The endless difficulties experienced in attempting to obtain the efficient combustion of substances containing as much as 33 per cent. by weight of ash and moisture have not, as indeed might be expected, caused the authors' opinion of coke and coke breeze to be unprintable.

The few pleasant moments spent during the trials, even with the coke breeze, which on one occasion gave as high a boiler efficiency as 58 per cent., when things went well, were sufficient to show what excellent fuels both coke and coke breeze might be under happier conditions.

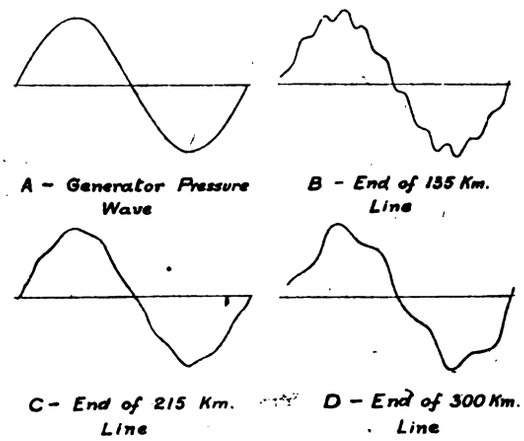
Spain.—La Sociedad Espanola de Industria Electricas is the name of a new undertaking which has lately been started in Madrid (Plaza de Carlos Camboronero), to carry on an electrical engineering business.

Fire.—On Friday morning last, damage to the tune of £2,000 was done by fire at the premises of the Yorkshire Cable Co., Ltd., Old Park Works, Bradford. The testing department and insulating shed were saved, and there will be no stoppage of work as temporary premises will be secured to replace those destroyed.

PRESSURE CURVES OF LARGE HIGH-TENSION NETWORKS.

It is now generally realised that, under suitable conditions, the distributed inductance and capacity of overhead lines may lead to serious pressure rise at the end remote from the charging station. Ordinarily, these phenomena are not apparent at commercial supply frequencies, but they may be set up by the higher harmonics of an impure pressure curve. Modern turbo-generators, with cylindrical rotor and distributed winding, give a practically pure pressure curve, which retains its sinusoidal character at all symmetrical loads; but, even so, quite impure curves may be obtained on long overhead lines fed from turbo-generators. Inductive loads reduce the tendency to such results, but capacity loads increase the tendency, and the use of transformers between generator and line also favours distortion of the pressure curve.

Small though the harmonics be in the pressure curve of a modern turbo-alternator, they are magnified by overhead lines and by step-up transformers feeding the latter. The impurities in the wave are more noticeable on the secondary than on the primary side of the transformers, and increase in amplitude, the greater the length of line to the observation point. As their amplitude increases, the harmonics are apt to cause disturbances on telephone lines, converter flash-over, and other troubles. From an analytical consideration of pressure and current distribution on an open line, it may be shown that the harmonics in the generator pressure



wave are not all magnified by an equal amount in the line. One harmonic is magnified more than the others, and which it is depends on the electrical constants of the line and on its length. The various waves are distributed (in space) along the line according to a cosine function. Full mathematical proof of this and subsequent statements, involving simple, but very cumbersome, equations, is to be found in a recent issue of the *E.T.Z.*, whence these notes are derived.

Suppose that a 50-cycle turbo-alternator is connected to a line which has (per 100 km.) an inductance of 0·15 henry, a capacity of 0·75 mfd., and a resistance of 20 ohms. Calculated curves plotted as above, show marked pressure-wave distortion, despite the purity of the generator wave. The latter is shown at A; and B, C, D, respectively, show the form of the pressure curve at the end of a 135-km., 215-km., and 300-km. line of the above characteristics. In cases B, C, and D respectively, the 11th, 7th and 5th, harmonics are specially magnified. The conditions assumed may be considered somewhat exaggerated, but, on the other hand, the generator wave assumed is of exceptional purity and symmetry, and the resultant distortion depicted does give a fair idea of practical occurrences.

The effective resistance of an A.C. line increases as the frequency becomes higher. This effect is not pronounced for lower harmonics than the 11th in waves of commercial frequency (say, 50 cycles), but it prevents higher harmonics from resonating to any marked degree. It can be shown mathematically that an inductive load connected at the end of an overhead line tends to suppress resonance, and hence prevents individual harmonics from attaining excessive amplitude. On the other hand, a load of high capacity or leading power factor favours resonance of the higher harmonics in the generator wave to an extent dependent on the ratio of the load and line capacities. By combining capacity and inductance in series at the end of the line, to form an oscillating circuit tuned to any particular harmonic, the latter is almost entirely suppressed.

In almost every case in practice, overhead lines are fed through step-up transformers, and the precise effect of the latter as regards pressure distortion depends on their construction and characteristics, but by assuming the simplest possible type of transformer, and making perfectly general assumptions as to electrical characteristics, it is possible to demonstrate mathematically that, even on light load, large transformers may cause pronounced magnification of harmonics in the secondary pressure wave, the natural frequency of such transformers being sometimes as low as 500 cycles per second.

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INDUSTRIAL RESEARCH IN THE U.S.A.

Under the auspices of the Council for the Organisation of British Engineering Industry a lecture on "Industrial Research" was given in the Manchester School of Technology on Tuesday, April 4th, by Mr. A. P. M. Fleming, M.I.E.E. There was an attendance of about 300. The chair was taken by Mr. Chas. Day (Messrs. Mirrlees, Bickerton & Day), who mentioned that at the works in which he was interested a small laboratory was provided in which new ideas were tried and developed before being finally adopted on engines supplied. The laboratory certainly cost something to run and maintain, but it paid for itself in many ways. He thought it a mistake to embody new ideas without first having given them a thorough trial, and he considered the last person to experiment on was a customer.

At the close of the lecture, a vote of thanks was accorded to Mr. Fleming, on the motion of Principal Garnett, of the Manchester School of Technology, who gave an outline of the research work carried on in the School in conjunction with the Manchester Association of Engineers.

The following is an abstract of the lecture:—

An industry depends for progress on a continual influx of new knowledge, and it may be conceived that industrial research embraces all means whereby this new knowledge having application in industry can be obtained.

Industrial research in the United States is mainly accomplished by individual firms, although a good deal is done in the universities and national institutions.

As regards the work of individual firms, during the past ten years there have been very considerable sums spent by the leading manufacturing corporations to provide facilities for scientific investigation. Annual expenditures for this purpose of £25,000, £50,000, and even £100,000 are not uncommon.

Among the important features of the work of many of these private laboratories is the equipment of full-scale manufacturing plant, which enables discoveries in the laboratory to be fully tried out and manufacturing methods perfected, relieving the manufacturing departments from the hampering effects of new developments. Many of the laboratories also are equipped for the manufacture on a commercial scale of some of the commodities developed from their discoveries which are not of a character adapted to production in the manufacturing departments. The laboratory production in such cases is continued until it reaches such dimensions as justify the starting of a separate works. There is a growing tendency in many of the research laboratories to devote more and more attention to investigations in pure science having no immediate commercial object in view, with an appreciation of the fact that almost invariably such investigations result in some industrial application, sometimes resulting in the development of entirely new industries. Prominent examples of this kind are represented by the work of the General Electric Co.'s laboratory, at Schenectady, and the National Electric Lamp Association. In connection with such work, a very broad-minded policy is shown by the publication of the scientific investigations carried out.

It is also noteworthy that these research laboratories serve as very effective advertising means, by inspiring confidence in the minds of purchasers as a result of such visible evidence of scientific working.

There appears to be no doubt that these laboratories have proved financially successful, not only in that they afford the greatest possible assistance to the works with which they are connected in solving manufacturing troubles, developing new materials, methods, tools, and making discoveries which result in new industrial developments, but also in the direct manufacture and sale in many cases of valuable products straight from the laboratory.

A great deal of the research work of the universities is devoted to purely scientific investigations arising in connection with the preparation of degree theses by students, and from work done by the staff in their spare time. Apart from this, however, many investigations directed to the solution of particular manufacturing problems are carried out for private firms, and in a number of cases experiment stations have been arranged, the staffs of which devote all their time, or most of it, to research investigations.

In connection with Columbia University, it is proposed to erect a laboratory specifically devoted to research, the cost of which it is estimated will be of the order of £130,000 for buildings and equipment, and it is expected that an endowment fund, for extension and maintenance, of from £400,000 to £1,000,000 will be required. This proposal appears to be inspired to some extent by the success of the research laboratories associated with the large industrial corporations already referred to, and it is realised that there are many smaller manufacturers who are unable to support individually the burden of such laboratories, but who would be glad to avail themselves of the opportunities which this university research laboratory would afford.

An important feature of the proposal is the intention of devoting means to the collection of all possible information bearing on the industrial problems that are likely to be considered.

The most striking feature of the research work of the universities is this provision of research facilities and the use of a staff of highly-trained scientific men who can devote their whole efforts to scientific investigation without the handicap of a great deal of teaching work as well as of financial anxiety. It is also noticeable that increasing numbers of young men who have taken their bachelor's degree proceed to a doctor's degree, possibly on account of the extended opportunities for employment now presented by the increasing number of research laboratories for men of the highest scientific training.

While there is as yet no national plan of industrial research, there are tendencies in that direction, some of which are directed to linking up the efforts of the universities, the extension of the experiment station scheme to a number of universities and colleges, and the co-ordination of the work of some of the existing laboratories connected with industrial concerns.

The work done in the United States is of considerable value to us in this country in enabling us to shape our own schemes with reference to research. The distinguishing feature of work done in America is that it is mainly in the hands of private companies, and is carried out in order than one company may more effectively compete with another. The development of the internal resources of the country has occupied most attention, and little work has been done with a view to encouraging export trade. In this country our export trade is of the first importance, and it is here that the country most feels the pinch of German competition. The opportunity, therefore, arises to take the greatest possible advantage of laxity in the past and, at the same time, to take steps to conserve our overseas trade.

This can only effectively be done by co-operating and pooling our scientific resources, which have hitherto lacked organisation. Doubtless each manufacturer will in future provide himself with a small laboratory where manufacturing difficulties peculiar to his own works can be solved, but the big advances in the future can only come by concentrating advanced research in a large central institution. The materials, tools, and processes which are common to any industry would be considered in such an institution and efforts devoted to improving them for the common benefit of the industry. Processes which are the monopoly of any individual firm would have to be left out of such a scheme. Differences of factory organisation and management and methods of distribution would still enable manufacturers to compete amongst themselves, but the whole industry would be lifted to a higher plane through discoveries arising from work done at a research institution, which would enable foreign competition to be met most successfully.

Such an institution would comprise a laboratory for each of the great industries housed in a large central building. Much of the work done would be along lines of pure science investigation so as to ensure priority of new applications in industry. Patents would be taken out on behalf of the Government, and manufacturers in this country or the colonies would be licensed to manufacture at a nominal charge. Work would be done without the overlapping which inevitably occurs among a number of different institutions, and which results in great lack of economy, and administrative expenses would be kept to a minimum.

The above scheme presents advantages over any proposal to distribute the research work among the universities.

English people seem to possess a certain industrial genius which assured them priority in the industrial world in the past, and the records of our inventors and discoverers lead to the belief that what has happened in the past may with suitable organisation be repeated in the future.

RÖNTGEN SOCIETY.

At the meeting of the Röntgen Society, on April 4th, Mr. B. H. Morphy and Mr. S. R. Mullard read a paper on the subject of the enclosed tungsten arc as a source of ultra-violet light. They have adapted the new "Pointolite" lamp of the Ediswan laboratories to a therapeutic purpose by enclosing it in a quartz bulb, so that the ultra-violet output is very largely increased. The open tungsten arc had a spectrum which extended further into the shorter wave lengths than did the enclosed arc, but even if these very short wave lengths were of therapeutic value, the authors contended that the sputtering of the open arc and its constant need of attention militated against its value in hospital work. The enclosed arc gave off a large quantity of ozone, owing to the ultra-violet radiation, thereby showing that its value in this direction must be considerable. If the lamp was over-run, the rays obtained extended much further into the ultra-violet, but this practice, of course, diminished the life of the lamp.

Major Wilson, of the Canadian Medical Service, said that ultra-violet light was proving of great use in the treatment of wounds at the base hospitals, and the French were using it extensively. He had himself made some experiments with a view to obtaining ultra-violet light of much shorter wavelength than hitherto by striking an arc in tungsten vapour, or using a tungsten base as one electrode, and a carbon as the other.

Mr. E. Schall, B.Sc., read a paper on some experiments he had been conducting with a Coolidge tube. He said that he thought it possible that X-rays might be discovered having a quality so "hard" as to be capable of passing through sub-

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stances, whether photographic emulsions or the tissues of the human body, while producing a very small effect indeed. He believed that the explanation of some curious phenomena he had observed in the case of the Coolidge tube was that the radiation from this tube was heterogeneous, and that the more current that was passed through it, the greater was the proportion of exceedingly hard radiation which could not be detected, and which approximated to the gamma radiation of radium in hardness.

Mr. P. J. NEATE, one of the Governors of the Cancer Hospital, demonstrated a chronograph which he had constructed to work with the electroscope, in response to a suggestion by the hospital physicist that a chronograph substitute for measuring the duration of the electroscope readings would be very useful. The prime mover was a rotating gramophone cylinder, and by means of opposing magnets, armatures were oscillated in such a manner that a pen in connection with them was made to record a line of jerks corresponding to brief intervals of time.

At the same meeting the Society passed a resolution expressing concern at the present conditions of X-ray examination in naval and military hospitals, in view of the number of installations, some of which were believed to be defective in their means of protection, in the hands of inexperienced X-ray workers. The suggestion was made to the authorities that every installation, both at home and abroad, should be inspected by experienced radiologists.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Engineer in the Tropics.

I have to thank "Koie-Hai" in your issue of March 31st for his criticism of my article of March 17th.

His severe strictures upon my suggestion that corrosive sublimate should be carried seem to be the result of a misapprehension on his part. I thought I was quite clear in stating that corrosive sublimate was a *first-aid* remedy. It is not intended for a regular dressing.

During the time I spent up the Amazon River I was responsible for about 500 men; amongst such a number, accidents were of daily occurrence. When a man was brought into the First-Aid Station his wounds were completely washed out with a 5 per cent. solution of corrosive sublimate, thereby rendering the wounds completely aseptic, after which the usual dressings were applied.

Hundreds of cases were treated by this method, and, so far as I can recollect, we never had a case of septic poison in any wound so treated.

In view of this experience, I am still convinced that corrosive sublimate should be carried amongst the *first-aid* remedies in a tropical country.

Geo. R. Archdeacon.

Blackpool, *April 4th*, 1916.

Australia and the Metric System.

In my country, Australia, we have on our Statute Book a law which only requires a Royal Proclamation to banish all weights and measures outside of the metric. We have held our hands till now, because we feared to damage the trade which we bring to the Mother Country. If we despaired of your adopting the metric system, we should put our law into operation, for we cannot wait for ever. In the near future, we hope to see every young man studying science and, necessarily, learning and using the metric system. Shall we, in deference to your inertia, condemn those young men to learn, in addition, every remnant inherited from bygone attempts to establish a perfect system of weights and measures? Let us give credit to the more mathematical ancients for trying homogeneous systems, such as the Chaldean, with a basis of 60: but why take thence our time and angle divisions, from another our binary divisions of the gallon and the inch, from elsewhere a duodecimal division of the shilling, and of one breed of ounces?

One cannot help feeling that the greatest enemy of progress is the one who, like "Cantuck," has had a scientific training and advocates metric reform, but points with trembling finger to the dangers lurking in every change. Even the misfit of the ounce with the Canadian cent worries him, although it would (at 16 to the lb.) fit no better with the 12 pennies in the shilling.

Edward C. Barton,
Secretary, Queensland Decimal Association.

London, S.W., *April 10th*, 1916.

[We hope the Commonwealth will continue to exercise pressure upon the Imperial Government, with a view to hastening the advent of the reform which is so long overdue.—EDS. ELEC. REV.]

Cause of Flicker.

There seems little doubt that bad valve setting is the cause of flicker in many cases of relatively small steam direct-driven sets.

I am familiar with the very small sets which, placed beside the driver on his seat, provide the electric lighting on the steam omnibuses of the National Steam Car Co., running on the London streets.

It was the practice in setting the valves of these little engines to adjust till flicker disappeared, and the method was found simple and satisfactory, being much simpler than setting to measurements.

Charles H. Wright.

Glasgow, *April 4th*, 1916.

I have been interested in the correspondence on the above subject, as a very remarkable case of lights flickering came under my notice some years ago. The firm I was with supplied a generating set to a central station for town lighting, the set being the largest in the station at that time, and consisting of a high-speed steam engine direct coupled to two direct-current generators in line, one generator being connected across the middle and one outer, and the other across the middle and the other outer. The set thus formed a balancing generator set. Whenever this set was put on the bus-bars the lights flickered all over the town, which was of fair size. Although having previously had nothing to do with the design or manufacture of the set, I was eventually sent down to endeavour to locate the trouble. I went very carefully into the whole matter, and found that every part of the shaft and armature ran perfectly true, and all electrical details appeared to be quite all right on both machines. Now, there was a bearing between the two generators, and, of course, another bearing on the end spindle of the generator remote from the engine; there was a coupling between the two generator armatures, a spare armature had to be supplied, and all armatures had to be interchangeable. Thus, the outer bearing and the bearing between the two machines had to be the same size. Unfortunately, both bearings were made to the standard of the outer bearing for that size of armature. After my tests, I came to the conclusion that the journal of the shaft in the bearing between the two machines was too small in diameter, and was causing a whip. As this meant three new shafts, two new bearings, and altogether an expense of some hundreds of pounds, it was not accepted at once. However, eventually the alteration was carried out, and no further trouble was experienced. Thus, I would suggest that your correspondent should see if his shaft is not small somewhere between his engine and his generator armature.

Richard C. Dieppe.

London, S.E., *April 7th*, 1916.

The Council of the I.E.E.

I am pleased to see that your journal has taken exception to the nominations of what is, to all intents, a self-elected Council of the Institution, and rightly, when one considers that the country is passing through the most critical period in its history, and as far as the electrical industry is concerned, a crisis which, if not faced now, will mean after the war that English electrical houses will have to face competition seriously handicapped by the inroads which war has made. At such a time it is necessary that the Council of the Institution should have included on it men of *strong British* sentiments, whose one intention should be *Britain* for the *British* and a closed door to the enemy, with all his wares and hidden interests. It may be said that the Council of the Institution is not concerned with the commercial future of the electrical industry any more than it was in respect of excluding members of alien enemy origin, but it has been by popular demands very reluctantly forced to take steps towards dealing with such members, and there is no reason but to believe that equally dilatory action would be taken in regard to English commercial interests. It, therefore, behoves all members to see that this election is not as in previous years, but that other members are nominated against the Council's nominations and every endeavour made to elect them.

P. M. A.

WAR ITEMS.

Sports Outfits Wanted for the Front.—We have had a call from Corporal Watts, whose letter on "Wireless Wiring at the Front" appeared in our issue of March 3rd, page 271. He asks us to appeal to any of our readers who may not be using their sports outfits, or parts thereof, this year to send them for the Mechanical Transport Section at the Front. Cricket bats, stumps, and anything suitable for outdoor sport will be most welcome to aid in whiling away the half-holidays while waiting for the Huns. They should be addressed thus: Corpl. A. E. Watts, 5th A.S.P., B.E.F.

Glasgow and Enemy Aliens.—The "Times" says that a petition has been extensively signed in Glasgow calling on the Lord Provost to convene a meeting to consider the whole question of alien enemies being allowed to reside and trade in the city and whether alien professors and teachers should be allowed to occupy positions of profit.

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Exemption Applications.—At Ilkley the engineer of the Ilkley Electricity Works (Mr. Sidney Bell) applied for a month's postponement in respect of his switchboard attendant. He said that the attendant was really engaged in a reserved occupation and would have been in order in applying for total exemption, but he only desired a month's postponement. The application was granted.

At Burnley Tribunal, last week, an electrician made application for his motor repairer and armature winder. The Mayor: It will be easy to have this work sent away?—Not at present. We are doing work for firms doing Government work.—Not assented to.

At Berwick-on-Tweed, on April 5th, the local electric light company appealed for Mr. R. Hamilton, accountant, of Tweedmouth, whose services were deemed indispensable. It was stated that he had been with the company for 16 years, and it was claimed that he would be of more use to the country if he was allowed to remain. Capt. Nicholls (Military representative): He receives two months' clear notice before joining. He comes under the group known as "Britain's last hope," and he is kept at work till everybody is called up. Six months' exemption was allowed on condition that he remains in his present employment.

At Southend-on-Sea, on April 3rd, exemption until June 1st was allowed Mr. W. C. Smith, chief electrical engineer to the Kursaal Estates, Ltd.

At Guildford, Sergt.-Major E. J. Nunn, electrical engineer, who is in the 5th Queen's Regiment, appealed for Mr. C. G. Howard, works manager, and Mr. H. O'Connor, electrician. He said that seven employés had enlisted, leaving only the two applied for. If the request was refused he would have to take his own discharge at the end of the month in order to look after the business. On Mr. Nunn undertaking to re-engage for general service, Mr. Howard was granted absolute exemption, and Mr. O'Connor was given three months, with leave to appeal again.

At Walton-on-Thames, Mr. Scott, electrical engineer with Mr. W. H. Davies, of Cobham, was granted two months' exemption on the recommendation of the military representative.

Mr. S. Terry, electrical engineer, Canterbury, appealed to the tribunal, on April 3rd, for exemption on the ground that he was at present best serving the national interests. He said it had taken him eight years to build up the business, and he was carrying out important electrical work in connection with two local munition works. If he was called up the business would have to be closed. He was allowed three months.

Dudley tribunal has granted two months' exemption to an electrical engineer responsible for the maintenance and repair of electrical plants at six works, all engaged on Government work.

Clacton-on-Sea tribunal has granted conditional exemption, acquiesced in by the military representative, to the electrical engineer of the U.D.C.

Before the Surrey County Appeal Court, Mr. J. H. Batchelor, accountant to Edmundson's Electricity Corporation, of Dorking, appealed against the decision of the local tribunal refusing exemption, but the appeal was dismissed.

The Rochdale Tribunal last week granted conditional exemption to Harry Sprigg, an electric wireman employed by Mr. G. L. Adamson.

At Hurst (Lancs.) an appeal under the Military Service Act was heard, the appellant, J. H. Brownson (20), electrical fitter, stating that he had tried to join the Colours, on three occasions, but had been refused because he was wearing a munitions badge. He had this badge on when he appeared before the Tribunal, and the latter decided that he was exempt, and need not have appealed.

Middleton Tribunal granted conditional exemption to a pavior and platelayer employed by the Middleton Electric Traction Co., and appealed for by them on the ground that he was solely engaged in the maintenance of tramway track and was "reserved."

At Salford, last week, an electric wireman engaged on installations at controlled factories received exemption until June 7th, and he told the Tribunal that if the country was badly placed he would be in the Army by then.—Also at Salford, an electrical engineer appealed for exemption and stated that his firm were engaged on making fittings for sea mines. The members of the firm had invested all their savings in the business and in getting the machinery together. Exemption was granted conditional on his continuing in his present employment.

Exemption to the end of May was granted at Warrington to an electrician at a local theatre.

At Stretford a foreman electrician employed by a local engineering firm stated that he had been passed for home service, but he had stiff hands. The appeal was disallowed.

At the Lincoln Tribunal application was made for an electrician who is working at a flour mill. He was only 23 years of age, however, and the chairman said he could not think the man was indispensable.—Claim disallowed.

At the Oxford Tribunal, the City of Oxford Electric Tramway Co. applied for absolute exemption for its chief engineer, electrician, a fitter's mate and a unit adjuster, and a number of motor 'bus drivers, on the grounds that their present employment was in the national interests, and that the men were in a certified occupation. The Court granted conditional exemption for the four cases named, theirs being certified occupations, but the 13 other cases were adjourned for two months.

Before the Berks Appeal Court, on April 4th, the Military appealed against six months' exemption allowed by the local tribunal to six employés at the Maidenhead Corporation Electricity Works. The exemption was reduced until June 1st, with leave to renew the appeal.

At Old Hill, a Brierley Hill firm of electrical engineers applied for exemption for an electrical engineer on their staff. For the firm it was stated that they were employed at several munition works, and if the man appealed for went they could not assist these works in case of breakdown. The tribunal granted a month for the firm to get the appellant badged.

At Farnham, on April 4th, Mr. H. J. Reed, electrical engineer, in charge of the mains of the Farnham Electricity Co., applied for exemption. He said that he was in partnership with Mr. Kimber, and they were under contract to repair, lay, and renew the mains of the company, and had been asked to do similar work for the Farnborough Electrical Works. Three months were allowed, with leave to appeal again.

Mr. W. Jackson, chief assistant engineer at the Llandudno Electricity Works, has been exempted so long as he remains in his present employment.

French Works in Enemy Occupation.—A year ago it was impossible for the Société d'Electricité et Gaz du Nord to submit full accounts for the year ended with June, 1914, owing to the company's electricity and gas works being situated in the districts invaded by the enemy and the inability to obtain the figures for the final three months of the financial year. The same state of affairs still prevails for that year and also for the succeeding twelve months. Nevertheless the directors have endeavoured to secure information relating to the condition of the works during the period of enemy occupation, but it has not been possible to correspond advantageously with those members of the staff who remained in the invaded territory. Information derived from Government sources, however, shows that the works and installations have not suffered serious damage since the non-military personnel is engaged on the supply of current to consumers under the control of the Germans. The conditions under which the supply of coal and other materials is effected, as well as the regulations in regard to the collection of accounts, are quite unknown to the company. The situation in respect of the interest possessed in the Société de Gaz et d'Electricité du Hainaut, Belgium, and the Société d'Electricité, of the district of Valenciennes-Anzin, has also undergone no change. These companies are circumstanced similarly to the Electricité et Gaz du Nord, as the war has interrupted normal working, but there is reason for assuming that the German occupation has not stopped the operation of the works.

The Supply of Tramway Rails.—In the March issue of the "Journal" of the Tramways and Light Railways Association it is stated that negotiations are taking place between the special committee of the Association and the rail manufacturers with a view to securing a supply of rails during the next twelve months. "Members have been asked to supply the secretary with the minimum quantity of rails and fishplates required by them for repairs which are absolutely necessary for keeping their undertakings going. The manufacturers have now been asked to quote prices at which they would be able to deliver these, and members will in due course be advised thereof. It will then be necessary to apply to the Minister of Munitions for permission to roll these rails, and to grant facilities for their delivery to the various tramways requiring them. It is hoped that a satisfactory result may be obtained." According to the arrangement made with the manufacturers last November, the price of steel tires for the quarter ending July next will be the same as for the past quarter.

Warsaw Telephones.—With the occupation of Warsaw by the Germans, the authorities forbade private persons to use the telephone system. An exception was made in favour only of members of the Citizens' Committee and magistrates. But considerable losses resulted from this order, not only to the Polish citizens, but to the private companies of neutral powers operating in Warsaw. Amongst those that suffered considerably may be mentioned the Swedish Sedergren Company, the director of which is the Swedish Consul. This company applied to the authorities to have the prohibition removed. The result of this application was, says the "Gazeta Polska," that the authorities authorised the use of telephone lines to stores, trading and commercial firms, and to a small number of reliable people. The remaining subscribers had to continue without the use of the telephones, which had to be retained in the control of the military authorities.

To be Wound Up.—Orders have been made by the Board of Trade requiring a number of other companies to be wound up (the total is now 100), including the following:—Berkefeld Filter Co., Ltd., 121, Oxford Street, London, W., filter and pump manufacturers; controller, G. M. Robinson, 3, Raymond Buildings, Gray's Inn, London, W.C. Maschinenfabrik Augsburg-Nurnberg A.G., Caxton House, S.W., manufacturers of gas engines, &c.; controller, B. E. Mayhew, Alderman's House, London, E.C.

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French Economic Expansion.—The Paris correspondent of the "Daily Telegraph" states that a Commission was appointed recently by the National Association for Economic Expansion to examine the question of cartels and commercial "ententes." This body was composed of well-known politicians, economists, manufacturers, merchants, and agriculturists. The other day the chairman of the first meeting of the Commission, M. Guisthau, formerly Minister of Commerce, pointed out the difficult position in which French manufacturers are placed in respect of foreign competition by existing legislation, notably a clause of the penal code, which places French manufacturers at great disadvantage by depriving them of facilities enjoyed by foreign competitors in the liberty of making "ententes." The Commission is divided into two sections, economic and judicial, and these sections are now studying the question with a view to making considered proposals to be submitted to Parliament.

The Petrograd Lighting Co. of 1886.—A communication reported to have been forwarded by the Russian Prime Minister to the Moscow City Council states that the question of the liquidation of the Petrograd Electric Lighting Co. of 1886 is not yet ripe for discussion. The chairman of the company, Lieut.-General Swentorschitzky, is of the same opinion. During the war the company has merely remitted 166,409 roubles abroad, exclusively to allied and neutral countries, of which 53,000 roubles refer to England. The dividend declared for 1914 has not been paid. The assets of the company amount to about 60,000,000 roubles. If the Moscow City Council desire to take over the company's local works, the town must first ascertain whether it has now at disposal the necessary capital of 2,800,000 roubles.

St. Helens Corporation and its Contracts.—Considerable discussion took place at a meeting of the St. Helens T.C. on April 5th respecting the position of a firm manufacturing accumulators, from whom it was proposed to purchase plates. It was stated that the works were "controlled," and that contracts were being executed for the Government. A member of the Council objected to the firm having the order until the Electricity Committee had definitely ascertained that no British firm could deal with it. Sir Joseph Beecham said the committee had already ascertained this, and if the present offer was not accepted they would have to pay £600 extra. The Council rejected a proposal to refer the minute back to the committee.

Manchester Corporation Contracts.—At the meeting of the Manchester City Council on April 5th attention was called by Mr. McLachlan to tenders which the Tramways Committee had accepted for certain electric lamps, and it was asked whether the standing orders were complied with requiring that two-thirds of the capital of the companies tendering must be British controlled. He submitted that parts of the lamps in the tenders were monopolised by an article with a German influence, and he pleaded for fair play for the British manufacturer. Alderman Bowes assured the members that so far as they were aware the firms whose tenders had been accepted were British. If there was any doubt about it he would take back the minute. It was resolved that the minute relating to the tenders be referred back.

Lighting Prosecutions.—In a prosecution at Bolton, on April 6th, under the Lighting Order, one of the magistrates said he had every sympathy with the defendant because the Corporation should apply the law to itself before proceeding against ratepayers. The tramcars were setting a bad example in regard to lights, and these should be dealt with before the law was applied to citizens.

At Bury County Police Court on April 6th, the Lancashire E.P. Co., of Ainsworth, were summoned for a breach of the lighting restriction regulations. It was stated that the place complained of was a sub-station. A fine of 20s. was imposed.

Air-Raid Fatality.—At an inquest in a North-East Coast town upon the body of a local electrician it was stated that he had escorted a young lady home and was returning when the Zeppelin bombardment commenced. He was blown through a plate-glass window, and was found in the shop some hours later by a policeman. He was terribly injured and succumbed in the Infirmary. The jury returned a verdict of death from peritonitis, set up by injuries sustained through the explosion of a bomb thrown from a hostile air-ship.

Trading with the Enemy.—The "London Gazette" for April 7th contains additional lists of persons or bodies of persons with whom dealings are prohibited, in the Netherlands, Netherland East Indies, Portuguese East Africa, Morocco and Portuguese East Africa, also some amendments to earlier lists.

Not for War Service.—The Ministry of Munitions has declined to allow Dick, Kerr and Co., Ltd., to deliver to the Reading Town Council six motors for tramcars, on the ground that the motors are not needed for cars used exclusively for carrying munition workers. The cars were ordered last August.

Exports to China.—The "London Gazette" for April 11th contains a further list of persons and bodies of persons to whom articles to be exported to China may be consigned.

Municipal Corporations and Enemy Firms.—Other municipal bodies which have decided to give support to the action of the Manchester Corporation in adopting standing orders prohibiting trading with persons or firms of Austrian or German nationality or composition, include Crewe and Southport. The Nelson Corporation has decided to leave the matter alone. The Bury Town Council, after a lengthy discussion on April 6th, decided to take a similar course, an amendment that they should support the Manchester resolution being defeated by 17 votes to 15, two members of the Council remaining neutral.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Simplex Lanterns.

We illustrate herewith two of the latest patterns of Simplex fittings for industrial lighting with "half-watt" lamps. In these designs the æsthetic as well as the utilitarian aspects of the question have been studied, the glassware has been specially chosen, and provision has been made for using lamps of a wide range of wattage.

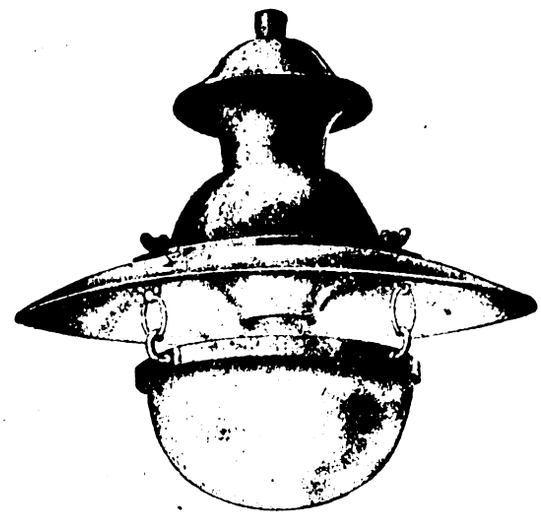

FIG. 1.—SIMPLEX SEMI-INDIRECT FITTING.

Fig. 1 shows a fitting for semi-indirect lighting, 20 in. in diameter × 20 in. high, for lighting large areas such as public halls, railway stations, &c., with lamps up to 1,000 watts.

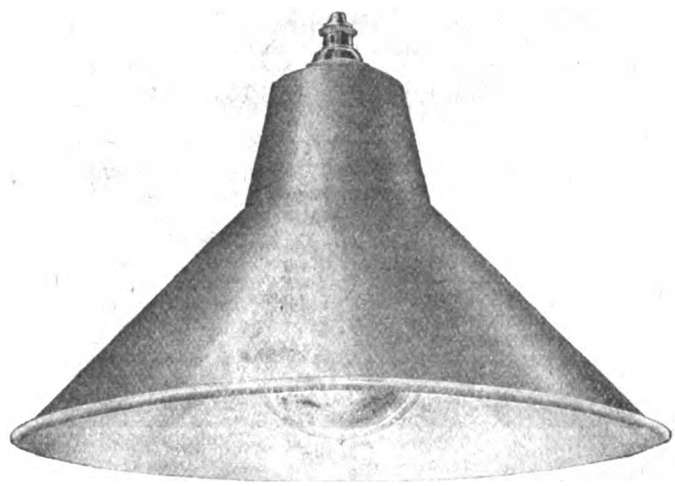

FIG. 2.—SIMPLEX CONCENTRATING REFLECTOR.

Fig. 2 shows a reflector for workshop and office lighting, taking ordinary tungsten lamps up to 50 watts, and half-watt lamps up to 100 watts. A variety of other designs is available, including a number of anti-Zeppelin reflectors.

Safety Device for Electric Motor Vehicles.

Particular interest attaches to a safety device for electric motor vehicles, which has recently been worked out in the mechanical engineering department of the Eastman Kodak Co., the well-known photographic apparatus concern, of Rochester, N.Y., U.S.A., in that no patent has been taken out for it, the designers having commendably decided not only to make it known as widely as possible, but to couple with any publicity regarding it, the announcement that any user or builder of electric motor vehicles is at liberty to adopt the idea.

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Like many other concerns in the United States, the Kodak Co. is a large user of electric delivery vehicles; it has also, in the interests of its many employés, a Department of Safety and Welfare, of which Mr. H. E. Akerly is the engineer. It has been found that despite the care exercised by trained drivers, it occasionally happens that when the vehicles are stopped by switching off the current, the speed control lever is not always at the same time brought back to the neutral position, with the result that, overlooking this fact, the car bounds away unexpectedly when the current is again switched on, with the risk of causing both physical injury and material damage, and even giving rise to fatal accident. It was occasional experiences of this kind that led the Department of Safety and Welfare to introduce on all the Kodak Co.'s fleet of electromobiles the safety device illustrated herewith, and by means of which it has been rendered impossible for a driver to close the main switch when the controller is off the neutral position.

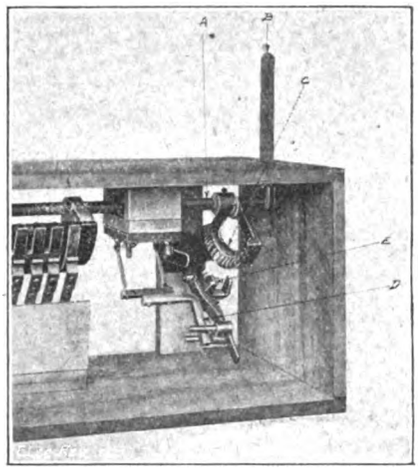

Fig. 3.—Controller in Neutral and Current Switch in Off Position.

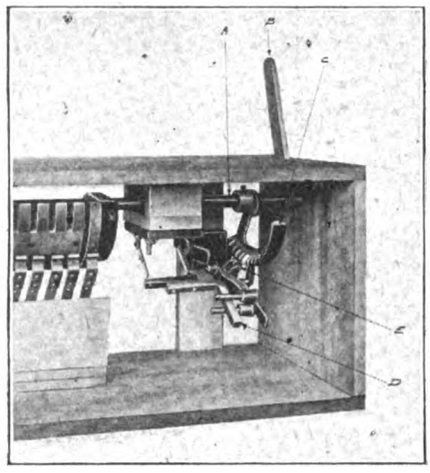

Fig. 4.—Controller in a Speed Position; Current Switch Blocked.

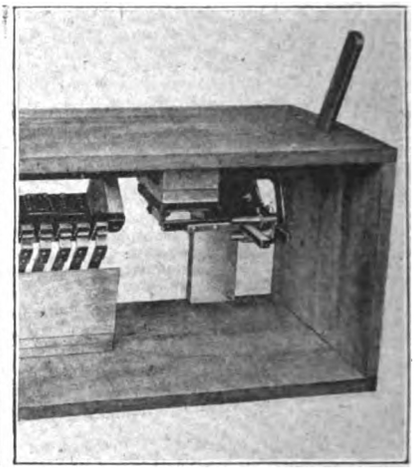

Fig. 5.—Switch properly Closed; Controller Moved into Speed Position.

Figs. 3, 4 and 5 show, in different positions, one of the devices mounted in a box similar to a driver's seat in the rough, the photographs being taken from the front. The driver sits at the left side of the box—that is, at the right of the picture—and operates the controller B, with his left hand. The rheostat selector shaft A, to which the controller B is attached, also carries a sector C, which prevents the main switch being closed except when the controller and all the selectors are at the neutral point. The switch handle, which is connected with a lever D, is also provided with a pawl E, which, to fully close the switch, must first pass through the slot in the sector. Should the controller be in any other position than neutral, the pawl and slot no longer coincide, so preventing the switch being closed. The arrangement does not prevent the current from being switched off at any position, as, the pawl being held forward by a pressure spring, the switch lever can be dropped at any moment, and independently of the controller.

The arrangement, which is quite simple and inexpensive, should be the means of preventing many an accident, especially having regard to the fact, mentioned above, that it can be freely adopted by any user or maker of electric motor vehicles.

Austin Field-Workshop Electric Generating Plant.

In a recent issue we briefly described the compact little electricity generating set which the Austin Motor Co., Ltd., of Northfield, Birmingham, have constructed in large numbers for supplying current for X-ray apparatus in travelling operating theatres, while this week we are able to illustrate a plant they have recently designed for the special purpose of generating current for electric lighting and power purposes for field workshops.

The set consists of one of the standard-type Austin engines, with four separate cylinders coupled direct to an 18-kw. generator. The engine, which is provided with a governor in order to secure a constant speed, is fitted with magneto ignition, and is adapted to work with either petrol or paraffin; the former is used on starting up, and paraffin when the engine becomes warm, the heat of the exhaust manifold being utilised by means of a "muff" in conjunction with the gas admission pipe, to assist in the vaporisation of the heavy oil. An interesting feature of the plant is the method of cooling the cylinders; in place of the large tank of water usually employed for this purpose in stationary engines, an ordinary motor-car type radiator is employed, this being mounted on a separate bedplate and fitted with an enclosed fan driven by a small electric motor in order to maintain a strong current of cool air through the tubes of the radiator; flexible armoured hose is used to conduct the water from the engine cylinder to the radiator and *vice versa*, the circulation being assisted by means of a small pump. As will be seen in fig. 6, the set practically comprises four units—the engine and dynamo, the radiator and fan, and the paraffin and petrol tanks, the latter being mounted on stands in order to give the necessary flow of the liquid fuel to the carburetter, an arrangement which enables the plant to be quickly set up in any desired position.

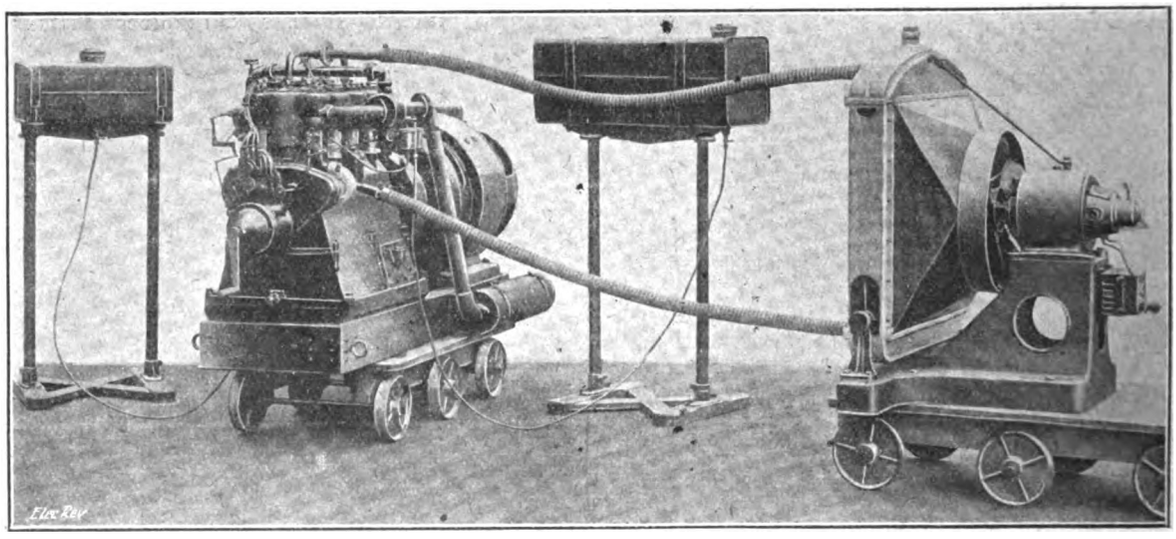

Fig. 6.—Austin Field-Workshop Electric Generating Plant.

Rochdale.—Having regard to the abnormal conditions of working and the rapid increase of the requirements of existing consumers, the Electricity Committee has decided that it cannot recommend the connection of any further large consumers at present. Mr. S. L. Pearce is to report upon the provision at the existing works to meet the increasing demand for energy, and to advise as to the charges for the supply of electricity for power purposes.

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LEGAL.

Krupp's Patents for Magnetic Separators.

In the Patents Court, on Friday last, before the Controller, Mr. Temple Franks, and the Deputy Controller, Sir Cornelius Dalton, the Rapid Magnetting Machine Co., Ltd., applied for a licence to use three of Krupp's patents for a magnetic separator for treating ores. The patents are Nos. 14,082, of 1908, and 29,230, of 1911, in the name of Georg Ullrich, and 4,595, of 1913, in the name of the Fried. Krupp Aktiengesellschaft Grusonwerk.

The patents cover a device for extracting from amid the material in which it is found wolfram, the ore from which tungsten is derived. Wolfram is mined largely in the Cornish mines in combination with tin, and was at one time regarded merely as an impurity presenting considerable trouble to tin smelters. The material being feebly magnetic is susceptible of high intensity magnetic treatment through an apparatus to which the patents apply.

Mr. Hunter Gray appeared for the applicants; Sir George Croydon Marks, M.P., for Messrs. Edgar Allen & Co., Sheffield, who opposed the application, and Mr. Rushen, of the firm of Messrs. Haseltine, Lake & Co., for the patentees.

Mr. Hunter Gray said he supposed Messrs. Edgar Allen & Co. also proposed applying for these patents.

Sir George intimated that he intended applying for a dozen patents in connection with this machine at a future date, and he did not know how the Rapid Magnetting Machine Co. thought they could get on with only three. They were already manufacturing to the order of the Government.

Mr. Gray went on to say that the applicants were incorporated in 1903, a British company with British capital, and were the only firm in the British Empire that specialised in magnetic separators. The principle of the machine applied for was that of a number of magnet poles placed in a ring over which rotated a disk-shaped magnetisable body. The electromagnets below, with attached pole-pieces, were excited by coils, and a rotating shaft, to which the upper ring or disk-shaped armature was attached, ran through the centre of the circular iron body which carried the magnets. Between the magnets and the armature rotating above them, the material, from which the metal was to be drawn, was fed in from a hopper. Round the under side of the revolving piece went concentric magnetisable, axially-adjustable rings, wedge-shaped below, at graduated distances from the magnets. The outermost ring-edge was the furthest away from the horizontal pole surfaces, and therefore produced the weakest zone in the magnetic field. This attracted particles of the highest permeability, whereas the inner ring-edge was nearest the pole surfaces, produced the strongest zone, and consequently attracted substances of lower permeability. Thus the material was graded. Midway between the magnets, the attracted particles fell off the rings, the place of minimum magnetic intensity having been reached, and were carried away in different directions in their separated and graded form.

In the 1911 patent the armature-rings, as they were called, were fixed and the field below was fixed, and there was a curious zig-zag-shaped trough running from the centre, through which the ore travelled. It was this trough now that revolved. The result was that the ore did not "stick," but it was carried away equally in graded sizes. It was an adjustment of the same principle and an improvement, and it was called the dry treatment. There was a further modification, known as the wet treatment, where water was played upon the points of the wedge-shaped rings, to drive off the ore as it got out of the field.

Sir George: Mr. Thompson, who will give evidence directly, has written a letter, which has appeared in the technical journals, casting doubt on the special value of this machine; why, then, does he come here and ask you to give him a licence to make it?

Mr. Gray: Because the public want it—misguidedly and foolishly they want it—and his firm have more experience than any other for making and selling it. They suggest the usual royalty of 5 per cent. on the selling price, and will give an undertaking that the price at which they sell shall be, at most, not more than the price charged by the patentees before the war.

Mr. H. Huband Thompson, the applicants' managing director, giving evidence, said magnetic separators had been the exclusive business of the Rapid Magnetting Machine Co., Ltd. Sir George Marks was wrong if he suggested that he ridiculed the German machine.

Sir George Marks: If Messrs. Edgar Allen & Co. may have a licence for a 5 per cent. royalty, too, that will simplify matters considerably. We are prepared to develop the sale.

The Controller said that as far as he was concerned both applicant firms should have a licence.

Mr. Thompson said that it was an extraordinary thing that the Government had not a British magnetic separator at the Imperial College of Science at South Kensington.

The Controller: The old story one hears here from time to time—no trouble taken by the British manufacturers to push their inventions.

Mr. Rushen, on behalf of the patentees, desired an adjournment to bring into the Court Mr. Walter Sully, whose wife's daughter was the inventor Ullrich's wife, to say he had practically concluded arrangements, when the war broke out, for erecting a manufactory for the supply of these machines in this country. He was to have paid a royalty of 30 per cent.

The Controller said he thought the application satisfactory. The only question was the royalty, and he should hear more about that next week. In the public interest he thought it advisable that the machines should be made in this country, and clients' letters which he had seen showed the estimation in which it was held. The applicants desired to say: "We can supply an efficient British designed machine, but if any customer is unpatriotic enough to require another type we can give him it." Their position was quite intelligible. The machine must be made in this country to meet the demands, and that being the position, he thought the Rapid Magnetting Machine Co., Ltd., should have their licence.

Munitions Appeal Case.

In the King's Bench Division, on April 7th, Mr. Justice Atkin heard an appeal by a firm of micanite and insulator makers from the decision of a Munitions Tribunal that they were not an engineering firm within the meaning of the Munitions of War Act, and therefore it was unnecessary for an employé to have a certificate on leaving their employ.

Mr. Alex. Nielson, appearing on behalf of the appellants, said that they were the makers of insulators and insulating materials for dynamos, &c., and much of their work was for Government contracts. During the last day or two workers in that trade had been put in the exempted list, and skilled men in the Army had been fetched back. The appellants' works were the only works of any substance to make micanite in this country, and he argued that this brought them under the definition of munition works.

Mr. Comyns Carr appeared for the Ministry of Munitions. Evidence was called.

In his judgment, his Lordship said the finding of the Tribunal was that the appellants' business did not consist wholly or mainly of engineering, and therefore a leaving certificate was not necessary. But the appellants had tendered evidence to indicate that their business was of a wide and different kind, and he was satisfied from that that they were engaged exclusively in making by means of machinery, articles which were the necessary parts of dynamos and other machines which were used for war purposes and for the production of power. Under those circumstances the question arose whether it was right or wrong to find that they were not engaged in engineering. The meaning of the word "engineering" had to be read in connection with the definition of munitions works in the Act. That definition applied to a factory or workshop engaged in manufacturing arms, and explosives, the repair of arms, naval and military buildings, and the supply of light, heat, water and power to such buildings. Having regard to this he came to the conclusion that the finding of the Tribunal was incorrect, and that their decision must be set aside. The appeal was brought purely for the purpose of obtaining a decision as to their actual position, and was, therefore, a test case.

Coal Mines Act: Prosecution.

At Merthyr, last Friday, the hearing was resumed of the summonses against Mr. W. W. Green, agent, and Mr. H. Thomas, manager, of Hill's Plymouth Co.'s Collieries, for offences under the Coal Mines Regulation Act, namely, failing to keep the plant in proper condition. After evidence had been heard respecting a length of bare cable, Mr. Vachell, for the Home Office, dealt with the charges of failing to earth a switch, instrument cover, and lampholder. He said that they were simply types of a number of offences of a similar character. Mr. H. Thomas, the manager, said he was under the impression all the parts mentioned had been earthed. It was the electrician's work to see that the earthing was done. He did not think Mr. W. J. Charlton, one of the inspectors, pointed out 170 unearthed pieces of apparatus, though he might have pointed out 90 unearthed lampholders.

According to the *Western Mail*, the next summons was that "the switchgear and all terminals, cable ends, cable joints, and connections of apparatus, had not been constructed and installed so that all live parts should be so protected or enclosed as to prevent accidental contact by persons and danger from arcs or short circuits, fire, or water."

Evidence was given by Mr. Charlton that there was a place in the colliery where there was no switch, and also no automatic means for cutting off the electrical pressure. At this place there were five lamps, and Rees Thomas, electrician, who was called for the defence, said these were only temporary lights, and the matter had been overlooked.

Giving evidence in support of the summons, "Cables not protected by metallic covering where pressure exceeds low pressure," Mr. Charlton said that at the No. 2 Pit he found a space of 4½ ft. where there was no metallic protection for the cable, and evidence was also given in support of the summons that unarmoured cables were not hung on proper insulators.

The hearing was adjourned.

Patents and Alien Enemies.—Application has been made to the Board of Trade by Messrs. Edgar Allen & Co., Ltd., Sheffield, for the avoidance or suspension of Patents No. 14,082/08, granted to Ullrich; and Nos. 17,459/09, 29,201/11, 29,224/11, 29,230/11, 4,595/13, 14,426/13, 14,427/13, and 24,355/13, granted to Fried. Krupp, A.-G. Grusonwerk.

Japanese Electric Wire Exports.—One result of the war is seen in the development of the Japanese export trade in insulated electric wire; a return was recently issued showing that the shipments from that country during the 11 months ending with November last attained a value of £80,500, as compared with only £31,600 in the corresponding period of 1914.

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BUSINESS NOTES.

Catalogues and Lists.—Messrs. Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Sixteen-page pamphlet containing illustrated particulars and prices of lanterns and reflectors suitable for industrial lighting. The types shown include enclosed lanterns for half-watt lamps, semi-indirect half-watt fittings for office and public interiors where glare would be objectionable. Several types of anti-Zeppelin reflectors, of which many thousands have been sold during the last few weeks, are shown, as well as a new concentrating reflector specially designed for workshop and office local lighting, and large reflectors for the larger types of half-watt lamps specially made for positions where it is proposed to replace arc lamps.

Reason Manufacturing Co., Ltd., Lewes Road, Brighton.—New catalogue, complete, with the exception of the street lighting fittings section, which will be ready shortly. The five sections now before us consist of a number of well illustrated leaflets filed in an expanding binder case. They deal respectively with electrolytic meters, maximum demand indicators, hand and electrically-wound time switches, fuse-boxes, current limiters, &c. In a number of cases dimensioned diagrams appear, and all prices are very boldly printed. Complete prices of the instruments are stated; as extras only such devices as are not necessary to the successful working of the various instruments are given.

The British Thomson-Houston Co., Ltd., Rugby.—Descriptive list No. 7,201 giving particulars and dimensions of small-power motors for A.C. and C.C.

Swedish General Electric, Ltd., London, W.C.—Three illustrated catalogues dealing respectively with split-phase motors, single-phase motors and A.C. fans of Century U.S.A. types.

Book Notices.—"*Journal* of the Institution of Electrical Engineers." Vol. LIV. April 1st, 1916. No. 258.—This issue contains the following papers:—"Continuous-current Railway Motors," by Mr. E. V. Pannell; "Application of Telephone Transmission Formulæ to Skin Effect Problems," by Prof. G. W. Howe; "Magnetic Behaviour of Iron at very High Frequencies," by Mr. N. W. McLachlan; "Duplex Balances on Long Submarine Cables," by Mr. W. Judd; "Notes on Electrical Work in Australasia," by Mr. C. J. Calman; and a Report on Insulating Oils.

"On the Relation of Imports to Exports." By Mr. J. Taylor Peddie. London: Longmans, Green & Co. Price 5s. net.

"Technological Papers of the Bureau of Standards." No. 62. "Modern Practice in the Construction and Maintenance of Rail Joints and Bonds in Electric Railways." Washington: Government Printing Office.

"Quarantining Germany: A Common-sense Precaution." By P. J. Ford. Glasgow: J. Maclehose & Sons. Price 1d.

"Continuous-Current Engineering." By A. Hay. London: Constable & Co. Price 6s. 6d. net.

"The Dynamical Theory of Gases." (2nd edition). By J. H. Jeans. London: Cambridge University Press. Price 16s.

"Alternating Currents." By H. R. Kempe. London: Crosby Lockwood & Co. Price 3s. 6d. net.

Russian Trade Possibilities.—The *Electrical World* states that Mr. Marcus Stowe Hill, who recently returned from a seven months' stay in Europe as the representative of 18 large Middle West manufacturers, reports excellent trade possibilities for electrical goods in Russia. "The markets of the country, he said, are absolutely bare. The merchants are hungry for American goods, and American Consuls are flooded with inquiries as to where all kinds of manufactured articles can be purchased. Orders for great quantities of telephone and telegraph apparatus and for tons of wire are awaiting American manufacturers. There is an exceptionally strong demand for small motors from ½ H.P. to 4 H.P. Electrical equipment for demonstrating purposes in schools, X-ray apparatus, batteries and absolutely all kinds of electrical supplies are wanted in large quantities. Mr. Hill said that when he left Petrograd there was not a dry cell in the city to be purchased, and he repeats that the market shelves are practically bare of everything. Between 125,000 and 150,000 resident German merchants and manufacturers have been sent to Siberia, and the Russians are anxious that Americans should take their place. They are offering to provide three-fifths of the required capital investment if Americans will furnish the other two-fifths and the brains to establish American manufacturing plants in Russia. Mr. Hill has been working in Russia on a basis of sales direct from manufacturers to dealers, eliminating the commission system, under which Russia has been greatly handicapped. In the purchase of manufactured articles at the present time it is not so much a matter of price as it is one of getting the goods, for the prices being quoted by American manufacturers, while very substantial, are nevertheless considerably under what the German merchants, acting as jobbers in Russia, have heretofore charged for the same articles. The Russian credit, Mr. Hill said, is not only unquestionable but there is a great abundance of ready cash in the country, more so at this time than ever before. This is on account of the fact that the use of vodka has been abolished.

"American manufacturers have, he stated, a great advantage over British manufacturers in shipping goods to Russia in that the latter must make application to the War Office for permission to export. At the least, it is three months before they get a decision, and permission may then not be granted. American manufacturers thus receive a tremendous advantage on time of delivery, which is one of the very important considerations under present conditions. The Russians are prepared to pay the price because of the shipping difficulties, and they will furnish bankers' irrevocable confirmed credits with each order. Any firm contemplating granting a sole agency to a Russian is warned by Mr. Hill to investigate the standing of the individual very closely before so doing, to determine whether he intends to use this agency or to sell it. He says that a great many sole agencies are passed around from one man to another, none of whom knows anything about the business involved or cares to do so, since he only intends to sell the agency for $2,000 or $3,000 to the next man. Mr. Hill urges that no agency be granted until the reliability of the proposed agent has been positively established."

Machine Tool Association.—The annual report of the Machine Tool and Engineering Association shows a membership of 134. The matter of date of the next exhibition being dependent upon the coming of peace, cannot yet be settled definitely. "In view of the fact that the existing classifications of machine tools for Customs purposes is very imperfect, in consequence of which the Board of Trade returns are very misleading, representations have been made to the Board of Trade, and a promise has been given that the matter shall receive attention after the war, during which no alterations are being made to the classifications." "Negotiations have been opened with the British Electrical and Allied Manufacturers' Association with a view to the re-adjustment of certain trading practices as between machine tool makers and electrical manufacturers. While it is not possible to continue usefully the negotiations at present, it is proposed to resume them after the war. A recommendation was made to the members as to the attitude to be adopted to firms having connections, direct or indirect, with alien enemies."

Russian Trade Exhibitions.—A Reuter dispatch from Petrograd states that the Odessa branch of the Anglo-Russian Chamber of Commerce, with a view to the improvement of economic relations between Great Britain and Russia, has decided to open an exhibition of Russian goods in London, and an exhibition of British goods in Odessa.

LIGHTING AND POWER NOTES.

Accrington.—Proposed Extensions.—At the Council meeting, last week, Mr. Ashworth moved that certain alterations and additions at the electricity works be referred back. He thought they ought to extend on a new site, and not spend money on the present works; he also urged the calling in of an expert. Ald. Higham explained that in going in for steam turbo-generators they were reverting to lines adopted by all the Councils in the country; they departed from orthodox lines when they went in for gas engines. With steam turbo-generators and the present lodge and a water tower, they would have sufficient capacity to deal with 4,000 kw. of plant. The amendment was lost.

Argentina.—A public electric light service has been inaugurated at Diamante (Entre Rios).

The Ministry of Finance has authorised the Direccion-General of the Port of Buenos Aires to arrange with the Compania Italo-Argentina de Electricidad for the suspension of the work of renewal of lighting material for a period of three years. This decision represents a saving of $23,000 gold per annum, so long as the arrangement subsists.

Bacup.—Bulk Supply.—The Rawtenstall Corporation has offered to continue the supply of energy to Bacup from the end of the first period of five years (August 2nd next), on existing terms, and the matter has been referred to a Sub-Committee. The Rawtenstall T.C. has also given notice that from the 1st inst. the basis price of coal for the purpose of charging large power consumers has been further advanced 1s. per ton.

Beckenham.—The Council has decided that in future the charge for electricity used at the various hospitals and hostels in the district shall be at the rate of 3d. per unit.

Birkenhead.—Loan Sanction Refused.—The L.G.B. has refused to sanction the borrowing of a loan of £6,400 for high-tension plant, mains, &c., on the ground that the extensions cannot be regarded as complying with the official stipulations.

Bolton.—Loan Sanction.—The L.G.B. has sanctioned the borrowing of £2,281 for purposes of the electricity undertaking.

Bradford.—Plant Extensions, &c.—The Electricity Committee has come to an agreement with Messrs. Jeremiah Ambler & Sons, with reference to a bulk supply of electricity. The electrical engineer's estimate of the cost of extensions to the boiler house and cooling plant at Valley Road electricity works, now on order or in contemplation, amounts to £53,113. The L.G.B. has given formal sanctions to the borrowing of two sums of £20,102 and £6,814 respectively, parts of the above-mentioned sum of £53,113, and the Committee has decided to adopt the estimate, and to make application to the L.G.B. for sanction to the borrowing of £26,196, the balance of the sum of £53,113.

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Carnarvon.—Proposed Loan.—Application has been made by the T.C. for sanction to a loan of £2,780 for a 100-kw. Diesel engine set, with fuel storage tanks, switchboard, &c., for the electricity works.

Continental.—Russia.—It is stated that, notwithstanding the war, the Russian Government is making preparations for an extensive utilisation of the watercourses of Finland for the generation of electricity for lighting and power purposes.

Italy.—In connection with the destruction of the Conti electricity works in the Val Brembana, it is reported in the *Rivista Tec. d'Elettricità*, that in consequence of the heavy snowfall an attempt was made to shut down the supply, but a short circuit occurred which resulted in the entire destruction of the plant, the loss being about a million lire.

Dartford.—Loan Application.—The U.D.C. has applied to the L.G.B. for sanction to borrow a loan of £1,000 excess expenditure on extensions to the E.L. station and plant, and to cancel £75 not spent in connection with an overhead cable.

Doncaster.—Electric Pumping Plant.—The Water Committee of the Council has had under consideration a report of the engineer regarding the existing plant in use for pumping river water, and at the last meeting it was proposed to abandon the present pumps and boiler, and to install electrical pumping plant capable of delivering water under pressure of 120 ft. head, at an estimated first cost of £300, and an annual cost of £840.

Dungannon.—Hospital Lighting.—The Co. Tyrone Tuberculosis Committee has decided to recommend the installation of an electric plant in the new sanatorium.

East Cowes.—Street Lighting.—The U.D.C. has accepted an offer by the Isle of Wight E.L. and Power Co. of a further allowance of 30s. per lamp for the lights to be dispensed with from April 1st to September 30th. The company had already reduced the charges for public lighting by one-half to 31s. 9d. per lamp per quarter.

India.—Street Lighting.—The Calcutta Electric Supply Corporation is pushing forward energetically the preparations for lighting Chowringhee with 900-c.p. half-watt lamps.

The electrification of the Bombay cotton mills is now nearly completed; motors of approximately 86,000 h.p. have been installed, divided amongst 26 mills, in addition to complete sub-station equipments for 30 cotton mills and two flour mills.—*Indian Textile Journal.*

Indian Engineering states that the Ootacamund Municipal Council has decided that the question of electrically lighting the town by suction-gas engine plant must stand over in consequence of the high price of the plant, and the probability that it might not be obtainable at all at present.

London.—Westminster.—The St. James's and Pall Mall Electric Light Co. has advised the City Council that it will be compelled from June 24th next, to charge for electricity for lighting purposes at 4d. per unit net. It is not proposed to increase the charge for power supply. The Contracts Committee has instructed the city engineer to report as to the practicability of substituting and using gas lighting, and the cost thereof, at those buildings now lighted by current supplied by the St. James's Co.

Battersea.—The Electricity Committee has been in negotiation with the Fulham B.C. with reference to the supply of electricity in bulk under the terms of the linking-up agreement. The electrical engineer reports that the test supply given by Fulham during January to March has been satisfactory, and the Committee is arranging for a continuance of this supply during the year ending March, 1917.

Manchester.—Loan Sanctions.—The L.G.B. has sanctioned the borrowing of £30,000, repayable within 15 years, for equipment of sub-stations, and £10,000, repayable within 10 years, for the provision of motors for hire.

The Education Committee has accepted an offer by the Electricity Committee with regard to the electric lighting of the Municipal School of Art extension.

Nelson.—New Plant.—The electrical engineer has been instructed to obtain estimates for a complete turbo-generator set.

Nuneaton.—Subject to satisfactory terms being arranged, the T.C. has decided to extend the mains to Weddington Hall Hospital. It is anticipated that other consumers will be secured *en route.*

Rathmines.—Street Lighting.—The Urban Council has decided that every alternate public electric lamp shall be left unlighted during the present financial year with a view to saving expense.

Rotherham.—New Plant.—The Electric Light Committee proposes to purchase an additional rotary converter to meet the demand from Tinsley, and has accepted an offer for the supply of such plant for £690, the money to be defrayed out of the renewals fund.

Scarborough.—Street Lighting.—The T.C. has instructed the Lighting Sub-Committee to consider the question of electric lighting in certain main streets after the war; the public gardens have been electrically lighted for some time, but the streets are entirely gas lighted.

South Africa.—A domestic water scheme and electric lighting installation has been completed at Pietersburg, and Mr. Curtis, late town engineer of Wimburg (O.F.S.), has been appointed engineer. Mr. H. Hancock, of Klerksdorp, acted as consulting engineer, and Mr. R. Turnbull Mawdesley acted as his representative on the construction works.

Stockton-on-Tees.—Year's Working.—The loss on the Corporation electricity undertaking for the past year amounted to £1,008, against £651, as estimated. Sales of current produced only £9,120, being about £680 short of the estimate, due to lighting restrictions, while for public lighting only £62 was received against the estimated £300. The total income was £9,509, instead of the estimated £10,325, the actual expenditure being £10,517, or £459 less than anticipated. For the current year a loss of £1,998 is estimated for; expenditure is estimated at £11,580, the large increase in the item being due to the purchase of electricity in bulk. The revenue is estimated at £80 more than that received last year.

Teignmouth.—The U.D.C. has decided not to object to the whole of the proposed electrical mains in Shaldon being overhead, subject to steel poles being used in certain streets, and to the proposed Shaldon Electric Lighting Co-operative Society entering into an agreement with the Council on similar terms to the agreement with Messrs. Purves, subject to such modifications as may be necessary.

Torquay.—During the past month 158,490 units were generated at the electricity works, an increase of 29,695 units as compared with the corresponding month last year. For the year 1915 the electricity undertaking shows a net profit of £1,200, which has been expended on services.

Wakefield.—Price Increase.—In view of the increased cost of generating electricity, the charges to power consumers are to be increased by 12½ per cent. and cash discounts are to be abolished.

U.S.A.—The Great Western Power Co. has carried out an extensive investigation into the possibilities of electro-chemical development in the Californian area which it serves, and a company has now been organised, to be known as the Great Western Electro-Chemical Co., which is to erect an initial installation on a 15-acre site at Pittsburg, Cal., to produce caustic soda and bleaching powder. The plant will be the first of the kind west of Detroit.

Walsall.—The Committee has decided to place certain sums received on the sale of superseded plant to a special account, to be utilised in repayment of the outstanding debt on plant.

Wigan.—In connection with the proposed supply of current to the premises of the Northern Coarse Spinners, Ltd., the Electricity Committee has decided to apply for permission to borrow £781 for cable, switchgear and a transformer. The motors and the electric lighting installation at the mill of the Coarse Spinners, Ltd., are being supplied by the Corlett Electrical Engineering Co., Ltd., Wigan. Mr. H. Dickinson, city electrical engineer, of Liverpool, is to report on the electricity undertaking for the fee of 150 guineas.

Wolverhampton.—Plant Extensions, Loans, &c.—The Electricity Committee reports that the continual demand for energy renders it necessary to make extensions to the generating station plant, in order to cope with the load during the winter of 1917. Having considered reports of the electrical engineer (Mr. S. T. Allen) upon the question, the Committee recommends the extending of the boiler house, at a cost of £17,160, made up as follows:—Building, £1,000; steel work, bunkers, &c., £2,200; two water-tube boilers (40,000 lb.), complete with mechanical stokers, £8,000; feed, steam and blow-off piping for boilers, £500; forced draught plant, £500; feed pump plant, £400; coal and ash-conveying plants, including ash-bunker, £2,500; erecting a steel chimney on foundations already provided, £500; contingencies, £1,560. The Committee further recommends that application be made for sanction to borrow the above-mentioned sum, and that it be authorised to invite and accept tenders for all necessary works. It is also proposed to make application for permission to borrow £6,600 for defraying expenditure to be incurred in connection with extensions to mains, foreshadowed in the report.

TRAMWAY and RAILWAY NOTES.

Bacup.—Consideration has been given to proposals from the Rawtenstall Corporation for alterations in the tramway fares, but the Electricity and Tramways Committee is unable to agree to the proposals, holding that the increases would be paid entirely by Bacup.

Burnley.—The Tramways Committee has considered the question of the financial position of the undertaking, and has decided that the charges for all privileged tickets shall be increased by 7½ per cent.

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Bradford.—Year's Working.—The tramway manager has submitted a report showing the approximate result of the past year's work of the tramway undertaking. The estimated total receipts were £334,315, an increase of £14,921 as compared with the previous year; the total number of passengers carried was 74,000,000, an increase of 4,000,000 on the previous year's figures; wages £129,313, show an increase of £9,182, whilst the department had paid a sum of £7,102 in war bonus, and £7,352 to dependents of employés who had joined the Forces. There had been an increased consumption of electricity in connection with the tramways, notwithstanding the fact that the car mileage was less than a year ago—this being attributed to the larger loads, the severe weather conditions, and the absence of many old and skilled drivers. This increased consumption will involve an amount of something like £1,000 being charged against the undertaking. Last year's car mileage was 6,199,601, a decrease of 172,109 miles.

The Traffic and Fares Sub-Committee of the Tramways Committee of the Corporation has authorised the general manager (Mr. C. J. Spencer), to engage additional women conductors whenever male labour for the purpose is not obtainable. The tramway manager has received authority to equip an electric lorry, or to place an order for a suitable petrol chassis. In response to an instruction of the City Council for the Tramways Committee to report at the April meeting as to what it can do to deal equitably with all tramway fare stages in the city (including Great Horton), the Committee states that it will not be in a position to submit the desired report until the balance sheet has been prepared.

Continental. — Spain. — The Sociedad de Tranvia Urbano de Bilbao has applied for a concession to construct and work an extension to the existing tramway system in the town of Bilbao to the Barrio de Irali Barri.

Croydon.—Strike.—A strike occurred on Saturday morning last among the drivers and conductors on the South Metropolitan Tramway Co.'s system running to Sutton, Tooting, Penge, &c., owing to two women receiving instruction in driving for test purposes. A restricted service was maintained over the week-end, the Tooting route being closed.

Later information shows that the strike has spread to the employés of the Croydon Corporation tramways—who demand concessions in regard to wages and hours—and a reduced service is being given on the Corporation lines. The Croydon authorities state that the increase in wages, and other concessions in their case, would cost £10,000 a year, and would equal a 2½d. rate on the town. The B. of T. intervened in the dispute on Tuesday, without result, and there appears to be a prospect of the strike spreading.

Doncaster.—At a meeting of the T.C. last week, at which the local rates were reduced by 4d., satisfaction was expressed at the success of the new Woodlands tramway route. In five weeks 23,006 passengers have been carried, and it was stated that a reduction of fares on the route was under consideration.

Edinburgh.—The Tramways Committee has reported against any immediate decision to adopt electric traction on the tramways when taken over; the burgh engineer is to report on the matter at a later date. Councillor Allan has a motion before the Council urging the adoption of some form of electric traction when the company's lease expires.

Gateshead-on-Tyne.—The Town Improvement Committee has received a letter which has been sent to the Gateshead and District Tramways Co. by the B. of T., with reference to the accident on Bensham Bank, in which Lieut.-Colonel Von Donop, R.E., calls attention to the fact that a slight change in the position of Ravensworth loop would provide a better gradient for cars to stand on, and, further, recommends that motormen should not leave their cars during the journey. The Committee has written to the company, inquiring what action it was proposed to take, and the company has intimated its willingness to carry out the suggestions. The matter was left in the hands of the Town Improvement Committee with full power to act.

Halifax.—Year's Working.—The financial statement of the borough treasurer shows that the total income of the Corporation tramways during the past year has been £113,492 (12·404d. per car-mile), whilst the expenditure has totalled £95,486 (10·436d. per car-mile), leaving a profit of £18,006, as compared with £17,052 for the preceding year. The number of passengers carried showed an increase of 1,316,932 at 21,024,003.

Leeds.—From a statement which has been issued by the tramway department it appears that the receipts for the year ending March 31st last (£475,661) show an increase of £11,150, as compared with those of a year ago. There has been a decrease in the car-mileage (9,405,121) of 117,616 miles, due to inability to use the full stock of cars owing to enlistment of employés. The number of passengers carried showed an increase of 7,814,533 at 103,453,801. The receipts per car-mile (12·138d.) increased by 1·187d.

London.—Kensington.—The B.C. has been recommended to raise no objection to the proposal of the M.E.T., Ltd., to use trailer cars, on the understanding that such consent is for the period of the war only.

Oldham.—Year's Working.—The returns of the tramway department up to March 25th show, subject to audit, a profit of £3,985. On the Hollinwood extension £1,000 has been expended, and allowances to employés with the Colours have amounted to £5,225. Ald. Isherwood told his Committee, on April 6th, that the result was as good as the Committee had ever had.

Rochdale.—Tramway Lease.—The Tramways Committee has intimated that it cannot accept the draft lease of the Milnrow tramways as returned and altered by the Milnrow D.C., and further suggests that the matter might be postponed until after the war.

During the last year the total receipts of the tramway department amounted to £82,836, an increase of £4,477. The passengers carried numbered 13,705,871, an increase of 298,553.

Rotherham.—Rolling Stock Purchase.—The Tramways Committee has recommended the Corporation to exercise its option to purchase the additional 11 bogie tramcars from the Oldham Corporation. Repairs are to be carried out during the month to various parts of the tramway track.

Stockport.—The Tramways Committee has decided to accept the offer of £600, made by the General Electric Construction Co., Ltd., for one of the Corporation's railless trolley-buses.

Swansea.—Overhead Breakdowns.—The electrical engineer has reported on the number of breakdowns of overhead equipment on the Morriston section of the Corporation tramways during the past three months. He stated that practically all breakdowns were due to falling of guard wires. The tramway engineer reported that the steel guard wires originally installed had corroded to such an extent that the Tramway Co. had decided to replace them on a section of about six miles with bronze wire.

Swinton and Pendlebury.—Tramway Lease.—The U.D.C. has, subject to the approval of the B. of T., decided to lease the tramways to the Salford Town Council for 21 years from January 1st, 1905.

Warrington.—The free use of the tramway cars and municipal omnibuses by soldiers, other than wounded soldiers in hospital dress, is to be withdrawn, because the privilege has been abused.

TELEGRAPH and TELEPHONE NOTES.

France.—The French Government has drawn up a Bill to be presented to Parliament, providing for an outlay of over 120,000,000 fr. for the improvement and extension of the telephone system of Paris. A technical Commission has been appointed, and has handed in its report. The chief provisions of the proposed scheme are as follows:—The construction and equipment of six large new telephone exchanges in Paris; the enlargement of three existing telephone exchanges; the introduction of new multiple switchboards for 12,600 lines; the installation of automatic meters in the Paris exchanges; and the laying down of long-distance subterranean lines.

The Telephone System.—Last month the laying of an underground cable between London and Liverpool was completed. Considerable progress has been made in restoring the overhead telephone lines brought down in the storm. Of 600 lines going out of London which were down, 370 had already been repaired by last week-end. Just after the storm there were from 40 to 60 important places in the country to which it was impossible to get through from London; on Saturday the number had been reduced to four.—*The Times.*

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—April 19th. U.D.C. Twelve months' supply of lubricating and other oils, for the Electricity and Tramways Department. See "Official Notices" to-day.

Australia.—Sydney.—May 24th. N.S.W. Government Railways and Tramways. 16/600-volt D.C. motors for tramway stores, Randwick.*

April 26th. Victorian Government Railways. Car-lighting material—cables, switches, fuses, &c.*

May 1st. City Council. Meters and maximum-demand indicators. See "Official Notices" April 7th.

May 10th. Victorian Government Railways. Motor-generator set and accessories for battery-charging of baggage trucks.*

May 17th. Victorian Government Railways. One 2-ton electrically-operated goods elevator for Jolimont car-shed.*

Manchester.—April 17th. B. of G. Electrical materials for Withington Institution in connection with the additional electric lighting of the main side of the establishment. Particulars from the acting master at the Institution, Nell Lane, West Didsbury, Manchester.

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New Zealand.—June 23rd. Oamaru Borough Council. Overhead mains and street-lighting equipment (Contract No. 2); power-station equipment (Pelton wheels, alternators, &c.) (Contract No. 3); service meters (Contract No. 4); line transformers and accessories (Contract No. 5).*

North Africa.—May 30th. Sixty years' electric tramway concession for Melilla; work to be completed in two years. Tenders to Direccion General de Obras Publicas, Ministerio de Fomento, Madrid. The *Board of Trade Journal* contains some further particulars.

Salford.—April 17th. Electricity Committee. Switchgear for 5,000-KW. sub-station equipment. See "Official Notices" April 7th.

Walthamstow.—April 26th. U.D.C. Water-softening plant for the Electricity Department. See "Official Notices" April 7th.

Warrington.—April 26th. Electricity and Tramways Committee. Boiler plant and economiser. See "Official Notices" April 7th.

West Hartlepool.—April 28th. Electricity Department. Two water-tube boilers with superheaters and mechanical stokers. See "Official Notices" to-day.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Belfast.—Messrs. Venner Time Switches, Ltd., have received a contract from Belfast Corporation for automatic time switches for a year.

Bradford.—The Electricity Committee has accepted the tender of Messrs. Haywards, Ltd., for glass flooring, and that of Messrs. Redpath, Brown & Co., Ltd., for constructional steelwork required at the Valley Road electricity works; also offers for plant for the Valley Road works as follows:—

Musgrave & Co., Ltd.—Induced-draught plant and two steel chimneys.
Electromotors, Ltd.—Three 50-B.H.P. pipe-ventilated fan motors.
Ferranti, Ltd.—Two 250-K.V.A. transformers.

Burton-on-Trent.—T.C. Jonathan Longbotham and Sons are to supply 4,000 tons of coal to the Lighting Department.

Gillingham (Kent).—T.C. Coal for the electricity works:—

Household screenings, Gillingham Co-operative Society, 20s. per ton; ditto, Anderson, Cornelius & Snow, Ltd., 20s. 6d. per ton; 200 tons Baddesley 1¼-in. nutty slack, Clewes & Co., 26s. 8d. per ton; Welsh coal, J. Gill & Son, 30s. 9d. per ton.

Gloucester.—T.C. Tramway points and crossings: Edgar Allen & Co., Ltd., £2,500.

London.—HAMMERSMITH.—The Electricity Committee recommends the acceptance of the offer by Messrs. Cory Bros. to supply 100 tons weekly for six months of Abercrwyd coal, at 23s. 6d. per ton.

Meter Contracts.—Messrs. Chamberlain & Hookham, Ltd., have received contracts for electricity meters for the ensuing 12 months from Pembroke, Walthamstow and Bermondsey.

The Electrical Apparatus Co., Ltd., has received a contract for a year's supply of electricity meters for the borough of Basingstoke.

Nuneaton.—T.C. Coal for the electricity works for a year:—

Haunchwood smudge (1,000 tons), Wm. Jeffcoate, Ltd., 9s. 6d. per ton; Ansley Hall smudge (1,500 tons), Mr. Geo. Smith, 9s. 6d. per ton.

Sheffield.—City Council. The following tenders are recommended for acceptance:—

W. Marlow & Sons, Ltd.—Erection of electricity sub-stations: Sidney Street, £1,011; Stanley Street, £1,216.
Mortimore, Lyon & Co.—Increasing efficiency of the six-cell unit at Lumley Street destructor by 75 per cent., £1,029.
Edison Accumulators, Ltd.—Three-ton wagon, £1,200; two-ton wagon, £1,000.

Sunderland.—The T.C. on Wednesday accepted the following tenders:—

Babcock & Wilcox.—Superheater tubes.
G. & J. Weir.—Impellers for boiler feed pumps.
I.R., G.P. & Telegraph Works, Ltd.—Insulating tape.
Dussek Bitumen Co.—Box compound.
W. Simpson.—Hand-carts.

Swansea.—Council. Ferranti, Ltd., at £66, for a three-phase transformer for supplying a new school.

Wimbledon.—The Electricity Committee considers it undesirable to enter into contracts for supplies during the ensuing year. The borough electrical engineer has obtained offers from certain firms for the supply of various goods and materials, which the Committee recommends for acceptance, and also that the remainder of the supplies required should be purchased as and when required at the lowest prices obtainable.

Wolverhampton.—The Electricity Committee recommends the T.C. to accept the following tenders:—

Brush Electrical Engineering Co.—Two 800-KW. transformers, £899 10s.
Reyrolle & Co.—Switchgear, £796.
Stirling Boiler Co.—Two Stirling boilers, two super-heaters, and two sets of mechanical stokers, £8,222.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, April 14th. At 6 p.m. At Great George Street, S.W. Paper on "Theory and Practice in the Filtration of Water," by Mr. W. Clemence.

Physical Society of London.—Friday, April 14th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Papers on "The Variation of Resistance with voltage at a Rectifying Contact of two solid conductors with applications to the Electric Wave Detector," by Mr. D. Owen; and "The Electrical Capacity of a Gold-leaf Electroscope," by Mr. T. Barratt.

Chief Technical Assistants' Association.—Saturday, April 15th. At 3 p.m. At the Tavistock Hotel. Discussion on "The Advantages and Disadvantages of Various Systems of Laying Mains."

Royal Institution of Great Britain.—Friday, April 14th. At 5.30 p.m. At Albemarle Street, W. Lecture on "The Genesis and Absorption of X-rays," by Prof. Sir J. J. Thomson.
Saturday, April 15th. At 3 p.m. At Albemarle Street, W. Lecture (VI) on "Radiation from Atoms and Electrons," by Prof. Sir J. J. Thomson.

Institution of Civil Engineers.—Tuesday, April 18th. At 5.30 p.m. At Great George Street, S.W. Annual general meeting.

Post Office Telephone and Telegraph Society of London.—Tuesday, April 18th. At 6.30 p.m. At the I.E.E., Victoria Embankment. Paper on "Telegraph Tariffs and Economic Needs," by Mr. J. Lee.

NOTES.

Easter Holidays.—Owing to the Easter Holidays, the ELECTRICAL REVIEW for Friday, April 21st, will be published on Wednesday, April 19th. All matter for both the editorial and advertisement pages for that issue should be in our hands at the earliest possible moment. A notice regarding the latest times for advertisements to be received, appears in our advertisement pages to-day.

Foreign Trade.—THE MARCH FIGURES.—The following are the electrical and machinery figures given in the official returns for March:—

	Month of March.		*Inc. or dec.*		*Inc. or dec. to date compared with 1915.*
IMPORTS.					
Electrical goods and apparatus, excluding machinery and uninsulated wire... ...	£115,409	+	£47,783	+	£137,236
Machinery	685,507	+	103,419	+	225,891
EXPORTS.					
Electrical goods and apparatus, excluding machinery and uninsulated wire	328,173	+	51,203	+	186,011
Machinery	1,424,140	−	166,294	−	110,860

Gas v. Electricity.—An Indian contemporary quotes a recent article in the American *Gas Age*, which sums up the results of an investigation as follows:—"It can be said that there is no question but that gas lighting stands behind electric lighting in every respect, for the latter causes no vitiation of the air, develops no humidity and moisture and produces little heat." It appears from the results of experiments that the claims for superior ventilating effect of gas are unfounded. The tests made were various, one of these being the cooking of sauerkraut in the room, and then observing how long the odour could be detected in the room. There was no difference in the room lighted by gas or electricity. Tests for CO_2 showed a higher percentage for gas, and two curves illustrating the decrease of bacteria in the air, when subjected for a definite time to gas or electric lighting, showed little difference.

Vacuum-Fused Silicon Iron.—In the *Bulletin* of the American Institute of Mining Engineers, Mr. T. D. Yensen, of the University of Illinois, has given the results of his experiments on vacuum-fused iron containing varying percentages of silicon. The experiments were made in an attempt to improve the iron used in dynamo-electrical machinery. The qualities desired were low hysteresis loss, high electrical resistivity (to reduce eddy-current loss), and high permeability. Previous experiments by the author had shown that pure electrolytic iron, melted and cooled in vacuo, possessed desirable properties in respect of high permeability (about twice that of the best commercial iron) and low hysteresis loss. If the electrical resistivity of this iron, which in the pure state is very low, could be increased without impairing its magnetic properties, an excellent iron for electromagnetic purposes would be produced. Previous experiments by Prof. C. F. Burgess, at the University of Wisconsin, had shown that when melted in an atmosphere of carbon monoxide at ordinary pressures, pure iron absorbed about 0·1 per cent. carbon, and probably some oxygen, as the electric resistance increased more than would be expected from the carbon alone. The iron used in the present experiments was doubly refined electrolytic iron deposited from Swedish charcoal iron, according to the methods of Burgess. The refined iron had the following composition:—Carbon, 0·006 to 0·01 per cent; silicon, 0·01 per cent.; sulphur, trace; iron (by difference), 99·98 per cent. Previous experiments by the author had shown that carbon and boron, when alloyed with this vacuum-fused iron, lowered the magnetic quality, and they were thus undesirable where high permeability and low hysteresis were needed. The present experiments with silicon gave opposite results, and seem to have produced

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an iron which possesses very remarkable properties, highly desirable in iron for electrical machinery.

The maximum tensile strength of 105,000 lb. per sq. in. (73·5 kg. per sq. mm.) occurs with a silicon content of 4·5 per cent.

With regard to the magnetic properties, the best alloys are obtained with about 0·15 per cent. and 3·40 per cent. silicon after annealing at 1,100° C. The maximum permeability for both of these alloys is above 50,000, and the hysteresis loss for B_{max} = 10,000 and 15,000 is about 300 and 1,000 ergs per cb. cm. per cycle respectively. This hysteresis loss is ⅛ and ⅛ of the corresponding loss for commercial silicon steel. The most favourable annealing temperature is in every case 1,100° C.

The specific electrical resistance increases about 13 microhms for the first per cent. silicon added. For each additional per cent. added the increase is about 11 microhms. Consequently, the 3·40 per cent. alloy mentioned above has a resistance more than four times that of the 0·15 per cent. alloy.

By the vacuum process two silicon alloys have thus been produced that have very valuable characteristics: one low in silicon, not very strong, but extremely ductile, of high permeability, low hysteresis loss, and low electrical resistance; the other high in silicon, very strong, moderately tough, of high permeability, low hysteresis loss, and high electrical resistance. The properties of these alloys are summarised in the table below. The first is evidently suitable for use in places where high permeability and low hysteresis loss are the chief requirements, while the second alloy is suitable for electromagnetic machinery, principally transformers, where a low eddy-current loss is an additional requirement.

Properties of the Two Best Iron-Silicon Vacuum Alloys.

Silicon content per cent.	Stress at yield point, lb. per sq. in.	Ultimate strength, lb. per sq. in.	Elongation, per cent.	Reduction of area, per cent.	Maximum permeability.	Density for max. permeability, Gausses.	Hysteresis loss, ergs/c.c./cycle. For B_{max} = 10,000	Hysteresis loss, ergs/c.c./cycle. For B_{max} = 15,000	Spec. Elect. Resistance, microhms.
0·15	18,500	37,000	56	90·0	Above 50,000	6,500	288*	916†	11·8
3·40	58,000	76,500	21	28·5	Above 50,000	6,500	280*	1,025†	48·5

* From data recently obtained with rings these values may be 10 per cent. to 20 per cent. low.

† From data recently obtained with rings these values may be 5 per cent. to 10 per cent. high.

—*Met. and Chem. Eng.*

Institution and Lecture Notes.—Institution of Electrical Engineers.—The annual general meeting of the Institution will be held on Thursday, May 11th, at 8 p.m., to receive and consider the accounts for the year ended December 31st, 1915, and the annual report of the Council, and to elect two auditors.

In view of the Government restrictions with regard to the supply of paper, and also owing to the great increase in its cost, the Council has decided to reduce the amount of matter in the *Journal*, and to publish it monthly, instead of fortnightly, until conditions are again normal.

At the meeting of the Yorkshire Local Section on Wednesday last, a paper was read by Mr. George Wilkinson on "Electric Heating: Its Present Position and Future Development."

Iron and Steel Institute.—The annual meeting will be held on May 4th and 5th, at the Institution of Civil Engineers. After the presentation of the Bessemer Gold Medal to Mr. F. W. Harbord, F.I.C., and the delivery of the inaugural address of the President, Sir W. Beardmore, a number of papers will be read, including one by C. Benedicks, Ph.D., on "A New Thermo-Electric Method of Studying Allotropic Changes in Iron or other Metals." The following new by-laws, as already proposed and amended, will be formally moved and voted upon during the proceedings:—

1. In the event of a state of war existing between the United Kingdom and any other country or State, all members, honorary members, and honorary vice-presidents who shall be subjects of such enemy country, or State, shall forthwith cease to be members, honorary members, or honorary vice-presidents of the Institute, but they shall be eligible for re-election after the war in the usual manner.

2. The Council shall have absolute power to remove from the list of members of the Institute the name of any member, whether ordinary or honorary, for wilful contravention of the by-laws or for any other reason which seems to them sufficient, and such ordinary or honorary member shall thereupon cease to be a member of the Institute.

The autumn meeting will take place in the same building on September 21st and 22nd.

Electrical Association of Australia.—Recently in a paper read before the N.S.W. Section, Mr. Wm. Corin, chief electrical engineer of the N.S.W. Public Works Department, read a paper on the "Power Requirements and Resources of N.S.W.," attention being particularly given to the applications of electricity. The H.P. of various types of stationary industrial prime movers in use in 1913: was steam, 67,045; gas, 12,294; water, 77; oil, 1,142 (total non-electric, 80,558 H.P.); electric, 35,885 H.P., excluding electrical power stations. At the beginning of the century the H.P. supplied by other forms of prime mover was 112 times that supplied by electric motors, in 1913 the ratio had been reduced to 2¼ times; the electric motor curve shows an accelerating upward tendency, while the non-electric curve indicates retardation in the rate of increase. He anticipates that in the next 15 years stationary industrial purposes will require 381,000 H.P. additional to 1913, *i.e.*, a total of 497,000 H.P., of which 416,000 H.P. may be anticipated to be electrical. He further estimates that this will require 300,000 Kw of plant and represent the use of 600 million units a year, and points out that anything up to half this amount may be required for electrochemical and electrothermic processes alone and the total may be largely increased. In 1913 there were in N.S.W. 113 townships of 1,000 inhabitants and upwards, with a total population of 350,000, and by 1930 he anticipates that there will be 170 such townships with half a million population. Assuming that these will demand an electric supply for lighting and small power uses, he estimates a further demand of 15,000,000 units a year and a maximum load of 15,000 Kw. If power were available on a comprehensive scale, a great impetus would be given to the use of power-using contrivances for all agricultural purposes. Mr. Corin considers that railways and tramways will require 185,000 Kw. additional, and suggests a total demand in 1930 for 700,000 Kw. or 1,860,000,000 units. He further deals with the coal and water-power resources of the State, mentioning that he is carrying out a systematic preliminary examination of the whole of the water-power resources.

The Chemical Society.—An extraordinary meeting of the Fellows is to be held on May 11th, to consider the question of removing from the list of members the names of nine alien enemies. In the annual report of the Council, presented to the Fellows on March 30th, it was stated that the Council, by a large majority, had decided that no steps should be taken in this direction until after the cessation of hostilities; but the meeting, by a large majority, repudiated this view, with the result above mentioned. The Fellows have not forgotten that the use of poisonous gas originated in Germany, and will for ever remain a foul stain on the fair fame of chemical science.

In an address to the Halifax, N.S., Commercial Club recently, a scheme to harness the Bay of Fundy tides for the development of hydro-electric power was outlined. The proposal is to install tidal motors in Minas Channel, where the flow is between 9 and 11 miles an hour, by means of which sea-water would be pumped up into reservoirs on the cliff top, subsequently being used to develop a steady output of electricity in a power house at sea level. A suitable type of tide motor has already been developed experimentally. The most suitable power site is at Cape Split, which is within 125 miles' distance of most of Prince Edward Island, and about 85 miles from Halifax. It is estimated that the scheme would render 2 million H.P. available.

Decimal Coinage and the Metric System.—The report of the Decimal Association for the past year, which was issued recently, draws attention to a distinct advance during the year in public (as differentiated from scientific) opinion in favour of the adoption of the decimal system of coinage and the metric system of weights and measures, especially in commercial circles. The severity of the handicap imposed upon our manufacturers by the use of two systems in the works and offices and by the complicated nature of the British system is emphasised, but it is pointed out as a hopeful feature of the situation that the war has familiarised our armies with the metric system, and after the violent changes which the nation has already experienced it is more ready than formerly to entertain proposals of reform. In November last the Association circularised the Chambers of Commerce of the United Kingdom, inviting them to induce their members to introduce the metric system into their own works, and received a favourable response, all the replies expressing complete agreement with the work of the Association. The use of metric equivalents of all British standards in parentheses in recent specifications issued by the Engineering Standards Committee is welcomed, and resolutions urging the general and immediate adoption of the metric system which were passed by the Council of the British Horological Institute and the Committee of the London Wholesale Jewellers' and Allied Trades' Association are recorded. The fact that last year no fewer than 38,373 metric weights and measures were submitted for testing in the City of London, as compared with 1,741 in 1914, to which we have already drawn attention, is quoted as a proof that the metric system is being more widely employed. The report further states that "the Electrical Review has been conducting an extremely useful canvass among electrical engineering firms in regard to the desirability of adopting the metric system in this country," and reproducing the series of questions which we addressed to manufacturers, expresses gratification at the fact that there was a majority of four to one in favour of the general adoption of decimal coinage and the metric system. A similar canvass instituted by Messrs. Richard Klinger & Co. amongst engineering and kindred trades produced a like result.

The diversity of the systems of weights and measures in use in Egypt has led the British Chamber of Commerce of Egypt to recommend the adoption of the metric system (which is already used in all Government Departments, public works, post offices, and railways). The coinage is already decimal, the Egyptian pound being divided into 100 piastres of 10 millièmes each (practically the system which we have recommended), and it is proposed by a very slight alteration to make the £E identical in value with the pound sterling. In January last the Second Pan-American Scientific Congress, sitting in Washington, U.S.A., passed a resolution urging the American Republics to adopt the metric system for all purposes. All the South American Republics already use it, and our trade with them is gravely prejudiced by our neglect to quote in the terms which their peoples understand. The income of the Association has suffered through the effect of the war, though a number of new supporters have joined it, and further support is urgently needed; the address of the Association is Finsbury Court, Finsbury Pavement, E.C.

With the report is issued a leaflet showing how decimal coinage can be adopted without altering the value of any of the gold and silver coins now in use in this country. The unit proposed is the

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florin, the sovereign being the 10-florin piece; the florin would be divided into 100 cents, and new nickel coins, of the values of 10 cents (2½d.) and 5 cents (1¼d.), would be introduced together with bronze coins denominated 4 cents, 2 cents and 1 cent, practically equal in value to the penny, halfpenny and farthing. In essence, the system is identical with that which we have recommended, for it retains the sovereign absolutely unchanged in value; whether the sovereign or its tenth part be regarded as the unit is purely a question of convenience.

At the spring meeting of the Lancashire, Cheshire, Cumberland, and Westmorland Division of the Incorporated Association of Head Masters, a resolution was passed urging head masters to emphasise the importance of the metric system, especially among boys who are leaving this year, and that special attention be devoted to practice in converting British into metric weights, measures, and coinage. A Sub-Committee was appointed to suggest ways of discovering and overcoming existing objections to the introduction of the metric system.

The *Indian Textile Journal* states that the Karachi Chamber of Commerce, in reply to Government, which invited its opinion on the reports of the Weights and Measures Committee, has replied that it is of opinion that any changes made should be in the direction of the decimal system.

The Electrification of Fibres.—The research which is about to be undertaken by the Leeds University into the causes of the electrification of fibres and fabrics during manufacturing processes will cover various classes of fibre, commencing with silk, as the phenomena are most readily produced with this material. Great interest is taken in the scheme by manufacturers, many of whom have offered their assistance. Hitherto the endeavour has been to cure the trouble; in the present research the fundamental causes will be sought with a view to preventing its occurrence. Wool, silk, cotton, and linen, says the *Yorkshire Observer*, all become electrified in the process of manufacture. The electrification of wool means that spinning from newly-made tops cannot be done satisfactorily. Sometimes tops have to be laid aside for at least a month before they are spun, and yarn is allowed to wait from 10 to 14 days before it is used. The tops of the yarn have to be put aside to allow the fibres to lose the electricity set up by the friction incidental to their manufacture.

Assuming a spinner to be producing 50,000 lb. of yarn per week, and the price to be 3s. a lb., the amount involved is £7,500. In the event of the reduction by a week of the time the yarn has to be allowed to lie to get rid of the electrification of the fibres, the saving to the spinner in interest alone would be about £30 a week. What this would mean throughout the textile industry cannot be comprehended except by the imagination of an exceedingly large sum of money. The importance of the forthcoming investigation will therefore be apparent. Attempts have been made, and with a considerable amount of success, to overcome the difficulty by the humidification of mills, and many mills are fitted with plant to humidify the atmosphere for this purpose. Humidification, however, is but a remedial measure after the electrification has taken place. The object of the research to be undertaken by Dr. Shorter is radical—an attempt is to be made to eliminate the electrification. Success in this direction will mean not only the saving in the direction already mentioned, but also the abolition of the expensive apparatus required by the humidification process, which has to be maintained and constantly kept in order.

The investigation to be undertaken is to be traced to two lectures delivered to the British Association of Mill Managers some years ago by Prof. W. H. Bragg, formerly of Leeds University.

Visits will be paid to works to investigate the electrification of silk, wool, cotton, and linen, and evidence will be gathered with respect to the effect on the electrification of fibres of the following conditions:—(*a*) Dry and wet weather; (*b*) east wind or south wind; (*c*) frost; (*d*) Monday morning—the effect of week-end rest, and the cooling and the drying of air. Steps will be taken to solve one fundamental point—namely, the question whether the difference between electrifiable and non-electrifiable specimens of the same species of fibre is a matter of electrical conductivity or surface structure. To settle this question it will be necessary to devise a method of measuring the conductivity of fibres. As in any case the conductivity will be very small, none of the ordinary methods will be applicable, and the deciding of this question will have an important bearing on the future course of the research. Thus the question of the effect of the nature and the quantity of the oil used for wool will depend largely on the solution of this problem. The research will have two main branches—the study of the means of getting rid of electrification, and the study of the process of "ageing" wool, with a view to shortening the time required.

Crystal Palace School of Engineering.—The Crystal Palace school has given up the premises at the foot of the South Tower, which it has occupied since it started some 40 years ago, and next term will be at a new home on Anerley Hill, close by. Mr. J. W. Wilson, the principal, recently stated that something like 2,000 students had passed through the school; more than 200 were on the roll of honour, and four had gained the Military Cross.

Appointments Vacant.—Electrical engineer and fitter (£85 +), for the Axbridge Union; telegraph foreman (£250), for the Government of the Gold Coast; junior shift engineer (£104), for the Birmingham Corporation electricity department; assistant (45s.), for the motor and meter department of the Heywood Corporation electricity department; temporary chief clerk (£140), for the Aberdare U.D.C. electricity and tramways department. See advertisement pages to-day.

Volunteer Notes.—Engineering Institutions' V.E.C.—Orders for week commencing April 17th, 1916.—By Lieut.-Col. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, April 17th.—Sections 1 and 2, Technical; Sections 3 and 4, Squad and Platoon, Signalling Class.

Tuesday, April 18th.—6 to 7 p.m., School of Arms; 7.15 to 8.15 p.m., Recruit Drill.

Friday, *Saturday*, *Sunday*, *Monday*} Easter Training.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, April 13th, 1916:—

Battalion Parades.—Saturday.—Field Day. The Battalion will Parade outside Baker Street Station at 2.15 p.m., and proceed by train to Wembley Park, for Field Operations with the Corps of Citizens Battalion and other units. Operations will cease about 6.30 p.m.

Sunday.—The Battalion will Parade at Liverpool Street Station (low level entrance, G.E.R.), at 9.30 a.m., and proceed by train for Entrenching duties. The Battalion will return to town about 6 p.m.

Easter Holidays.—The Battalion will proceed for Entrenching duties on Saturday and Easter Monday.

Musketry.—The Ranges at Bisley and Acton will not be open on Saturday and Sunday next, the 15th and 16th inst.

A. G. Joiner, *Major and Adjutant*, O.B.C.

For Sale.—The Port Talbot Railway and Docks Co. has for disposal two sets of 44-kw. Belliss engines and Crompton dynamos, and two sets of 36-kw. Scott & Mountain engines and dynamos. See advertisement pages to-day.

Electrometallurgy in Spain.—The engineer Domingo de Orneta, who is the discoverer of valuable deposits of chrome, nickel, and ferric ores in the Serrania de Renda, gave an exposition recently before the Sociedad Malaguena de Ciencias of the measures he proposes to adopt for the electric smelting of the ores. Water power for the generation of electrical energy is available, and there are suitable sites for ironworks in the neighbourhood of the deposits. King Alfonso, in an interview granted in November last, conferred on Senor Orneta a concession for a complete scheme for the manufacture of ferro-chrome and ferro-nickel. Platinum obtained from these deposits is likewise the subject of present investigations.

An Electrician's Default.—At the Belfast Munitions Court, Wm. J. Burns, electrician, pleaded guilty to absence from work in a local engineering establishment without satisfactory reasons, and was fined 20s. The firm's representative stated that employment throughout the entire establishment was retarded by bad timekeeping in the electricity department.

Fatality.—Rotherham.—While A. Nicholls (40) was employed at the works of Messrs. Steel, Peech & Tozer, Ltd., cutting off lengths of steel with an electrically-driven saw, the saw broke, fracturing his skull and killing him. Verdict: Accidental death.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with th, technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—A long discussion *re* the resignation of the Oldham tramway manager (Mr. J. W. Dugdale) took place at the T.C. last week. The resignation was accepted at a private sitting, and the minute recording it added: "That Mr. Dugdale be paid his salary for a period of four months from date, and be relieved of all further duties in connection with the department."

The Walsall Electricity Committee has agreed to pay Mr. J. D. Spark, mains engineer, a bonus of £15 in respect of extra work performed by him up to the time the new station is working.

The Bury Corporation has increased the salary of Mr. J. G. Potts, electricity works superintendent, from £180 to £200 per annum, and the following other increases have been granted:—Mr. E. B. Pausey, chief shift engineer and assistant works superintendent, from £2 15s. to £3 per week; Messrs. J. Harridance, J. W. A. Renshaw, and V. Walker, shift engineers, from 50s. to 55s. per week; and Messrs. W. R. Bland, J. Stephen, and H. Strong, shift engineers, from 45s. to 50s. per week.

The Newport (Mon.) electrical engineer proposes to appoint Mr. W. H. S. Clarke, now distribution assistant, to the position of installations assistant, at £140 per annum. This fills the vacancy caused by the death of Mr. C. E. Covell.

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The Rotherham Tramways Committee proposes increases in salaries to Mr. C. Webster, chief traffic clerk, and Mr. H. Jagger, traffic superintendent.

The Fulham Electricity Committee recommends that Mr. G. Hicks, assistant mains superintendent, be appointed assistant mains superintendent and supervisor of meters. His salary is to be increased to £160, with a maximum of £200.

General.—Mr. Claude W. Hill has removed his offices to 19, Old Queen Street, Westminster, S.W.

Mr. W. O. Mercer, of the electrical department of Messrs. Vickers, Ltd., Sheffield, and later electrician-in-charge at Messrs. J. & G. Wells, Ltd., Holbrook Colliery, has been appointed electrician-in-charge to the group of collieries owned by the Nunnery Colliery Co., Ltd., Sheffield, and he desires to receive lists, &c., of cables, mining switchgear, &c., at the Nunnery Pit, Sheffield.

Sir William Crookes, O.M., and Lady Crookes celebrated their diamond wedding on April 10th.

Dr. Edward Hopkinson is one of the members selected to go to India in connection with the inquiry of the Indian Commission on Industrial Development.

Anticipating the calling-up of his "Group," Mr. G. W. P. Page, A.C.G.I., A.M.I.E.E., who, for the past two years, has been chiefly engaged on publication and other technical work in the publication department of the General Electric Co., Ltd., has enlisted in the London Electrical Engineers.

Mr. H. B. Rowell has been elected president of the North-East Coast Institution of Engineers and Shipbuilders for the 1916-1917 session.

On April 4th, at Glasgow, Lieutenant G. S. Helme, A.M.I.E.E., R.F.A., of Messrs. Kelsall & Parsons, engineers, Glasgow, was married to Miss A. C. Morton, of Barrhead, Glasgow.

Roll of Honour.—Second-Lieutenant H. P. Bramwell, R.F.C., reported wounded with shrapnel while doing photographic work over the lines, is shortly being sent home. At the outbreak of the war he was with the B.T.H. Co.

Private Fred Worsman, who was formerly employed at the Bradford Corporation electricity works, has been killed whilst on active service.

Private James Wilkinson, of the Manchester Regiment, who has died of wounds, was formerly with the British Westinghouse Co., at Trafford Park.

Private Ernest Budding, aged 19, formerly employed by Messrs. Ferranti, Ltd., was killed during a Zeppelin raid.

Nelson Electricity and Tramways Committee has decided to place on record its appreciation of the gallantry of Corporal J. W. Smith, a tram conductor in the employ of the department, who has been awarded the D.C.M.

Obituary.—Mr. Barnet Weatherley.—The death has occurred, in his 78th year, of Mr. Barnet Weatherley, of High Street, Lewisham, S.E., for many years in business as an electrical engineer in the Borough.

NEW COMPANIES REGISTERED.

E. Powell, Ltd. (143,534).—This company was registered on April 7th, with a capital of £4,000 in £1 shares, to take over the business of an electrical engineer, motor and cycle agent and engineer, and gunsmith, carried on by E. Powell, the elder, at 41, High Street, Tunbridge Wells. The subscribers (with 200 shares each) are: E. Powell, sen., 41, High Street, Tunbridge Wells, engineer; P. Powell, 41, High Street, Tunbridge Wells, engineer. Private company. The number of directors is not to be less than two or more than five; the first are E. Powell, sen. (permanent), E. Powell, jun., and P. Powell. Qualification, £200. Solicitor: E. C. Frend, Tunbridge Wells. Registered by Jordan & Sons, Ltd., 116-17, Chancery Lane, W.C.

H. G. Cooper, Ltd. (143,526).—This company was registered on April 6th, with a capital of £2,000 in £1 shares, to take over the business of an electrical engineer and general office furnisher carried on by H. G. Cooper at 6, Fen Court, E.C. The subscribers (with one share each) are: H. G. Cooper, 6, Fen Court, E.C., electrical engineer and general office fitter; G. S. Edwards, 28, Plashet Road, Upton Manor, Essex. Private company. The number of directors is not to be less than two or more than five; the first are H. G. Cooper, G. S. Edwards, and Alice H. Cooper. Qualification five shares. Registered office: 6, Fen Court, E.C.

Selective Signal Co., Ltd. (4,330).—This company was registered in Dublin on April 4th, with a capital of £5,000 in £1 shares, to acquire any interests in patent rights, licences, &c. The subscribers (with one share each) are: W. J. Lyons, Royal College of Science, Dublin; G. M. Meares, Fernhill, Dundrum, Co. Dublin, solicitor; J. Lindsay, 17, Westland Row, Dublin, engineer; W. Conan, 44, Kildare Street, Dublin, merchant; F. P. Griffith, Temple Gardens, Rathmines, Dublin, engineer. Private company. The first directors are W. J. Lyons, W. Conan, F. P. Griffith, and G. M. Meares. Qualification, £50. Registered office: 17, Westland Row, Dublin.

Innovation Light Co., Ltd. (143,505).—This company was registered on April 3rd, with a capital of £2,000 in £1 shares, to carry on the business of makers and vendors of gas mantles, manufacturers of and dealers in lamps, brackets, globes, films, shades, glasses, burners, meters, galvanometers, ammeters, voltmeters, carbons, cut-outs, switches, motors, batteries, stoves, turbines, pipes, wires, and appliances used in connection with gas, electricity, &c. The subscribers (with one share each) are: J. O. Stacey, 2, Norfolk Street, Strand, W.C., solicitor; J. M. Avery, 2, Bridge Road, St. Margaret's, Twickenham, clerk. Private company. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first. Registered office: 146, Bishopsgate, E.C.

Baxendale Bros., Ltd. (143,544).—This company was registered on April 8th, with a capital of £5,000 in £1 shares, to take over the business of a dealer in electrical supplies carried on by W. I. Baxendale at 29, Harrington Street, Liverpool, as Baxendale Bros., to carry on the same and the business of electricians, electrical and mechanical engineers, manufacturers of, dealers in, agents and contractors for electrical, mechanical, telegraphic, telephonic, photographic, optical, and other appliances, rubber, rubber hose, tires, motor cars, motor cycles, and accessories, &c. The company may not carry on any electrical business within 12 miles of the Manchester Town Hall, nor, prior to July 8th, 1923, carry on any business competing with the plumbers' material business of Baxendale & Co., Ltd., provided that this is not to restrict the company from dealing in plumbers' materials in a minor way as an adjunct only to its electrical business. The subscribers (with one share each) are: W. I. Baxendale, 5, Lingdale Road, West Kirby, Cheshire, dealer in electrical supplies; W. Walker, 81, Queen's Drive, Walton, Liverpool, manager (electrical supplies). Private company. The number of directors is not to be less than two or more than five; the first are W. I. Baxendale (permanent managing director, with £500 per annum) and W. Walker. Solicitor: J. T. Simpson, 42, Kennedy Street, Manchester. Registered office: 29, Harrington Street, Liverpool.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Isle of Thanet Electric Tramways & Lighting Co., Ltd.—Agreement to issue debenture stock, dated March 16th, 1916, to secure £6,500, and any sums which the mortgagee may have to pay under a joint and several promissory note for £3,000; also agreement to issue debenture stock of even date, to secure any sums which the mortgagee may have to pay under a joint and several promissory note for £3,000; also agreement to issue debenture stock of even date, to secure £2,500, and any sums which the mortgagee may have to pay under a joint and several promissory note for £3,000; also agreement to issue debenture stock of even date, to secure £2,500, and any sums which the mortgagee may have to pay under a joint and several promissory note for £3,000. Property charged: The company's undertaking and property, present and future. Holders: W. M. Murphy, 39, Dame Street, Dublin; A. R. Monks, 123, Cannon Street, E.C.; H. Brown, The Red House, Parkside, Wimbledon Common; and J. B. Glenn, Moorgate Station Chambers, Moorfields, E.C.

Bright's Light & Power Co., Ltd. (58,290).—Capital, £200,000 in £1 shares (100,000 pref.). Return dated December 31st, 1915 (filed April 5th, 1916). All shares taken up; £1 per share called up on 66,667; £66,489 5s. paid, leaving £177 15s. in arrears; £33,333 considered as paid on the remainder. Mortgages and charges: £16,000.

City of Buenos Aires Tramways Co. (1904), Ltd. (82,214).—Capital, £1,240,000 in £5 shares. Return dated February 29th, 1916. All shares taken up and considered as fully paid. Mortgages and charges: £174,000.

United Flexible Metallic Tubing Co., Ltd.—A memorandum of satisfaction in full on March 29th, 1916, of debentures dated January 1st, 1907, securing £5,000, has been filed.

Woodbridge & District Electric Light Co., Ltd.—Issues on various dates from October 27th, 1913, to March 31st, 1916, of £1,000 debentures, parts of a series of which particulars have already been filed.

H. J. Cash & Co., Ltd. (79,701).—Capital, £10,000 in £1 shares. Return dated February 29th, 1916. All shares taken up; 17s. 6d. per share called up; £8,750 paid. Mortgages and charges: Nil.

Cambridge Electric Supply Co., Ltd. (36,457).—Capital, £100,000 in £10 shares. Return dated March 8th, 1916. 9,911 shares taken up; £9 per share called up; £89,199 paid. Mortgages and charges: £30,000 first debentures; also one debenture with bankers, to cover £15,000.

Atlas Carbon & Battery Co., Ltd. (34,857).—Capital, £2,000 in £1 shares. Return dated December 29th, 1915 (filed March 7th, 1916). All shares taken up; £8 paid; £1,992 considered as paid. Mortgages and charges: £3,000.

Electric Train Lighting Syndicate, Ltd. (112,932).—Capital, £5,200 in £1 shares. Return dated March 20th, 1916. All shares taken up; 5s. per share called up on 900; £225 paid; £4,300 considered as paid on 4,300 shares. Mortgages and charges: Nil.

Crossley Bros., Ltd. (51,970).—Capital, £973,700 in 40,380 pref. and 57,031 ord. shares of £10 each. Return dated March 9th, 1916. All shares taken up; £278,200 paid on 27,820 shares; £695,500 considered as paid on 12,519 pref. and 57,031 ord. shares. Mortgages and charges: Nil.

CITY NOTES.

British Westinghouse Electric and Manufacturing Co., Ltd.

Mr. J. Annan Bryce, M.P., presided on April 6th, at Hamilton House, over the annual meeting of this company. He said that sundry creditors stood at £409,000, as compared with £265,000, the increase being due to the larger scale of the business. There was an increase of £5,000 in the reserve for employer's liability, which the board considered advisable in view of the abnormal conditions existing at the works, arising out of the extra pressure at which they were operated, the large amount of female labour employed, and the inexperience of the fresh labour from which they had had to recruit their forces. The balance of £44,632 carried forward was an increase of £36,511 over last year, and it was necessary in view of the legislation of last session. As the nature of the excess profit tax was not even now generally understood, he referred to this at some length. It was imposed largely in deference to the demand of workmen that their labour should not be exploited by manufacturers making exceptional profits through war conditions. If the tax had been imposed solely on profits due to the war no exception could have been taken, but it speedily appeared that it would have been difficult, if not impossible, to distinguish profits arising *from* the war from profits made *during* the war. Naturally, the Treasury chose the course which not only was simpler, but brought a great deal more grist to its mill, and, accordingly, the tax was imposed on all businesses which had made more

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profit during the war than before it. But it was unfair in all cases where a business was in a state of development, and where the larger profits in the year 1914 had no necessary connection with the war, and where, indeed, in many cases they would have been still larger but for the war. This was pre-eminently their own case. The war began on August 4th, 1914, and their accounts were closed on December 31st, 1914. They had, therefore, in their accounts only five months of the war, during the first of which business was almost paralysed, and during the last four of which it was exceedingly difficult to conduct owing to the loss of much of their skilled labour, partly by recruiting and partly from the sudden demands of the Government factories which, by enormous wages, tempted away many of their best men. Moreover, during the last four months of 1914, not only labour, but materials advanced in price, so that their costs were higher than estimated. Furthermore, in a business like theirs, the profits were not realised till long after the order was taken, and it might be said that none of their profits in the year 1914 were due to orders taken during the war months of that year, or even to orders taken in the pre-war months of that year. From all the above considerations they would see that not only were their larger profits of 1914, as compared with previous years, not due in any sense to the war, but were actually smaller than they would have been had there been no war. Yet they were called upon to pay to the Government half of the excess profits of 1914 over those of two out of the three pre-war years, 1911, 1912, and 1913, merely because, as the result of hard thought and hard work, their profits happened to be on an ascending scale, while other concerns which had reached their development sooner, were, though making far larger profits than themselves, entirely exempt from the tax. Surely, nothing more unfair could be imagined; yet the Chancellor turned a deaf ear to every argument, and in the Budget introduced two days ago he proposed to increase the injustice still further by raising the tax from 50 per cent. to 60 per cent. In August, 1915, they became a "controlled establishment" under the Munitions of War Act, 1915, and were consequently, as regarded the accounts for the year 1915, liable to a levy of 80 per cent. of their excess profits. How the taxing provisions of these two Acts would work out in practice had not yet been ascertained, as the basis of calculation was not quite the same, but the Chancellor of the Exchequer had announced in his Budget speech that he was determined to make the best of both worlds, and would levy the taxation under whichever Act gave the best return to the Treasury. The ordinary income-tax had within the last two days been raised from 3s. 6d. to 5s., and how much further it would go would depend on the duration of the war. Had the report been delayed until after the Budget, he was by no means sure that the directors would not have decided on a still greater provision. On the credit side of the balance sheet, stock and material on hand £1,098,000, showed a large increase on last year's figures of £759,000, but that and the increase of £128,000 in "sundry debtors" was accounted for mainly by the increased scale of the business, and partly by their having to work as a controlled establishment. Shares and debentures in other companies stood at about the same figure, but there had been an exchange of shares with their American friends who had parted with their holding in the French Co. in return for shares in the Traction & Power Securities and Clyde Valley Companies. In the profit and loss account, the net profit was £176,752, against £151,627, an increase of £35,125. It was not so large an increase as was shown in 1914 over 1913, but, under the circumstances, could be considered satisfactory. With regard to the business generally during 1915, their total orders received compared with those of 1914 showed an increase over the latter year of about 73 per cent., but this included one large single order for the electrification of an important railway amounting to about £500,000, to which there was no corresponding order in 1914, and certain war munitions work. After eliminating these two items, the general orders still showed an increase over 1914 of some 30 per cent. A considerable part of this increase was probably due to the absence of German competition, from which they had suffered so much in the past. They must hope that when peace was concluded this competition would be scotched for some time to come. Mr. Lloyd George was doubtless actuated by Christian principles when, in a speech the other day, he deprecated the introduction of revenge into the business, but, with human nature as it was, it would be surprising if the nations who had suffered from German barbarism were content to kiss and be friends, receiving Germany back into the comity of nations as if nothing had happened. And revenge apart, did not the policy of "kiss and be friends" simply mean that they would again lay themselves open to that unscrupulous penetration, as a step to domination, from which all the world had so long been suffering? The Commonwealth of Australia, under the bold leadership of Mr. Hughes, had already shown that she did not mean to run any such risk, and perhaps Mr. Asquith, during his journeyings, might have learned something of the intentions of their Southern Allies. Those who knew what was going on to-day in France were aware that she, at least, was determined in the future to allow no penetration, however peaceful. Both their domestic and Continental orders showed a good increase, but, as was only natural, having regard to prevailing conditions, their export sales showed some falling off. It was interesting to note that, notwithstanding the changed conditions at their works, they had had the minimum of friction with their workpeople, and, generally speaking, the most wholehearted assistance; and much credit was due to the tactful manner in which those in charge had dealt with the many difficult problems presented by present conditions. At the outbreak of the war they had on their hourly pay rolls 4,720 men and 513 women, = 5,233 total, while at the present time they had 5,504 men and 1,344 women, = 6,848 total. The Chairman next dealt with the war relief fund inaugurated by the staff to assist the dependents of men called to the Colours, and said the employés had raised £13,648, to which the board added £6,291. The number of men who had joined the Forces was approximately 2,000, and of these 70 had been killed in action, and many grievously wounded. In addition to this, some 3,500 men had attested under Lord Derby's scheme. Their school for the instruction of apprentices had grown considerably. Whereas on January 1st, 1914, they had 100 apprentices, of whom 30 attended school, on January 1st, 1916, they had 330 apprentices, of whom the whole number attended school, in addition to which 120 had joined the Colours; and they were particularly pleased to state that the class of boy now attracted to the works was greatly superior to that in former years. Twenty-three of their foremen were giving lectures, numbering in all nearly 100 in the course of the year, and the co-operation between school and shops was improving all the time. They had also inaugurated classes for girls engaged in the drawing offices, and were preparing a class for girl meter testers. The work of the school was attracting great interest on account of its novel nature. Four of the chief inspectors of the Board of Education had visited the school and discussed very fully the lines on which it was conducted, and Mr. Fleming had had several conferences with leading officials of the Board on the system pursued. Inquiries with regard to their methods had been received from many public bodies, companies, and private firms, and the fame of their system having spread, numerous applications for apprenticeships were coming from all parts of the country. Altogether, the school seemed to be doing a valuable pioneer work, and the greatest credit was due to Mr. Fleming, the superintendent of the transformer department, who had initiated and developed the scheme, and to those who had co-operated with him. Let them pay the devil his due. The efficiency of Germany, everyone must admit, was mainly due to the development of such methods of technical training, in which, unhappily, England had till now lagged behind. He did not believe in being too optimistic, neither did he desire to go to the other extreme, but they must all appreciate the trying times through which they were now passing, and, while their accounts showed that they had still further progressed over those of last year, there were indications that they might be still further taxed in order to help towards the heavy expenditure due to this devastating war, and further difficulties might be placed in the way of carrying on their normal business. Orders were still coming in well, and at the moment were slightly in excess of those at the corresponding period of last year, but it must be remembered that the large railway order in 1915, to which he had alluded above, was an exceptional one. Last year he discussed the destruction of capital likely to be caused by the war, and hazarded an estimate of 5,000 million pounds. That estimate to-day appeared absurdly moderate. Certainly they must look to a diminished purchasing power in the world, and a consequent depression in industry, but that depression would probably not show itself immediately after the war ended, and he still held to the view that even when it did come it might not affect, at least at first, industries such as theirs, which were necessary for the purposes of reconstruction and the economical working of other industries, especially as in their particular business the pressure of German competition was not likely to be so severe. It was partly due to their anticipation of post-war conditions that, with a view to broadening the basis of their business, they acquired the controlling interest in the French company. In France, as in England, German competition was before the war exceedingly keen, while after the war it was even less likely to be felt than here. The Italian company, in which they held through the French company a controlling interest, was also fully employed, mainly on munitions work, but here, also, the post-war prospects were good. The use of electrical apparatus, both for railway and other purposes, appeared likely to increase largely, while in Italy also a diminution of German competition appeared probable, though perhaps not to so great an extent as in France.

Mr. N. B. Dickson seconded the motion.

Mr. Tomkinson did not think Mr. Lloyd George intended they should kiss and be friends, and thought that it would be detrimental for such a statement to go out from that meeting.

Mr. Acland emphasised the injustice done to shareholders in the company, who had received no return for years, by the imposition of the excess profits tax. He suggested that they might protest to the Government, and say they would close their factory against Government orders.

Mr. Birks thought the shareholders would have something to say with regard to closing the factory. He saw no reason for the Chairman speaking in a minor key.

The Chairman said the interpretation put on Mr. Lloyd George's speech was not his, but that put on it by the Press. He had been a Free Trader all his life, and went into Parlia-

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ment ten years ago to defend Free Trade. In a proper ideal state of affairs he was still a Free Trader, but could anyone go and shake hands with a man who had been robbing and violating and slaughtering all over the world? He did not feel he could do that, and, after all, nations were made up of individuals. He did not feel that this country, and still more France, Belgium, and Russia, would "kiss and be friends" with Germany after the war. If the Germans in the course of years became civilised, if they became entirely regenerated and changed their whole view of life, it might be possible to be friends with them. He had already urged the injustice of the excess profits tax in the case of a company like theirs, but he had not the slightest hope of convincing the Chancellor of the Exchequer.

The report was then adopted. A hearty vote of thanks to the staff was carried.

German Electrical Companies.

The Voigt & Haeffner A.G., of Frankfort-on-Main, proposes to distribute 12 per cent. for 1915, as contrasted with 8 per cent. in the preceding year.

The Dr. Paul Meyer A.G., of Berlin, which company makes switch apparatus, and closed the year 1914 with a deficit of £10,000, intends to pay a dividend of 7½ per cent. for 1915.

The report of the *Norddeutsche Kabelwerke A.G., of Neukolln*, which company was formed about a year and a half ago under the heading of the Mix & Genest Co. to acquire an undertaking having the same title, states that the results achieved in the year ended with September 30th, 1915, corresponded to expectations. The gross profits total £12,700, and the net profits £6,500, and a dividend at the rate of 8 per cent. has been declared.

The report of the *Deutsche Kabelwerke, of Berlin-Lichtenberg*, states that the company was satisfactorily occupied during 1915. Including the balance brought forward, the gross profits amounted to £73,000, as against £98,000 in 1914, but on this occasion the profits have been arrived at after making reserve provision for outstanding debts, investments, &c. After deducting general expenses, &c., and appropriating £1,500 for depreciation—all other accounts are already written off—the accounts exhibit net profits of £35,000, as compared with £32,000 in 1914. The dividend proposed is 6 per cent., as in the preceding year.

The Sachsenwerk Licht und Kraft A.G., of Niedersedlitz—the former Kummer works—reports that ordinary requirements in electrical manufactures existed in 1915, principally for various authorities and large industrial works. The change over for the production of war material which was begun in 1914 was continued last year, and the total turnover exceeded £1,500,000. As gross profits, the accounts show the sum of £209,000, as compared with £66,000, and net profits of £184,000 and £47,000 in the two years respectively. The directors propose a dividend of 18 per cent. on the ordinary capital of £225,000, as compared with 8 per cent. in 1914.

Swiss Electrical Companies.

The accounts of the *Aluminium Industrie A.G., of Neuhausen*, show net profits, including £14,000 brought forward, amounting to £379,000 for 1915, as compared with £280,000 in the preceding year. After allocating £140,000 to the fund for the gradual payment in full of the share capital, which at present is paid up to the extent of 60 per cent., it is proposed to distribute 20 per cent. on the paid share capital, being the same rate as in 1914.

The Société d'Exploitation des Cables Electriques, of Cortaillod, reports gross profits of £10,000 for 1915, as contrasted with £6,900 in 1914. The amount set aside for depreciation is £3,500, as against £2,900, and the net profits and balance forward are returned at £10,900, as compared with £9,500 in the preceding year. It is intended to pay a dividend of 30 per cent. on the share capital of £20,000, the rate in 1914 having been 25 per cent.

The Schweiz. Gesellschaft fur Elektrische Industrie, of Basle, which is an investment company associated with the Basle Handelsbank and the Siemens & Halske group, records gross profits of £173,000 for 1915, as against £193,000 in the previous year. After meeting interest on the loans totalling £2,400,000, and making various appropriations, the accounts indicate net profits of £49,000, as compared with £69,000, and the directors recommend a dividend of 5 per cent. on the share capital of £800,000, this contrasting with 7 per cent. in 1914. The undertakings in which the company is interested continued favourably to develop, with few exceptions, in the past year, but no new transactions were embarked upon.

Folkestone Electricity Supply Co., Ltd.

The annual meeting was held on March 31st. Ald. G. Spurgen said that, considering the abnormal circumstances under which the company had been working during the past year, the financial results were in every way satisfactory. The restricted lighting orders had necessarily affected to some extent the revenue receipts from private users and for public lighting. Substantial allowances had been made to the municipal authorities concerned. Capital expenditure during the year was £2,689. The all-round advances in the prices of materials and other costs were responsible for increased costs of production. Coal was the principal item, and their contract having expired they were obliged to enter into a fresh one at prices very considerably advanced. The gross profits amounted to £16,758, and although those figures were less than the corresponding amount of 1914, they were consoled by the fact that they had a larger amount to deal with as brought forward, and much less provision to make for the special items of depreciation. After payment of the usual debenture interest and preference dividend, they were able to maintain the same dividend on the ordinary shares (7 per cent.) as last year, to place £5,000 to the depreciation fund, £500 to the reserve, and to carry forward £2,602. During the year 2,333,415 units were generated, and 1,753,390 were sold. There were 116 new consumers, with an equivalent of 7,508 8-c.p. lamps. So far 22 men had joined the Imperial Forces, and half wages, amounting to £735, had been paid.

Clevedon, Portishead and District Electric Supply Co., Ltd.

The directors report a very satisfactory growth of the undertaking, the gross revenue for 1915 being almost exactly double that of 1914. The consumers connected to the mains in Portishead had increased from 130 to 179, and the new substation at Bower Ashton, now complete, had been supplying the South Liberty Colliery since Michaelmas. Further motors were now being put down at that colliery. The total revenue was £1,737, as against £887, and the gross profit was £696, against £444. The net profit was £487 (against £343), plus £72 brought forward. After paying 6 per cent. on the preference and 2½ per cent. on the ordinary shares, £150 was put to depreciation fund, £100 was put to writing down preliminary expenses, and £37 was carried forward. Units sold were 209,524, as against 56,006 in 1914. A further issue of 6 per cent. preference shares is being offered to holders, for extension purposes. The board thanks Messrs. Christy Bros., Ltd. for advancing (at 5 per cent. and without any security) the sums necessary to complete several very lucrative extensions. The Board of Trade is considering the company's application for leave to extend the mains through the village of Long Ashton.

Urban Electric Supply Co., Ltd.

For 1915 the gross profit was £68,513, as against £68,962, and after deducting expenses the balance was £65,312. Interest and debenture stock redemption absorb £43,423, leaving £21,889, which is applied thus:—5 per cent. dividend on preference shares, £12,500; to reserve for depreciation, £9,389. Annual meeting: Yesterday.

The following comparative table shows the equivalent in 33-watt lamps connected, also the profits:—

	Lamps.			Profits.		
	1913.	1914.	1915.	1913.	1914.	1915.
Hawick	76,964	82,665	91,909	£4,952	£5,503	£7,460
Stamford	40,261	44,985	49,948	2,004	2,351	2,643
Weybridge and Walton	78,725	86,545	93,122	5,881	6,281	5,473
Godalming	37,759	40,268	43,633	3,443	3,040	2,585
Twickenham and district ..	146,462	167,492	194,338	12,129	12,128	12,960
Dartmouth	26,539	27,393	27,948	2,171	1,821	1,886
Camborne and Redruth ("A") and Cornwall ("B")	179,038	199,877	215,202	"A" 7,882 "B" 11,775	"A" 7,477 "B" 17,325	"A" 7,499 "B" 14,273
Newton Abbot	24,950	28,647	32,852	2,252	2,549	2,451
Grantham	42,902	46,235	50,538	3,182	5,636	7,014
Glossop	35,422	36,390	38,341	2,651	3,018	3,727
Berwick	24,958	26,721	28,948	1,728	1,548	932
Caterham	19,916	21,079	23,421	2,074	1,925	1,688
Newbury	26,423	28,222	30,305	2,746	3,505	3,357
Totals	760,319	836,519	920,505	£64,871	£74,107	£73,890

Altrincham Electric Supply, Ltd.

During 1915, 76 new installations were connected to the mains, and the number of consumers is now 1,632. £4,059 new capital was expended. After providing for debenture interest, premium on debenture redemption policy, legal expenses, &c., the profit was £5,578, plus £1,567 brought forward, making £7,145. The dividend on the preference shares is paid, £500 is transferred to general reserve, and £1,500 to reserve for depreciation of plant, leaving £4,016 to be carried forward, out of which a dividend of 7s. 6d. per share is to be paid on the deferred shares, absorbing £2,625. The units sold were 1,676,081; units generated 2,059,855.

Brush Electrical Engineering Co., Ltd.

The report for the year 1915 states that the volume of output has been maintained, but high wages, the shortage of skilled labour, and heavy increases in the cost of fuel and materials have all tended to offset the improvement that would otherwise have been apparent in the net earnings. After providing for general charges, maintenance of plant and buildings, and interest on debenture stocks and loans, there remains £17,300, and £7,065 was brought in, making £24,365. The directors recommend that £8,000 be applied for depreciation of property, patents, and goodwill, £2,044 in payment of the further 4 per cent. interest to which holders of the 6 per cent. prior lien participating second debenture stock are entitled out of the first net profits available for dividend in any year, and £5,000 placed to reserve, carrying forward £9,321. £31,955 has been expended on capital account during the year, and the directors have not yet issued the balance of the 6 per cent. prior lien participating second debenture stock referred to in the last report, for the issue of which consent of the Treasury has been obtained.—*Financial News.*

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Cork Electric Tramways and Lighting Co., Ltd.

The revenue for 1915 was £63,905, and the expenses were £42,415, leaving £21,490, plus £2,480 brought forward. Interest on debentures requires £4,600; 5 per cent. preference dividend £6,163; there is added to reserve for depreciation and renewals £6,500; £1,776 is to be written off wiring consumers' premises, repair shop equipment, plants on loan, &c.; £890 written off investments; and £4,041 is to be carried forward. Lighting and power business continues to show satisfactory progress, agreements for 147 connections being made, the additional connections amounting to 405 KW., as against 467 KW. in 1914. The revenue increased by £2,301, and the expenses by £4,457, due to high price of coal, war bonuses and allowances. The net revenue shows a material reduction in consequence, and no dividend on the ordinary shares is possible, as it is necessary to carry forward a larger sum than usual to provide against further increases in coal and other materials. Owing to the increase in expenses, the lighting and power tariff was raised from July 1st last, but the additional charges to the consumers represents a very small percentage of the increased cost of operating. £1,663 was spent on capital account, mainly for house services and cables, during the year. The 1,250-KW. Curtis turbine will be delivered shortly. Annual meeting: April 19th.

Passengers carried 5,899,003, as against 5,858,904 in 1914; car mileage 870,094, as against 832,227; lighting and power customers 2,973, as against 2,826; 8-c.p. lamps, 200,030, as against 186,477.

Woking Electric Supply Co., Ltd.—Mr. J. Ashby presided at the annual meeting, and, in referring to the large amount set aside to depreciation and renewals fund and to reserve account, he said that the company was not affected to any material extent by the war, but they could not say what might happen. The cost of coal had increased by £205 (6 per cent.), but they had sold 31,841 more units. It was largely due to the efforts of Mr. Bowden that they had reduced the coal consumption per unit. The increase in sales was largely due to the extra number of cookers sold during the year, there having been a great demand for cookers and heating apparatus.

Wycombe (Borough) Electric Light and Power Co., Ltd.—The connections increased during 1915 by 137 KW. to 2,392 KW. Including £184 brought forward, there is a net profit of £7,065, and after paying interest on debentures and outstanding accounts amounting to £3,263, £3,802 is available. A dividend of 2½ per cent. absorbs £1,000, £2,000 is to be placed to the reserve fund for renewal account, leaving £802 to be carried forward.

Lymington Electric Light & Power Co., Ltd.—Including £897 brought forward, there is a net profit of £2,447, and after paying debenture interest £450, and income-tax £112, £800 is placed to reserve, 5 per cent. dividend is paid on the preference shares, and £764 is to be carried forward. During the year £1,512 was invested in Colonial Government stock and War Loan.

Western Union Telegraph Co.—The *Times* New York correspondent states that this company reports for 1915 gross operating revenues of $51,171,795; operating expenses and taxes, $10,199,254; income from investments, $1,303,926. Interest charges amounted to $1,335,588, and the balance available for dividends is $13,531,921. The surplus, after providing for dividends, is $8,545,557. The total accumulated surplus is $18,882,969.

Yorkshire (Woollen District) Electric Tramways, Ltd.—A dividend of 4½ per cent. on the ordinary shares is to be paid for 1915, and £2,948 is to be carried forward. The revenue increased from £65,385 to £71,593.

Western Telegraph Co., Ltd.—Should the present net revenue be maintained, the directors will recommend at the general meeting a bonus of 2 per cent., which, together with the ordinary dividend of 6 per cent., will make a total of 8 per cent., free of income-tax, for the year.

Eastern Telegraph Co., Ltd.—A final dividend of £2 5s. per cent., and a bonus of 2 per cent., both free of tax, making a total of 8 per cent. for the year on the ordinary stock, are announced.

Eastern Extension, Australasia and China Telegraph Co., Ltd.—A final dividend of 4s. 6d. per share is announced, together with a bonus of 4s. per share, both free of tax, making a total of 8 per cent. for the year.

Lancashire Dynamo & Motor Co., Ltd.—The *Financial Times* says that from various causes the balance sheet cannot be issued until some weeks later than usual, and the directors have, therefore, decided to pay a further interim dividend of 4½ per cent., free of tax.

Direct United States Cable Co., Ltd.—A final dividend of 2s. per share, less income-tax at 3s. 2d. in the £, making the total for the year 4 per cent., is announced.

Kalgoorlie Electric Power & Lighting Corporation, Ltd.—A dividend at the rate of 4 per cent. per annum for the past half-year has been declared.

Bombay Telephone Co., Ltd.—An Indian exchange states that this company proposes to increase its capital to Rs. 20,00,000 by the creation of 41,600 new shares of Rs. 25 each.

Sao Paulo Tramways, Light & Power Co.—A dividend of 2½ per cent. on the issued common stock is announced.

Rio de Janeiro Tramway, Light & Power Co.—A dividend of 1½ per cent. on the issued capital stock is announced.

STOCKS AND SHARES.

TUESDAY EVENING.

The effects of the Budget are beginning to be felt in the Stock Exchange markets, and certain of the purely investment sections show some slight heaviness in tone. On the other hand, the imposition of heavier income-tax is making investors eager for such stocks and shares as those upon which the dividends are paid free of tax. In our lists there are various examples to be found in the telegraph market; while, in the Home Railway list, Underground Electric income bonds fall into the same category.

Generally speaking, business throughout the House is not at all bad, and the way in which the attractions of Exchequer Bonds are being re-advertised suggests that the Treasury may postpone, for some time to come yet, the issue of another War Loan. This consideration counteracts in no small degree the full effect of the 5s. income-tax; and investment has been resumed on behalf of the people in the Midlands and the North who are making money out of the various industries connected with the war.

Underground Electric incomes have risen 3 points to 86, and the shares are better at 1¾, while, sympathetically, the shilling shares improved to 6s. Another dramatic feature is a rise, also of 3 points, in Districts, this taking the price to 19¾. Dealers in the market are at a loss to account for the buying, but the surmise is that some American group has taken the stocks in hand—or, rather, has tried to do so. Perhaps a more natural explanation lies in the limited character of the market. A demand for £5,000 District stock—which, after all, would involve less than £1,000 money—is quite sufficient nowadays to move the price a couple of points or more. Metropolitans went up 1¼, and there has been rather more demand for South Western deferred, upon renewal of the statement that the company is doing well with its electrified system.

The Telegraph market shows the principal movements. As we have pointed out on several previous occasions, there is not much floating stock, beyond that which became available through deceased accounts; and the greater part of this was taken towards the end of last week. Good rises have occurred in Eastern Telegraph ordinary stock, Eastern Extension, and Western Telegraph shares. Globe ordinary gained 7s. 6d. That it is the matter of income-tax which is the principal attraction is obvious from the fact that the stocks of the Anglo-American and other companies which pay their dividends less tax have hardly participated—at any rate, up to the present—in the strength of the lists. The only exception is Great Northern Telegraphs, which are £1 higher.

Manufacturing shares are good. British Insulated are up 2s 6d., Telegraph Constructions £1, Henleys 5s., British Westinghouse preference 1s. 3d., and Electric Constructions 6d. Several of the others which exhibit no quotable change are difficult to buy at anything like the nominal prices. General Electric preference fell 5s. to 9½, and this is the only exception to the firmness of the market as a whole.

Electricity Supply prices keep somewhat irregular. The market is certainly getting into a healthier condition, and buyers are on the *qui vive* for cheap shares. The attention of these purchasers turns this week to the ordinary shares of the City, the County, and Westminster Companies. Chelseas have eased off, with Bromptons and Kensingtons. All the companies in this department pay their dividends less tax.

More favourable attention is being directed to Mexico. The stocks of the railway companies operating in the country are in some request, and there has been a little inquiry for the bonds of the utility concerns. Mexican Light & Power bonds are better, but Mexican Tramways are not quotably altered, though it is more difficult to get the offer of them than it was a week or a fortnight ago. The unexpected reappearance of Felix Diaz, the son of the old President, has reinforced the wavering hope that order will ever be restored in Mexico, although it is far from clear as to what recognition he will receive from the United States, committed, as they apparently were, to uphold the claims of Carranza.

Brazilian securities are also a little more popular, though Brazilian Tractions, after being 56, reacted to 54¼. The Argentine descriptions remain tolerably steady, but investors are a little cautious about the Argentine Republic at the present time, having regard to the unfavourable news with reference to the maize crop and the distinctly unpleasant nature of the traffic receipts on the various railways.

Canadian and American utilities are mostly good. The sensational rise in City Services common shares took the price up to within a point or so of 200, from which it fell back to 190 on sales by those who had got in early, when the rumours were first circulated as to the company's having discovered oil on its property. British Columbia Electric preferred and deferred stocks are both a point down, although the 4½ per cent. debenture hardened to 62.

Interest in Marconis stands arrested for the time being, awaiting a more definite statement from the Government as to what the company will receive for the use of its system. The United States has bought a few American Marconis, but the price has not improved to any noticeable extent; and Canadians loiter in the neighbourhood of 7s. 6d.

Armament shares are mostly better, thanks to the declaration by Armstrongs of a good dividend. The rubber market, too, is good, although business has fallen off fairly substan-

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tially from what it was a fortnight ago. The shrinkage of business, however, has not brought about profit-taking to the extent that it usually does in such cases.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price April 11, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6⅞	— ¼	£7 8 2
Charing Cross Ordinary	5	5	8½	—	7 18 10
do. do. do. 4½ Pref.	4½	4½	8¼	—	6 18 6
Chelsea	5	4	8⅞	— ½	6 8 1
City of London	9	8	11⅞	+ ¼	6 14 9
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10½	+ ⅛	6 16 7
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	9	7	5	— ¼	7 0 0
London Electric	4	3	1	—	9 0 0
do. do. 6 per cent. Pref.	6	6	4½	—	7 5 5
Metropolitan	3½	3	2⅝	—	6 4
do. 4½ per cent. Pref.	4½	4½	8	—	7 10 0
St. James' and Pall Mall	10	8	5⅞	—	6 16 2
South London	5	5	2⅝	—	8 18 10
South Metropolitan Pref.	7	7	1⅞	—	6 14 0
Westminster Ordinary	9	7	5½	+ ¼	6 1 9
Telegraphs and Telephones.		Dividend, 1914.			
Anglo-Am. Tel. Pref.	6		98½	—	6 1 10
do. Def.	33/6		21½	—	7 19 3
Chile Telephone	8		6⅝	—	6 5 6
Cuba Sub. Ord.	5		7⅞	—	6 9 0
Eastern Extension	7		18½	+ ⅛	*5 5 8
Eastern Tel. Ord.	7		131	+ ½	*5 6 10
Globe Tel. and T. Ord.	6		10½	+ ⅛	*5 11 8
do. Pref.	6		10	—	6 0 0
Great Northern Tel.	22		85½	+1	6 4 0
Indo-European	13		50	—	6 10 0
Marconi	5		2·7/16	— ⅛	4 11 4
New York Tel. 4½	4½		100⅞	—	4 9 4
Oriental Telephone Ord.	10		1⅝	+ ⅛	8 6 8
United R. Plate Tel.	8		6	+ ⅛	*6 13 4
West India and Pan.	1		1 1/16	—	9 10 6
Western Telegraph	7		13½	+ ⅜	*5 5 8
Home Rails.					
Central London, Ord. Assented	4		67½	—	5 18 6
Metropolitan	1½		24⅜	+1¼	4 9 0
do. District	Nil		19⅞	+⅜	Nil
Underground Electric Ordinary	Nil		1⅜	+ 1/16	Nil
do. do. "A"	Nil		6/-	+6d.	Nil
do. do. Income	6		86½	+3½	*6 18 9
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6		4⅞	—	6 8 1
Anglo-Arg. Trams, First Pref.	5½		8⅜	—	7 6 8
do. 2nd Pref.	5½		8⅝	—	8 3 0
do. 5 Deb.	5		78	—	6 8 2
Brazil Tractions	4		54½	—	6 8 5
Bombay Electric Pref.	6		10½	—	5 17 8
British Columbia Elec. Rly. Pfce.	5		53	—	9 8 8
do. do. Preferred	—		37	—1	Nil
do. do. Deferred	—		33	—1	Nil
do. do. Deb.	4½		62 xd	+ ½	6 17 1
Mexico Trams 5 per cent. Bonds	—		41	+	Nil
do. 6 per cent. Bonds	—		35	—	Nil
Mexican Light Common	Nil		20	—	Nil
do. Pref.	Nil		32	—	Nil
do. 1st Bonds	—		41	+ 3	—
Manufacturing Companies.					
Babcock & Wilcox	14		23	—	5 1 8
British Aluminium Ord.	5		23/6	—	4 5 0
British Insulated Ord.	15		104½	+ ½	7 2 10
British Westinghouse Pref.	7½		2 7/8	+ 1/16	7 5 8
Callenders	15		11⅛	—	6 10 5
do. 5 Pref.	5		4½	—	5 17 8
Castner-Kellner	20		8⅝	—	6 8 0
Edison & Swan, £8 paid	Nil		7/-	—	Nil
do. do. fully paid	Nil		1½	—	Nil
do. do. 5 per cent. Deb.	5		57 xd	—	8 15 8
Electric Construction	6		15/6	+6d.	7 14 1
Gen. Elec. Pref.	6		9⅛	— ⅛	6 6
Henley	20		15	+ ¼	*6 13
do. 4½ Pref.	4½		4	—	5 12 6
India-Rubber	10		9½	—	*10 10 6
Telegraph Con.	20		85½	+1	*6 13 4

* Dividends paid free of income-tax.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month. £		No. of weeks.	Total to date. £		Route miles open.	Inc.
Blackpool-Fleetw'd	April 1	1,168	— 162	13	4,060	— 83	8	..
Bristol (Trams)	Mar. 31	16,915	+ 181	13	57,361	+ 2,713	30·5	..
Cork	„ 30	1,722	— 85	13	5,829	+ 76	54·25	..
Dublin	„ 31	22,801	+ 246	13	75,344	+ 4,297	9·89	..
Hastings	„ 31	2,780	— 251	..	..	— 38	19·8	..
Lancashire United	„ 29	6,128	+ 25	13	20,247	+ 1,024	42	..
Llandudno-Col. Bay	„ 31	750	— 124	13	3,253	— 54	6·5	..
Tyneside	Mar. 15	1,885	— 193	11	5,272	— 179	11	..
Anglo-Argentine	Mar. 15	214,081	+5,528	12	609,322	— 1,354	..	..
Auckland	„ 10	20,711	+ 804	86½	189,937	+ 8,002	26·42	1·68
Calcutta	„ 28	18,038	+1,497	..	..	+ 836	..	..
Kalgoorlie, W.A.	Jan.	2,326	..	..	..	..	..	..
Madras	Mar. 31	4,853	+ 311	13	12,554	+ 1,280	..	..
Montevideo	March	31,956	+2,240	21	158,422	+10,553	..	..
Dublin-Lucan Rly.	Mar. 31	489	— 98	13	1,466	— 89	7	..

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, April 12th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/8	..
a Ammoniac Sal	„	£70	..
a Ammonia, Muriate (large crystal)	per ton	£54	..
a Bisulphide of Carbon	„	£28	..
a Borax	„	£28	..
a Copper Sulphate	„	£49	..
a Potash, Chlorate	per lb.	2/6	..
a „ Perchlorate	„	2/-	..
a Shellac	per cwt.	96/-	..
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	„	£14	..
a „ Lump	„	£9	..
a Soda, Chlorate	per lb.	1/4½	..
a „ Crystals	per ton	120/-	60/- inc.
a Sodium Bichromate, casks	per lb.	10d.	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	1/4½ to 1/4⅝	..
c „ Tubes (solid drawn)	„	1/5 to 1/6½	..
c „ Wire, basis	„	1/4½ to 1/4⅝	..
c Copper Tubes (solid drawn)	„	1/6½ to 1/6⅝	..
g „ Bars (best selected)	per ton	£148	..
g „ Sheet	„	£148	..
g „ Rod	„	£148	..
d „ (Electrolytic) Bars	„	£135	£2 dec.
d „ „ Sheets	„	£153	£3 dec.
d „ „ Rods	„	£142	£3 dec.
d „ „ H.C. Wire	per lb.	1/4⅞	½d. dec.
f Ebonite Rod	„	3/-	..
f „ Sheet	„	2/6	..
n German Silver Wire	„	2/2	..
h Gutta-percha, fine	„	6/10	..
h India-rubber, Para fine	„	3/0½	½d. dec.
i Iron Pig (Cleveland warrants)	per ton	95/-	6/3 inc.
l „ Wire, galv. No. 8, P.O. qual.	„	£33	..
g Lead, English Pig	„	£35 5	15/- dec.
g Mercury	per bot.	£16 12 6 to £16 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e „ „ „ medium	„	8/6 to 6/-	..
e „ „ „ large	„	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/8½	..
r Steel, Magnet, in bars	per ton	£35	..
g Tin, Block (English)	„	£201	..
n „ Wire, Nos. 1 to 16	per lb.	2/11	2d. inc.

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Holsworthy Gas & Electric Supply Co., Ltd.—Mr. J. Mc. T. Dickson, presiding at the annual meeting, said that the stand-by plant for the electricity undertaking, which had been contemplated ever since the inauguration of the company, was about to be installed at a cost of between £400 and £500, which would be raised by 5 per cent. second debenture stock shares. The receipts from sale of electricity amounted to £296 during 1915, and from gas £1,086.

Isle of Wight Electric Light & Power Co., Ltd.—The accounts for 1915 show a profit, including £2,374 brought in, of £12,867. After providing for interest and sinking fund on debentures and the 5 per cent. preference dividend, the directors transferred £3,500 to the renewal fund and carried £1,367 forward.—*Financial News.*

International Lighting Association.—For 1915 the net profit was £1,505. After paying the preference dividend, 5½ per cent. for the year, £451 is to be carried forward.

Cambridge Electric Supply Co., Ltd.—The profit for 1915, including £2,647 brought forward, was £12,006. After placing £2,000 to depreciation account, and paying 5 per cent. dividend, £2,753 is to be carried forward.

Winnipeg Electric Railway Co.—The *Financial Times* states that the net earnings for 1915 were $1,331,737, as compared with $1,685,093 for the previous year. After providing for fixed charges and dividends amounting to 9½ per cent., the net result was a deficiency of $388,898, reducing the credit balance brought forward to $782,598.

Oriental Telephone & Electric Co., Ltd.—A dividend on the preference shares at the rate of 6 per cent. per annum for the last half of 1915, less income-tax, is announced, also a final dividend of 6 per cent. on the ordinary shares, free of income-tax, making a total of 10 per cent. for the year.

City of Oxford Electric Co., Ltd.—After paying a dividend of 4½ per cent., £355 is transferred to reserve and £1,563 is carried forward.

Monte Video Telephone Co., Ltd.—An interim dividend at the rate of 6 per cent. per annum for the half-year, less tax, is announced.

Leamington and Warwick Electrical Co., Ltd.—After paying 5 per cent. dividend, £1,883 is to be carried forward.

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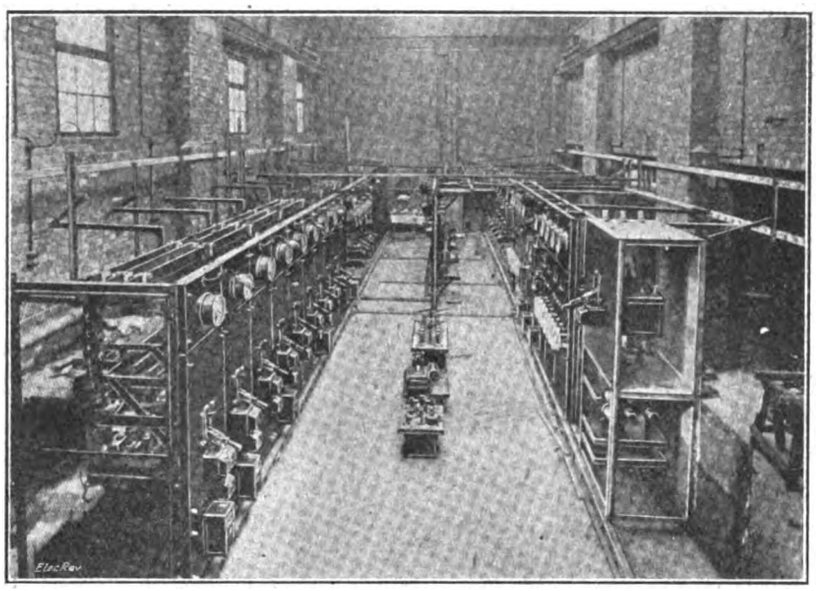
SWITCHBOARDS IN THE MAKING.

ALTHOUGH the standardisation of electrical apparatus and plant has made considerable progress in late years, yet in certain directions considerable variation in arrangement or design is still practically a necessary feature.

THE NEW DRAWING OFFICE.

The average switchboard is a typical example, in which the numerous combinations of measuring instruments, protective devices and controlling apparatus for plant of varying type and size almost always entails a special design to suit the particular conditions.

In fact, such are the peculiarities of this class of work, that large firms may find it desirable to leave the unstandardised portion to smaller organisations, while they concentrate their attention on the standard switches, instruments, &c., used in the construction of such boards. Another factor bearing on this arrangement is the frequency with which engineers specify particular makes of apparatus to be mounted on the boards, with the result that one firm's standard products cannot always be adopted.



EXTENSION TO THE SWITCHBOARD ERECTING SHOP, MESSRS. FERGUSON, PAILIN'S WORKS

The conditions referred to above led Messrs. Ferguson, Pailin & Co., Ltd., about 2½ years ago, to commence a specialist business in switchboard building at Higher Openshaw, Manchester, the principals having already had extensive experience in this class of work with well-known firms. The firm confines itself to the assembly and connecting up of proven apparatus made by reputable firms, and such has been the demand for its switchboards, that the firm has recently been compelled to extend its premises to cope with it. Our views show a new erecting shop and extended drawing office at the works; the former shop allows for three rows of switchboards being in progress at the same time, and, the building being lofty, enables one board, when complete, to be lifted over the others for removal for packing, &c. Each board is erected on channel bases fixed in the floor, while wall stays are provided attached to adjustable brackets. Every switchboard is assembled complete to ensure accuracy of finish, and for packing as little as possible of the gear is dismantled.

A special machine has been developed for bending the heavy copper interconnections required between pieces of apparatus.

The design of switchboards is a very considerable factor in the manufacture; each board is set out in detail, the general disposition of interconnections being determined, and complete records are kept in view of possible extensions being required.

The range of manufactures dealt with comprises all classes of flat-back boards for alternating and direct-current work, mechanically and electrically remote controlled boards for heavy plants, high tension cubicles, interlocked, and non-interlocked for sub stations, neutral point earthing resistances, &c.: heavy-power switchboards have been manufactured for plant of 30,000 volts and 15,000 amperes, and it is of some interest to record that the average yearly output of switchboards will control some 81,000 H.P. of plant, the apparatus having been supplied to 23 municipal electrical departments and many industrial firms, both at home and abroad.

SWITCHBOARD SUPPLIED BY MESSRS. FERGUSON, PAILIN & CO. FOR A GLASGOW SUB-STATION.

Chemistry at University College.—A series of new chemical laboratories and research rooms has been erected at University College, Gower Street, which is said to be the finest in the kingdom, and unsurpassed upon the Continent. A sum of £20,000 is required to complete the equipment, of which £14,000 is urgently needed, and the treasurer, Capt. the Hon. Rupert Guinness, M.P., will be glad to receive contributions for this purpose at the College. In view of the immense importance of chemical research to this country, we cordially commend this appeal to our readers.

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THE HIRE AND MAINTENANCE OF CONTINUOUS-CURRENT MOTORS.

On April 3rd the Western Local Section of the Institution of Electrical Engineers discussed Mr. H. Joseph's paper on this subject, of which an abstract appeared in our last issue.

Mr. H. Faraday Proctor said he noticed that the cost of maintenance had increased from .2 per cent. in 1903 to 6.2 per cent. in 1915, and that the author expressed his opinion that it had now just about found its level. He thought the cost of maintenance of large motors would prove to be less than the maintenance of small machines, and would depend on the class of parts supplied, and the number of breakdowns, rather than on the cost of repairing the breakdown. The author said he never disputed liability in the event of a breakdown; this was a point they considered very carefully when they were contemplating the hiring of motors in Bristol. They were afraid that if they undertook the maintenance of the motors it might lead to carelessness on the part of customers' employés. In Bristol, they only let motors out on simple hire, but a customer might take over the motor at an agreed depreciation at any time he pleased. He had often noticed that a man would hire a motor in the first instance, and directly he had proved that the equipment was to his satisfaction he would buy it.

Mr. E. G. Okell asked whether the author placed any limit on the size of the motor, and the character of the maintenance that was most expensive.

Mr. P. F. Crinks thought that a totally-enclosed motor would make a more satisfactory—and probably a cheaper—arrangement for a damp situation than placing the motor outside the building.

Mr. A. C. McWhirter, referring to the equipment of the workshop, considered that a stove with which to dry out the machines was a very essential item. Regarding soldered connections, he entirely disagreed with the author, as his firm did a great deal of soldering, and never got any trouble, unless it was due to careless workmanship. He thought many people under-cut the mica to too great an extent. Regarding the rewinding of armatures, his experience was that a tremendous amount of labour was wasted in using old material, which probably broke down immediately the motor was put to work. In certain cases, he considered ball-bearings very desirable, especially at the commutator end, although he agreed that a roller bearing constituted the best arrangement in most instances. He thought periodical and systematic inspection the best arrangement for maintenance jobs.

Dr. D. Robertson agreed with the author regarding the want of a really good starter. Recently he ordered a starter from a firm of good repute, and, although the resistance coils were very nicely built up, the frame on which they were mounted was much too light, and after a little time a number of short-circuits were caused owing to vibration. His experience was that, not infrequently, the starting gear was just as expensive as the motor itself.

Mr. Joseph, in replying, said that the arrangement he had adopted was to keep the cost of materials for motor repairs in a "motor repairs account," and not in a separate account of the repairs to each different size of motor. The smaller motors did cost more, in proportion, to repair than the larger ones. With regard to the question of liability in the event of a breakdown, they knew there was a certain amount of risk that a man might badly treat the motor, but they were prepared to take this risk in the same way as an insurance company had to take risks. He found that the motors were as well cared for since they had done the maintenance as in the days when they only did the simple hire. They endeavoured to get the owner to appoint one man to look after the motors in a particular department, and to make that man responsible for them. The man knew that if the motor broke down, the mill, or the section of the mill, would be stopped, and his desire to prevent such a thing happening was usually sufficient inducement to make him endeavour to prevent a breakdown occurring owing to neglect or carelessness. The maintenance factor that was most expensive was the labour involved. One man spent nearly all his time on repair work, and, when necessary, others were called off other jobs to give assistance, and the cost of their time was properly allocated to the work they actually did. He thought labour represented 75 per cent. of the cost of maintenance, especially now that they were doing their own rewinding. Referring to damp situations, he said that in a Scotch milling house the atmosphere contained a large amount of moisture and of nitrous oxide, which would be destructive of anything that could be used to make a motor. In these circumstances, and as they did not wish to supply special motors for special jobs, they preferred to install an ordinary motor outside the house rather than to supply a totally enclosed motor and run the risk of its getting corroded. They did not use a stove, but heat was obtained from steam supplied by the boiler house. He agreed as to the danger of under-cutting the mica to too great an extent. If a motor had been running very well, they would not cut the mica at all, but he had frequently found in the case of a motor described by the customer as a bad motor, that there was nothing really amiss beyond the mica being a bit high, and when this had been skimmed up the motor ran excellently. His remarks about ball bearings had been somewhat misunderstood. He did not mean to suggest that there was anything wrong with ball bearings; his objection to them was purely a local one, due to the time required for effecting a repair. For instance, it would probably take about three hours to take the armature of a 30-h.p. motor out, as they would have to take the end shields off, which would be a lengthy matter. He had some motors in use with ball bearings, and the proportion of troubles had been quite as great as with the other type. About four years ago he set to work to have all the motors inspected, as he thought this was the proper thing to do. His experience, however, proved most unfortunate, as he often found that probably a fortnight after the man had called a motor broke down, although the machine appeared to have been running satisfactorily when inspected. They were now getting the customers to let them know when they thought anything was amiss, as it was more likely that the customers would notice anything going wrong than a man who called and only saw the machine running for a short time. In Leeds, where there were about five times as many motors installed, he believed they had men going round who did nothing else but inspect motors. If they had this system in Hawick, the cost would probably be about double what it was; in other words, it would cost as much, or more, to inspect the motors as to repair them. With regard to the framework of starters frequently being too light, he had experienced this trouble himself, and he believed it was now quite a standard practice in most towns, where this business was carried on, to have iron fixing boards drilled with standard holes. This was an ideal arrangement, but he did not think it could be adopted in small towns like Hawick until there was some form of recognised standard starter; at present there were all sorts and sizes of starters.

HIGH-TEMPERATURE WORK.

The March meeting of the Faraday Society was devoted to what was called an informal discussion on "Methods and Appliances for the Attainment of High Temperatures in the Laboratory." Sir Robert Hadfield, F.R.S., President, was in the chair, and the discussion was opened by Dr. J. A. Harker, F.R.S., whose important work at the National Physical Laboratory entitles him to speak on this subject with exceptional authority. A large audience, which included some of the best-known workers in this field, kept up an eminently practical discussion till long after the normal time for concluding meetings.

The President's short introductory address told of the difficulties he and other experimenters had to contend with in times gone by in trying to melt small quantities of metals like steel or copper in the laboratory. That was before the advent of the electric furnace, which had wrought so great a revolution in high-temperature work; but progress in pyrometry was a factor of no less importance, and he gave in this connection a short historical sketch, beginning with Wedgwood's work in 1782, and coming down through Le Chatelier, Osmond, William Siemens, Roberts-Austen and Callendar to the recent work carried out by some who were going to take part in the discussion that night.

Dr. Harker dealt almost exclusively with carbon resistance furnaces, first made by Liveing and Dewar. A simple method of making a furnace was to bore out an arc carbon, but the hardness of the carbon made this difficult. Fortunately, the General Electric Co. now had a stock of thin-walled carbon tubes in many sizes for this purpose. The advantage of carbon was its high specific resistance. Graphite was much easier to handle and bore—it turned as easily as a hard wood—but its low resistance, one-fifth that of carbon, was a drawback, and it necessitated turning the tube into a spiral. One had only to wrap copper conductors round the ends of the tube and the furnace was essentially complete.

Dr. Rosenhain, later on, suggested coating the carbon tube with copper, aluminium, or iron, by the Schoop spray process, burnishing the coating to give good metallic contact. It was attention to small details, such as the resistance of the end contacts, which made all the difference between a good and a bad furnace. Great local heating at the contacts was fatal to success, and water cooling was now usually adopted. The furnace had, of course, to be enclosed, both for heat-insulation and to prevent the escape of carbon monoxide fumes. The most recent type of furnace, built by Mr. Eden at the National Physical Laboratory (shown in operation at the meeting), used ferro-concrete for this purpose, in preference to firebricks.

Dr. Greenwood, however, stated his preference for firebrick for many purposes, on account of the ease with which a brick furnace of any size or shape could be put together, and for lagging he preferred charcoal. Dr. Harker, on the other hand, recommended that fine grade of soot known as painter's lampblack. Filling up with this material the space all round the carbon tube for a radial distance of three inches gave most effective insulation at high temperatures. The one kilowatt which maintained the furnace exhibited at 2,000 deg. C. only heated the outside wall of the furnace to something over 100 deg. This temperature of 2,000 deg., by the way, was attainable in two or three minutes. To prevent the soot from falling through the spiral groove in the carbon or graphite tube, it was only necessary to wrap filter paper

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round the tube. Its ash sufficed to keep the light soot from falling.

An important point in connection with these furnaces was their economical running. It was necessary to obtain high temperatures with little power consumption. For this purpose Dr. Harker used a small, home-made portable transformer, on which were 80 turns of primary, split so as to be used at 300 volts and downwards, and 3 secondary turns capable of being coupled in series or parallel. Currents up to 1,000 amperes could be obtained. One of the furnaces exhibited was to be sent to Hadfield's Steel Works, at Sheffield, for standardising optical pyrometers, which appear to be largely in use, for these particular furnaces were used for a like purpose at the National Physical Laboratory.

Mr. R. S. Whipple said that furnaces like Dr. Harker's, but larger, had been installed by Northrup, in America, for gear-hardening. Thermo-couples passed through the furnace on to the work, which was simply brought above the recalescent point as indicated on a recording pyrometer, and then taken out and quenched—a beautiful industrial application of scientific phenomena.

Useful as is the carbon tube furnace, the presence of carbon and carbon compounds is often a drawback where perfectly pure metals or alloys have to be melted, and the discussion turned largely on substitutes for carbon. On a small scale, Dr. Rosenhain and others have found a tungsten wire vacuum furnace effective, and pure iron (M.P. 1,525 deg. C.) can be melted in such a furnace. But the tungsten becomes brittle on cooling from a high temperature, and a fresh winding is necessary for every run. Up to 1,000 deg. C. Mr. C. R. Darling and Mr. H. G. Lacell were able to recommend a kieselguhr tube wound with nickel-chrome wire. A furnace 1 ft. long, using an inch tube, consumes only ½ kw., and it can be rigged up in a few minutes. The arrangement should prove useful in innumerable directions. For very high temperature work, such as melting platinum or iridium (over 2,000 deg. C.), gas or oxy-hydrogen had still to be used, but experiments in the use of pure zirconia tubes for resistance furnaces are being carried out at the National Physical Laboratory, and if these should prove satisfactory this aspect of the high-temperature problem will be solved.

Mr. H. A. Kent drew attention to the possibilities of surface combustion; if one could use pure zirconia in granular form almost any temperature could be so attained. Nevertheless, the possibilities of gas furnaces have not by any means as yet been exhausted, although the present uncertain quality of coal gas is at the moment a difficulty. Much was said in the course of the discussion about the modern high-pressure types, in which not only the pressure, but the violence and turbulence of the explosive mixture as it enters the jet, is a necessary condition—as it is in a gas engine cylinder—of high-temperature combustion. One type described by Dr. Rosenhain in use at the National Physical Laboratory has a special form of injector burner for use with compressed air at 100 lb. per sq. in., and with this temperatures up to 1,800 deg. C. are obtained. An excellent burner is that bearing the name of Mr. Brayshaw, and it was described by the inventor. The essence of this burner is the wings, or side-pockets, round which the mixture of gas and air under pressure circulates becoming violently agitated on the way to the jet.

Mr. A. J. Webb said he had accidentally melted a large piece of platinum in this burner with an air pressure of only 20 lb., while small quantities could be melted with 3 lb. air pressure.

Sir Robert Hadfield said that Bessemer had worked with very high pressure blasts at one time, and he was glad the idea was being taken up again; he believed they would have a great future.

DIESEL ENGINE USERS' ASSOCIATION.

At the March meeting of the Association the subject of "Tar Oils as Fuel" was further discussed, and the President, Mr. Geoffrey Porter, gave some particulars concerning the unfavourable results which had been obtained in mixing tar or tar oils with ordinary crude oil for use in Diesel engines.

Mr. W. Fennell introduced the subject of the use of paraffin oil as fuel. In the discussion which ensued, the opinion was expressed that paraffin could be quite suitably used as fuel at times when its price showed any advantage as compared with the price of other fuels. It was necessary to run at a lower blast pressure when using paraffin.

The Honorary Secretary read a report which had been made to Lloyds' Underwriters by Mr. P. H. Smith on the accident which occurred in the Smithfield Markets Electric Supply Co.'s power station on February 6th.

According to the report, the compressor attached to the engine is of Messrs. Reavell & Co.'s standard quadruplex type, comprising four cylinders, viz., two low-pressure cylinders, one intermediate, and one high-pressure. The air is drawn into the low-pressure cylinders through slots in the piston pin, and is then compressed, passing into the L.P. receiver or purge pot, through copper pipes immersed in the water jacket of the compressor. This purge pot contains a drain and regulating valve, and a relief valve set at about 100 lb. per sq. in. The air from the L.P. purge pot is drawn into the I.P. cylinder past a valve through another cooling coil. Then it is compressed and delivered past another valve into the I.P. purge pot, which is almost identical with the L.P. pot, except that its relief valve is set to blow freely at 300 to 400 lb. pressure. From the I.P. pot it passes into the H.P. stage, from which it is delivered to the small bottle, being cooled immediately after passing the H.P. delivery valve.

The compressor is so designed that, under normal conditions, and when pumping its full capacity, the absolute terminal pressures of the various stages are approximately:—L.P., 60 lb.; I.P., 240 lb.; H.P., blast pressure.

A feature of the design to which particular attention is called is the construction and location of the I.P. plunger. This being, so to speak, inverted, receives an excess of lubricating oil, which when the engine is standing collects in the inverted piston and can, in actual practice, get past the rings into the cylinder itself. The rings are forced tight against the cylinder walls not merely by their own spring, but by air pressure passing behind the rings, the air being conducted thereto by four small holes communicating from the inside of the cylinder to the ring grooves.

It appears that this construction greatly facilitates the ingress of the oil to the I.P. cylinder when the engine is allowed to stand, and as seeming to corroborate that the oil actually takes this path, it is worthy of note that in most cases these holes soon choke up. In the case of the compressor under examination, two out of the four holes were choked. Further evidence of the ingress of the oil in this manner is supplied by the extraordinary condition of the H.P. valves, which were both very heavily carbonised in 30 hours' running.

Assuming that both H.P. valves are inoperative, the L.P. terminal pressure may reach a maximum of 60 lb. absolute and the I.P. terminal pressure is that of the blast. But the L.P. terminal pressure is approximately the I.P. suction pressure. If the compressor is running slowly with the L.P. drain valve fully open, the pressure in the L.P. purge pot will not greatly exceed atmospheric pressure. Hence, on the assumption that the H.P. valves are both inoperative, the pressure in the I.P. cylinder would be raised from slightly above atmospheric pressure to the blast pressure in a single stage.

These conditions apparently prevailed to an indefinite degree at the time of the accident, for, at the inquest, driver Baker remarked that he had started the engine in the usual way, the drain valves on the compressor being open. Then, when the engine commenced to fire, he closed them and immediately turned to the blast bottle. He had just commenced to throttle the blast to recharge the bottles when the explosion occurred. His estimate of the number of revolutions of the engine to the time of the explosion is only 20.

What happened was that the I.P. purge pot burst. The pot was of good average quality iron, and was of even thickness. Assuming its tensile strength at 7 tons per sq. in., its bursting pressure would be about 2,400 lb. per sq. in. Hence, no pressures ordinarily prevailing in the compressor would be likely to cause its fracture.

Mr. Smith therefore submits that the pressure originated from a spontaneous ignition of oil vapour in the I.P. purge pot, the temperature necessary to produce the ignition arising from the compression of the air in the I.P. stage. Provided that the oil is very finely divided, it may combine with oxygen with sufficient rapidity to cause it to ignite, notwithstanding that the surrounding temperature is well below the ignition point of oil vapour.

Assuming that the flash point of the oil were as high as 450 deg. F., the inlet temperature to the I.P. only 80 deg. F., and that the compression follows the law $PV^{1.25} = K$, then the I.P. stage has to compress the air to 1/14th of its original volume to attain 450 deg. F. as the terminal temperature. Working at full capacity, this is the equivalent of raising the pressure in the I.P. stage from, roughly, 60 lb. absolute to 800 lb. This of itself is quite feasible provided that the I.P. relief valve was inoperative.

The evidence is that the I.P. relief valve did not blow, so that it is very probable that the terminal I.P. pressure was well below 800 lb., as, on testing the I.P. valve, it commenced to lift at 350 lb. Probably the valve would not have lifted under 400 lb. pressure at the time of the accident, but assuming now that the terminal I.P. pressure was 330 lb. when the explosion occurred, or well below the pressure at which the valve was nominally set, the initial pressure would have been 10 lb. gauge pressure to result in the attainment of 450 deg. F. terminal temperature under the assumptions specified above.

From a study of different drivers, Mr. Smith is strongly of opinion that in the time elapsing between Baker's closing the L.P. drain valve and turning to the bottles, the L.P. pressure had not attained even this figure. Hence, on this hypothesis, he finds a very possible explanation of spontaneous ignition arising.

The fractured purge pot showed a black deposit on an otherwise clean fracture in the pipes communicating with the pot, and also inside the pot. The inside of the Chelsea purge pot recently examined did not dirty the fingers at all. Hence, he concludes that an ignition explosion occurred, and makes the following recommendations accordingly:—

1. Fit pressure gauges on both L.P. and I.P. purge pots.
2. The holes leading behind the I.P. rings to be plugged. This will probably prevent the oil gaining easy ingress to the I.P. cylinder and so reduce the heavy carbonisation of the H.P. valves.
3. Fit a large relief valve to the I.P. and L.P. pots.

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4. Relief valves should be tested periodically for lifting pressure.

5. There may be some advantage in fitting a non-return valve between the H.P. delivery and the bottle. This valve should be fitted as close to the H.P. outlet as is convenient.

6. Drivers in charge should make a habit of feeling the temperature of the purge pots. The L.P. is always the hotter when the machine is in good order, but when the H.P. valves become defective the I.P. becomes warmer.

7. To safeguard the water jacket, it is advised to work with an open top to the compressor, or where this is difficult to fit, then in place of the diaphragm or relief valve usually fitted, it is advised to place a stand pipe 4 in. to 6 in. diameter of sufficient height to obviate "head" difficulties.

The next meeting of the Association was to be held on Wednesday, April 12th. Information concerning the Association can be obtained from the Hon. Secretary, Mr. Percy Still, 19, Cadogan Gardens, London, S.W.

REVIEWS.

Single-phase Railways. By Edwin Austin. London: Constable & Co., Ltd. Price 21s. net.

This book consists of descriptions of complete railways or portions thereof which have previously appeared in the columns of *The Engineer*, considerably added to for publication in volume form. The author explains in his preface that, after delaying publication in order to make it cover everything, it became necessary to go to press without reference to the latest "split phase" developments. It can, therefore, be taken as being as nearly up-to-date as is practicable for a book describing the applications of a rapidly advancing art.

On the other hand, it is essentially descriptive and not theoretical. Although a good deal of information can be extracted on such matters as the characteristics of various motors, control systems, &c., involving more or less theoretical explanation, it is necessarily not in the consecutive form expected in a theoretical work.

The first chapter gives a *résumé* of the case for single-phase equipment of railways, pointing out particularly that the system lends itself to unlimited extension, whilst the low-tension direct-current system does not, and that though the direct-current system may be more suitable for suburban services, the inconvenience of working two systems is in favour of the one which can be extended. On the matter of overhead *versus* third rail equipment, it is remarked that the cost of the former has been considerably over-estimated by some advocates of the latter, that overhead equipment has been built at so low a cost as £800 per mile, that the high-tension direct-current system has to use overhead equipment, that the true criterion is relative total operating costs, and that every case should be decided on its merits. This is the true gospel, but its application is at present somewhat difficult owing to the paucity of data which can be fairly compared. It is quite on the cards that the controversy may be settled by delevopments permitting a combination of alternating-current transmission and distribution with continuous-current motor equipments, a combination of the strong points of both systems.

Very complete descriptions are given of the two English examples, the London, Brighton & South Coast suburban lines and Midland Heysham, Morecambe and Lancaster lines, with both of which our interested readers will be familiar. The illustrations of the Brighton work are particularly full, and include the profiles of the lines and a complete diagram of the distribution system, including the boosters used to keep the drop in the rails within the 20 volts allowed by the Board of Trade. Tests show that with the boosters out of operation 84 per cent. of the current returns by the rails and uninsulated outers of the feeders, but with the boosters in circuit nearly the whole current returns by the insulated return feeders.

The description of the Midland Railway work is less detailed, but the light, economical character of the overhead work is well brought out, as well as the ingenious trolley insulating devices.

A whole chapter is devoted to the electrified lines of the Midi Railway in France, notable as obtaining their power supply from Pyrenean waterfalls. Here, again, the overhead work is of a simple character, but of varying design on different sections, as at least four different contractors have had a share in the work and have each introduced their own material. It seems to have been the policy of the Midi Co. to divide the early work between different firms, as they have done the same thing in respect to locomotives, no doubt with the object of finding out by experience the most suitable equipment in each branch for guidance in future developments. There is, therefore, the interesting feature of illustrated descriptions of locomotives built by the French Thomson-Houston, Westinghouse, Constructions Electriques du Nord et de l'Est, Brown-Boveri, and A.E.G. Companies, all to the railway company's performance specification, and all differing in the ways the requirements are met. Regenerative braking was one of the requirements, important because the lines have considerable gradients, and the description includes a discussion of regenerative braking of an illuminating character. It suggests that this action is easier of attainment with single-phase than with continuous-current equipment. It may be said generally that with continuous current "it is not done," despite persistent and gallant attempts extending over nearly the whole history period of electric traction. There have, however, been recent important developments on American direct-current railways. The trolley wire on these lines is supplied at 12,000 volts 16⅔ cycles.

Chapter IV is occupied with descriptions of four German lines: The Blankenese-Hamburg-Ohlsdorf, Dessau-Bitterfeld, Murnau-Oberammergau, and the Mitterwald Railways. The second-named of these lines is remarkable for the size and power of the locomotives employed, and also for the elaborate design of the overhead contact system. The overhead supporting structures on the Blankenese line show much variety of contrivance to suit varying and difficult conditions. Both lines belong to the Prussian State Railways. The Murnau-Oberammergau line is notable for a gradient between three and four miles in length, with a general rise of nearly 3 per cent. The overhead work is of a much simpler character than on the State Railways before-mentioned.

The Mitterwald line is not exclusively German, as it extends into the Austrian Tyrol to Innsbruck. It is a characteristic mountain railway, with numerous tunnels, viaducts, and bridges, and some severe gradients. It was built for electrical working, and it is reckoned that about 2½ miles length was saved in the most difficult section by the use of steeper gradients than are permissible for steam traction. This saving in construction amounts to more than the total cost of the electrical equipment; an example worthy of note for future mountain railway propositions.

Chapter V is entirely occupied with a description of another mountain line, the St. Polten-Mariazell Railway, entirely in Austria, and also possessing a large number of tunnels, viaducts, and bridges. The gauge is only 0.76 m., say 2 ft. 6 in. It was built for steam working, but the capacity of the line so worked soon proved to be unequal to the traffic demands upon it.

Chapter VI describes four Swiss lines, of which the last, the Lötschberg-Simplon, is by far the most important in many respects. There are, however, some points worth notice in the equipment of the smaller concerns. The Martigny-Orsières line employs Déri repulsion motors, in which the reversal and torque and speed regulation are obtained by shifting a pair of auxiliary brushes, each connected to one of the fixed brushes. The electrical functions of the controller are limited to switching on and off the motor stator current. Everything else is done by the mechanical shifting of the brushes. The simplicity of this control gear is in striking contrast with the complexity of most of the alternative arrangements for series and composite series-repulsion motors, and as it is definitely stated that the starting torque, efficiency, and power factor of the motors compare favourably with those of series motors, the question arises, but is not answered in the book under notice, why has not the Déri system superseded all other single-phase traction motors. The claims are perhaps overstated.

The Lötschberg-Simplon Railway forms part of the international route from France through Berne and the Simplon Tunnel to Milan; it, therefore, has to carry trains of the heaviest character. The physical characteristics of the line are severe, including steep gradients, sharp and almost continuous curves, and long tunnels. The summit tunnel—Lötschberg—is 14¼ kilometres (say, 8¾ miles) in length, and on the northern approach there is a remarkable double loop shaped like an attenuated figure 8, of which much is in tunnel and little straight. The conditions are, therefore, exacting. For the purpose of local traffic, motor-cars are used. For the through traffic locomotives of 2,000 H.P. were first adopted, followed later by locomotives of 2,500 H.P. The former were driven by two motors, each carried on a six-wheeled bogie with coupled axles. The first reduction gear consists of a three-row Citroen pinion and gear wheel. This gearing permits the use of higher speed and lighter motors for the power than direct coupling.

The new locomotives of 2,500 H.P. exhibit considerable departures in design from the earlier ones. They also have two motors, but these are placed in the centre of the locomotive body, and drive the five coupled axles through two jack-shafts. The total weight is 107 tons, the weight on the driving-wheels 78.2 tons, the tractive force at the wheel rims 13¼ tons at a speed of 50 km. (say, 31 miles) per hour. The maximum speed is 75 km. (say, 47 miles) per hour, and they can haul a train weighing 310 tons up a grade of 2.7 per cent. These locomotives, therefore, compare with all but the heaviest of European steam locomotives, and are probably the most powerful electric locomotives yet put into European service. The control arrangement presents some interesting features. The controllers are fixed immediately above the transformers with the secondary tappings connected directly to the contact fingers. The controller drums are driven by a pawl and ratchet gear actuated by a motor. The direction of rotation is controlled by a pair of electromagnets which lift one or other pawl out of gear. By actuating these magnets, therefore, the driver permits the continuously-running motor to turn the controller drum in either direction, or to leave it stationary. For dealing with very large currents, in this instance up to 3,000 amperes, at 400 volts, it is claimed that this direct action is more satisfactory and simpler than con-

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tactor control. There are, of course, blow-out devices, and the usual series-parallel connections are available, both for the transformers and the motors. The supply on this line is at 15,000 volts, 25 cycles. The reader will not find any information about the difficulties with insulation which are said to have been experienced in the tunnels of this line. The overhead work is on the Siemens-Schuckert system.

Descriptions of the Rotterdam-Scheveningen Railway, a Siemens-Schuckert line (where the original three-phase scheme was altered to single-phase after the generating plant was far advanced, necessitating some ingenious adaptations resulting in the eventual supply of two phases to different line sections), and of two Norwegian lines occupy Chapters VII and VIII. The most interesting point in the latter is the description of telephone disturbances on neighbouring lines due to a large high-frequency harmonic in the generator voltage wave. This trouble was substantially overcome by connecting a tuned resonance shunt across the terminals, forming a virtual short circuit for the high-frequency current. This current proved to be of small magnitude, and, therefore, insignificant as a loss.

The Swedish State Railways have determined to adopt 15-cycle, single-phase energy as the general electrification standard. The conditions in Sweden are dear coal, abundant water power, and, in general, sparse population and low traffic density. These are evidently conditions in which economical transmission of energy is a ruling consideration. The first line electrified, described in Chapter IX, is that between Kiruna and Riksgränsen, only about eight miles in length, but wholly within the Arctic Circle, and the most northerly line in the world. It is mainly used for iron ore carrying, and, as in other mountainous mining districts, electrification has greatly increased the carrying capacity. The limits of steam traction had been reached. The practical and financial results are shown to be quite satisfactory.

The Panna single-phase line described in Chapter X is of somewhat special interest, because a portion of it is really a town tramway, and the remainder a roadside light railway. The tramway portion is worked at 400 volts and the railway part at 4,000 volts. The facility afforded by the single-phase system of working at the two voltages seems to have largely determined the choice, but the lines extend in two directions to about 15 miles from the power house, so that transmission and distribution economies were not negligible.

Chapter XI, the last, and nearly the longest, is wholly given up to descriptions of six American railways, commencing with the New York, New Haven & Hartford. This American work has been very fully discussed and described in the technical Press of both hemispheres. The problems offered by the New York, New Haven & Hartford line were particularly difficult at the time, including the requirement of running through from New York on 12 miles of direct-current track. The magnitude of the work done, between 500 and 600 miles of track, at an expense of £3,000,000, and the claims for lower capital expenditure and higher all-day efficiency put forward by the engineers, together with a large amount of experimental work of which many results have been freely published, tend to make this the typical single-phase main line, and the centre of controversy. It is, therefore, well that Mr. Austin has made his description full, and has been able to illustrate it lavishly. It is at least possible that this particular line will considerably modify its present system of operation before long, so that the record noticed may have historical value as showing a step in evolution towards settled practice.

The electrification of the Hoosac Tunnel, nearly five miles long, presented the difficulties usually found in adapting overhead work to a tunnel originally built for steam traction. How these were overcome is shown in detail, and as the working pressure is 11,000 volts the precedent is valuable. The insulators in use in the tunnel are two in series, each nominally capable of carrying 150,000 volts, so the factor of safety is large. It is noted that travelling in the tunnel is now quite a pleasure in hot weather, and that the tunnel is divided into three block sections with automatic signalling, so that its traffic capacity is trebled. The trains, with their steam locomotives complete, are hauled through the tunnel by the electric locomotives. This particular case is, therefore, an example of electrifying a tunnel section on which steam working is specially handicapped. The construction work was by no means easy. During steam working it was found that men could only work two hours per day in the tunnel, and were often rendered unconscious by the engine fumes. To assist matters during the electrification, traffic was carried on by oil-burning locomotives, which were also used on the two construction trains, each of which included a dining car! and compartments for the men to retreat to during the passage of steam trains, furnished with compressed air stores to keep out the smoke.

The St. Clair tunnel, on the Grand Trunk, between Michigan and Ontario, is another example of a difficult tunnel electrified to increase its traffic capacity. The approach gradients of 1 in 50 added to the difficulties of steam working. This particular tunnel is a "tube" of cast-iron segments 20 ft. in diameter. The pressure used is 3,300 volts. Although the tunnel is damp, no insulation troubles have been met with.

In concluding this notice, special praise must be given to the illustrations, especially the numerous diagrams of connections and line drawings of details, which are generally clear and satisfactory. If some of the connection diagrams require some puzzling out, that is due to the intricacies of the subject, and is in most cases eased by the textual descriptions. The lettering and figuring of these diagrams is clear, though sometimes minute enough to require a lens for easy reading. There is, of course, a large number of process block illustrations, but whilst these are not of so much technical value as the line drawings, they are of more illustrative value than is sometimes the case, and they add to the appearance, being generally excellently reproduced.—H. M. S.

Principles of Direct-Current Machines. By A. S. Langsdorf. London: Hill Publishing Co. Price 12s. 6d. net.

The author's preface states that "this book has been prepared with the object of placing before junior and senior students of electrical engineering a reasonably complete treatment of the fundamental principles that underlie the design and operation of all types of direct-current machinery."

The first chapter consists of 42 pages on general laws and definitions. The matter is well chosen and presented in an exceptionally clear manner. The methods of the calculus are freely used here, and, in fact, throughout the book, but a decided effort has been made to give prominence to the physical concepts of the various equations. Chapter II discusses the dynamo, the treatment being on orthodox lines and quite praiseworthy.

Armature windings are next dealt with. A full derivation of the rules covering armature windings (following Arnold) is included in addition to the usual description of typical windings. Chapter IV is devoted to the magnetisation curve and to magnetic leakage. The treatment of the saturation curve of machines is modern, the correction for the pole arc and slots due to Carter being given.

The complex subject of armature reaction next receives attention. The effect of fractional pitch armature windings and other refinements are much more thoroughly treated than usual.

Chapters VI and VII are occupied with the discussion of the characteristics of generators and motors. They include a considerable amount of new material, the treatment being largely graphical. The three-dimensional diagram is used for depicting the mutual relationships among the several variables. Several of the constructions are the same as are given in Arnold's "Die Gleichstrommaschine."

In Chapter VIII is developed a much more extensive treatment of the subject of commutation than has been heretofore easily accessible to students of the type for whom the book is intended. The treatment appears to be based very largely on Arnold's work, and on articles in the New York *Electrical World*. A good deal of advanced mathematical analysis is necessary before a student can read this chapter with advantage; in fact, this chapter is above the heads of the vast majority of ordinary students in technical colleges.

Efficiency, rating, and heating of direct-current machinery are next discussed on standard lines. The usual empirical curves for iron losses, &c., are included. The book concludes with a lengthy chapter on boosters, balancers, and train-lighting systems.

There can be little doubt that the author has succeeded in his purpose as set out in the extract from his preface above. The ground covered is comprehensive and the treatment thorough and rigorous. It should be distinctly understood that a competent knowledge of mathematics is necessary for the successful use of the book. The volume is well bound, the type very clear, and, as things are nowadays, it is worth its price.—H. G. S.

IMPORT TRADE OF CHINA.

The Chinese Imperial Maritime Customs have just issued an additional volume giving the countries of origin of the principal imports into China during 1912-14. The following figures, showing the value of imports in 1913 and 1914 of goods of interest to the electrical engineering industry, have been extracted from this new volume, and the increases and decreases shown. It is to be noted that the average value of the Haikwan Tael in 1913 was 3s. 0½d., and in 1914 2s. 8⅜d.

	Hk. Tls. 1913.	Hk. Tls. 1914.	Hk. Tls. Inc. or dec.
Electrical materials and fittings.—			
From Great Britain ...	596,000	736,000 +	140,000
,, Hong-Kong ...	174,000	244,000 +	70,000
,, Germany	845,000	705,000 −	140,000
,, Belgium	71,000	71,000	—
,, Italy	36,000	30,000 −	6,000
,, Japan	393,000	688,000 +	295,000
,, United States ...	179,000	135,000 −	44,000
,, Other countries ...	113,000	154,000 +	41,000
Total	2,407,000*	2,763,000† +	356,000

* Includes 85,000 Hk. Tls. re-exported.

† Includes 37,000 Hk. Tls. re-exported.

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	Hk. Tls. 1913.	Hk. Tls. 1914.	Hk. Tls. Inc. or dec.
Copper wire.—			
From Great Britain ...	21,000	7,000 –	14,000
,, Germany	17,000	29,000 +	12,000
,, Belgium	2,000	1,500 –	500
,, Japan	137,000	143,000 +	6,000
,, Other countries ...	12,000	6,500 –	5,500
Total	189,000*	187,000* –	2,000
* Includes about 5,000 Hk. Tls. re-exported.			
Copper, bars, rods, sheets, plates, and nails.—			
From Great Britain ...	12,000	12,000	—
,, India	5,000	3,000 –	2,000
,, Germany	14,000	4,000 –	10,000
,, Belgium	1,000	13,000 +	12,000
,, Japan	199,000	542,000 +	343,000
,, Other countries ...	27,000	11,000 –	16,000
Total	258,000	585,000 +	327,000
Aluminium, manufactures of.—			
From Great Britain ...	2,000	2,500 +	500
,, Germany	35,000	5,000 –	30,000
,, Belgium	1,000	1,500 +	500
,, Russia	2,000	2,000	—
,, Japan	21,000	22,000 +	1,000
,, Other countries ...	4,000	2,000 –	2,000
Total	65,000	35,000 –	30,000
Rails.—			
From Great Britain ...	3,500	3,500	—
,, Germany	66,000	22,000 –	44,000
,, Belgium	247,000	196,000 –	51,000
,, Russia	216,000	42,000 –	174,000
,, Japan	17,000	39,000 +	22,000
,, United States ...	372,000	394,000 +	22,000
,, Other countries ...	500	17,500 +	17,000
Total	922,000*	714,000† –	208,000
* Includes 26,000 Hk. Tls. re-exported.			
† Includes 160,000 Hk. Tls. re-exported.			
Asbestos.—			
From Great Britain ...	26,000	24,000 –	2,000
,, Germany	6,000	8,000 +	2,000
,, Belgium	4,000	16,000 +	12,000
,, Russia	4,000	16,000 +	12,000
,, Japan	14,000	19,000 +	5,000
,, Other countries ...	10,000	9,000 –	1,000
Total	64,000	92,000 +	28,000
Machine belting.—			
From Great Britain ...	140,000	144,000 +	4,000
,, Germany	31,000	31,000	—
,, Belgium	1,000	7,000 +	6,000
,, France	9,000	500 –	8,500
,, Russia	10,000	16,000 +	6,000
,, Japan	58,000	57,000 –	1,000
,, Other countries ...	19,000	30,500 +	11,500
Total	268,000	286,000* +	18,000
* Includes 8,000 Hk. Tls. re-exported.			
India-rubber and gutta-percha manufactures.—			
From Great Britain ...	58,000	40,000 –	18,000
,, Germany	27,000	9,000 –	18,000
,, France	30,000	14,000 –	16,000
,, Russia	223,000	186,000 –	37,000
,, Japan	36,000	47,000 +	11,000
,, Other countries ...	44,000	34,000 –	10,000
Total*	418,000	330,000 –	88,000
* Includes 58,000 Hk. Tls. re-exported.			
Telegraph and telephone materials.—			
From Hong-Kong ...	41,000	97,000 +	56,000
,, Great Britain ...	261,000	59,000 –	202,000
,, Germany	225,000	224,000 –	1,000
,, Belgium	90,000	56,000 –	34,000
,, Japan	89,000	78,000 –	11,000
,, Other countries ...	13,000	53,000 +	40,000
Total*	719,000	567,000 –	152,000
* Includes 32,000 Hk. Tls. re-exported.			
Railway carriages and wagons, including tramcars.—			
From Great Britain ...	83,000	603,000 +	520,000
,, Germany	370,000	75,000 –	295,000
,, Belgium	558,000	1,470,000 +	912,000
,, Russia	85,000	28,000 –	57,000
,, United States ...	33,000	86,000 +	53,000
,, Other countries ...	98,000	78,000 –	20,000
Total	1,227,000*	2,340,000† +	1,113
* Includes 33,000 Hk. Tls. re-exported.			
† Includes 117,000 Hk. Tls. re-exported.			

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

4,479. "Electric furnaces for smelting and refining metals." J. S. Romanes. March 27th.

4,509. "Contact breakers for magneto-electric generators." V. Dupont and M. P. P. Syndicate. March 27th.

4,518. "Receiving instrument for wireless signalling." A. Aktom. March 27th.

4,558. "Electric discharge apparatus." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 28th.

4,561. "Electric dynamos." T. L. R. Cooper. March 28th.

4,575. "Holders for incandescent electric lamps." J. Salt. March 28th.

4,596. "Portable electric battery lamps." H. F. Joel. March 29th.

4,606. "Ship propulsion." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 29th.

4,619. "Electric light watchstand." S. Worrall & J. H. Worrall, Son and Co. March 29th.

4,629. "Spark plugs." J. W. Baird. March 29th.

4,625. "Electric torches." A. A. King. March 29th.

4,629. "Electric ignition of explosives." R. Miller. March 29th.

4,661. "Bomb or explosive shell, and apparatus for lowering, sustaining, and exploding same by electricity from aeroplane, &c." S. H. Sturtevant. March 30th.

4,674. "Light telegraphy." J. A. Fleming. March 30th.

4,683. "Electric switches." W. T. Henley's Telegraph Works Co. and E. E. Judge. March 30th.

4,688. "Electrical systems for engines." W. A. Chryst & C. F. Kettering. March 30th. (U.S.A., July 16th, 1914.)

4,691. "Apparatus for guiding trolley pulley of electric cars and locomotives to overhead wire." W. G. Jenkins. March 30th.

4,697. "Electric oscillators." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 30th.

4,699. "Switching apparatus for inter-connecting telephone lines by electro-mechanically controlled switches." F. Aldendorff. March 30th.

4,703. "Circuit-breaking apparatus for electrical heaters." J. E. Harvey. March 30th. (U.S.A., April 3rd, 1915.)

4,713. "Electric cut-outs." F. D'Alquen. March 30th.

4,733. "Alternating-current systems." A. E. McColl. March 31st.

4,752. "Combined electric lampholders and switches." W. Donovan. March 31st.

4,771. "Machine tools." British Thomson-Houston Co. (General Electric Co.). March 31st.

4,775. "Carbon brushes for electrical machines." J. E. Grant & Morgan Crucible Co. March 31st.

4,780. "Process for electrolytic deposition of zinc on metallic surfaces." P. Makino. March 31st.

4,788. "Dynamo-electric machines." H. Chitty. March 31st.

4,816. "Wireless signalling systems." British Thomson-Houston Co. (General Electric Co., U.S.A.). April 1st.

4,827. "Automatic cut-in and cut-out for electric circuits." A. P. Tuckbull. April 1st.

PUBLISHED SPECIFICATIONS.

1914.

13,951. Electric Furnaces for Metallurgical or other purposes. H. Nathusius & Westdeutsche-Thomasphosphat-Werke Ges. June 9th.

24,056. Apparatus for Detecting the Presence of Electric Conductors. A. W. Sharman. December 15th. (Cognate application, 8,961/15.)

24,170. Electric Heat Radiators. A. F. Berry. December 16th.

24,644. Sparking Plugs. R. O. C. Hurst & F. B. Mills. December 24th.

1915.

247. Magneto-electric Generators for Lighting, Charging, and Ignition purposes. C. H. Melsome-Smith. January 7th. (July 1st, 1915.)

3,841. Electric Step-by-step Signalling Apparatus. Sterling Telephone and Electric Co., F. G. Bell, & H. W. Barclay. March 10th.

3,856. Apparatus for Measuring Electric Current. Landis & Gyr Akt Ges March 10th. (March 10th, 1914.)

3,882. Magnetos. G. A. Lister, E. A. Watson & M-L. Magneto Syndicate, Ltd. March 11th.

3,932. Method of and apparatus for Winding the Armatures of Electric Machines. G. Schongut. March 12th. (March 13th, 1914.)

3,949. Incandescent Electric Lamps. C. H. Harrison. March 12th.

3,950. Wireless Receiving Systems. L. de Forest & C. V. Logwood. March 12th. (March 12th, 1914.)

4,144. Oil-immersed Electric Switches or Circuit Breakers. F. B. Holt and H. Smith. March 16th.

4,229. Electrical Coils and Methods of Winding same. H. Wade (J. R. Leeson). March 17th.

4,401. Electric Rotary Converters. M. Walker. March 20th.

4,432. Protective Devices for Alternating-current Systems. British Thomson-Houston Co. & E. B. Wedmore. March 20th.

5,017. Automatic Telegraph Transmitters. A. C. Baronio & K. L. Wood. March 31st.

5,628. Electric Lamp Lock. W. G. Rudd. April 14th.

6,723. Equalising Field Windings for Multi-polar Dynamo-electric Machines. E. Rosenberg. May 5th.

7,492. Electric Soldering Irons. M. J. Railing & G. H. Ide. May 19th.

8,358. Field Telephone and Telegraph Apparatus. H. North. June 5th.

9,428. X-ray Apparatus. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 28th.

10,803. Vacuum Drying and Impregnating Device, more especially suitable for Treatment of the Coils of Electrical Machinery and Apparatus. Emil Haefeley et Cie. July 26th. (July 24th, 1914.)

13,754. Stationary Electrode for Igniters. Standard Co. September 27th. (September 26th, 1914.)

15,989. Terminal for Electric Switches, Couplings, and the like. G. Markt. November 12th

17,690. Electrically-controlled Electric Circuit Breakers. British Westinghouse Electric & Manufacturing Co. December 17th. (December 29th, 1914.)

1916.

2,056. Dry Battery. F. P. Baumann. February 16th, 1915. (Patent No. 100,086.)

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NATIONAL ELECTRICITY SUPPLY.

THIS subject formed the text of an interesting discussion which took place at the Institution of Electrical Engineers last week, and is reported elsewhere in this issue. The theme is by no means a new one in electrical circles, but Mr. E. T. Williams, who was responsible for bringing the matter forward, has undoubtedly helped to focus our attention on a problem, the importance of which the events of the last twenty months have amply demonstrated.

The proposals put forward by Mr. Williams represent in the main the logical sequel to the insistent demands for conservation of our national fuel resources, and the no less pressing necessity of improving our industrial equipment with a view to securing the maximum of efficiency in industry after the war. The suggestion, for the purpose of discussion, is, briefly, that the control of the electricity supply of Great Britain should be vested in an Electricity Board, having the weight of Government authority, and that the area in question should be divided into sections, each with an engineer manager responsible for its electrical well-being, who would occupy a seat on the Board, together with legal, accounting, financial, and Parliamentary members—one of each. The other essentials of the scheme are the provision of a bulk supply network to connect the existing generating stations and new ones which may be added by the Board. It is important to note that interference with existing stations and the capital invested in them is not contemplated, and it is anticipated that the benefits to be derived from the mutual interchange of load via the proposed bulk supply network will eventually lead to the smaller and less favourably situated generating plants disappearing.

Stress is laid on the possibility of equipping on a large scale at once, and fully loading within a brief period, any new stations feeding into the proposed network, with resulting all-round efficiency; Mr. Williams might have gone further and emphasised the important fact that only by means of such a scheme can our generating engineers make up the enormous leeway which exists between present British practice, as regards the size of unit employed, and the largest and most efficient units which are commercially obtainable. We must, as Mr. Williams hints, be prepared to depart from "cut-and-dried" methods, and such a scheme would enable us to fit the load to the most efficient station in the neighbourhood—to rule out the present disturbing and efficiency-destroying factor of load variation in the most modern plants, and so to obtain the maximum efficiency from them at least.

Judging by the experience gained from the interlinking of the London power stations, and the progress made in that direction, it is more than probable that provincial areas will follow suit, thus forestalling in part the larger scheme.

It seems very doubtful, however, whether such partial methods of mutual assistance, especially if dependent on local initiative, can take the place of a co-ordinated general scheme, although this was suggested by Mr. Merz. The tendency would be to super-develop certain supply areas which are already being developed, but the small towns, the villages, and the farms would be no better off than they are at present.

We regard it as essential that electricity supply shall be brought within reach of the agricultural

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industry at the earliest possible moment; in farming, as in other directions, the methods of the past will not serve, and there is every reason to believe that those of the future will be largely electrical, if we choose to make them so. Possibly the Board of Agriculture might be disposed to lend its aid to such a scheme, in view of the serious position which has arisen in connection with that industry, and to which Lord Selborne drew attention in the House of Lords last week. It seems likely that difficulty would arise in connection with the financing of a scheme of this nature unless its national character led to some form of Government guarantee being given; but our ideas on most things are undergoing revision, and it would seem scarcely consistent, after spending five millions a day for many months on war, to quibble about the expenditure of a few millions a year for two or three years on an epoch-making industrial development, as some people are disposed to do, because an immediate return on the money might not be visible.

If it is conceded that a supply of cheap electricity is likely to be a factor—and we believe it to be an essential factor—in our future commercial prosperity as a nation, then we must fearlessly accept the condition, put forward by Mr. Chattock, that no direct financial return should be expected for some years, but that the country should shoulder the loss in the meantime—if, indeed, that can be called loss which confers so many indirect benefits on a nation, and which holds the certainty of ample returns in years to come.

The electrical manufacturing industry in this country has been held back for years by our unenterprising and inelastic methods of electricity supply; but were it assured of the enormous home demand which would result from the supply of electricity on a wholesale scale in this country, its operations abroad could also be conducted with the same facility and success as those of its great rivals, in so far as these are due to their manufacturing resources.

Clearly the matter is one deserving of the closest consideration at the present time; so many interests are involved, however, and many of them of a non-electrical character, that it will be necessary to enter on a campaign of general enlightenment in order to obtain the needful support—we must, in fact, talk hard and keep on talking, if we are to attract public attention and arouse enthusiasm. In this connection Mr. Roles's suggestion as to enlisting the support of the chief engineers of existing undertakings, by giving suitable guarantees that they shall not be displaced, is worth consideration; we believe that engineers and managers would be in increased demand rather than otherwise under such a scheme, and that public servants have, as a rule, little to complain of in the matter of compensation, &c., when they relinquish a post to please the public, but it appears to be an easy way of securing five or six hundred missionaries, who would necessarily bring influence to bear on the various public bodies, and thus possibly enlist the services of some of the most prolific talkers in the kingdom in aid of the scheme.

Copper.

Recent vague indications of a falling off in the general demand for copper, possibly under the influence of the more hopeful views that were entertained as to the duration of the war, have proved rather deceptive. The abstention of buying, indeed, has been only temporary, as it was to some extent due to the opinion expressed by certain American critics that prices had been forced up to a point as high as could be reasonably expected even under the more stringent conditions. There was certainly a little more inclination on the part of a few smaller American producers to consider lower offers for forward shipment, but this change of sentiment has not exerted the least influence on the arbitrary attitude of the big American producing interests, who latterly have been more sparing in their offers for forward deliveries owing to another extension of buying, first by our Continental Allies, and subsequently on the part of American consumers, whose takings within the last few months have grown at a stupendous rate. Prices for distant shipment have certainly stiffened to a notable extent. The serious scarcity encountered in covering needs over the Spring now looks like spreading over the whole of the summer months, for which period extensive orders have apparently already been placed, which leaves the copper magnates in absolute command of the situation for an indefinite period, or so long as the chronic scarcity of spot metal continues. European stocks are virtually exhausted, as shown by the statistics, and there is no prospect of a replenishment for some time at any rate. Fairly liberal shipments are, it is true, pretty regularly made to this side from American Atlantic ports, but the whole of this copper is already sold, and the great bulk thereof goes straight into the hands of munition manufacturers, whose operations are in full swing at this critical stage of the great struggle. Never before in the history of the copper market has the demand for the metal been so extensive and so urgent. There has been for some time past a phenomenal wave of industrial activity across the Atlantic, in addition to which munition work on a considerable scale is apparently now being carried on in the United States as a precautionary measure. The world's production of copper has now by far eclipsed all previous records, but the extension of requirements has been no less marked, and this must be expected to continue for months to come, so that anything like a retrograde movement in prices is rather unlikely, unless unexpected developments arise in the war situation, calculated to hasten a conclusion of hostilities. The fact is worth noting that in spite of an absence of speculation in warrant copper under the Government prohibition, prices have steadily broken into new high records, owing to the famine conditions. The price has in the past week risen to about £126, and offers are as scarce as ever.

Water for Condensing Purposes.

The question whether a manufacturer can lawfully take water from a river for the purpose of condensing steam is one which is of increasing importance, having regard to the rising price of coal. There are few cases on the subject; and such cases as there are do not cover many of the important points. For instance, suppose a riparian owner has a mill which is worked by water power derived from the stream. He will naturally want all the water he can get to flow into his mill dam. Then suppose that another owner, a little higher up, takes water from the stream, uses it for condensing, and returns it, undiminished in quantity, below the dam. Has the mill owner any right of action? The authorities clearly establish certain propositions. In the first place, a riparian owner may take water from a stream for all ordinary purposes, *e.g.*, domestic purposes, supplying cattle, watering his garden, and even for irrigation. He cannot, however, draw off water and sell it to a water company for supplying a town. In the second place, every riparian owner may divert the water of a stream for purposes in connection with his land or for other purposes; but he is bound to return the water which he has diverted into the stream again before it leaves his land, substantially undiminished in volume and unaltered in character; for a lower riparian owner, subject to the rights of an upper owner, is entitled to have the water flowing in the natural bed of the stream come to him unaltered in quality and quantity, and to come to his land in its ordinary and accustomed channel. There is no case which holds that a man may abstract water for con-

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densing purposes and return it undiminished in quantity or quality lower down. Indeed, such a decision would appear to be contrary to the principle above enunciated. Where, however, he takes water for condensing, and returns it to the stream substantially at the same point on his own land, it has been held that he does not infringe the rights of the lower riparian owners (see Kensit *v.* Great Eastern Railway, 27 Ch. D. 122). All persons taking water for condensing purposes would therefore do wisely to see that it is returned to the river on their own land.

The Wire-Drawing Industries.

The increasing difficulties experienced by wire manufacturers in obtaining supplies of copper for rolling and drawing down, and the holding back of trade inquiries, in consequence of the abnormally high price ruling in the metal market, have resulted, during the past few weeks, in a decline in the output of many of the leading firms in this country. This, in some measure, is to be regretted, as, with fewer restrictions in obtaining shipment of goods, more attention could be devoted to the important question of the development of the oversea trade, a section which in the near future should prove to possess many attractive and promising features for enterprising firms.

In the home trade section, however, there is probably much yet to be done in the direction of preventing a repetition after the war of the German wire manufacturers' acquisition of trade in these markets with the same successful results as hitherto. It cannot be too often repeated that the basis of the German wire manufacturers' success in this country, and in the British markets overseas, has been a thorough and comprehensive system of personal representation. This fact, besides being now more than ever fully appreciated by British firms, has been vouched for in confidence on more than one occasion during the past few years by successful Germans themselves, who have made good in these markets with practically no opposition as regards being first in the field. Moreover, influential buyers in the cable and electrical industries in this country have confessed of late that frequently in the past the attractions and inducements to trade with German firms, in preference to British firms, have been due, not so much as has often been erroneously supposed, to undercutting in price and cheaper production, as to superior all-round attention in the matter of personal representation by qualified men.

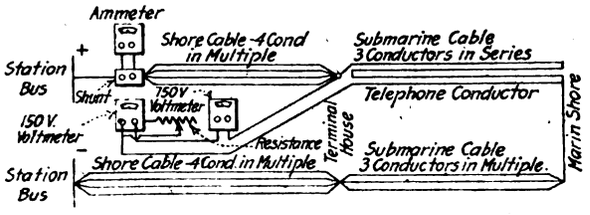
Hydro-Electric Power in Tasmania.

Operations that are in progress in Tasmania along hydro-electric lines are already more or less familiar to our readers, but Mr. C. T. Milne, H.M. Trade Commissioner in Australia, has recently reported on this matter, as mentioned here a few weeks ago, he having been in Tasmania at the end of last year. In order to bring the scheme to the notice of Australian manufacturers and other light and power users, the Government is carrying out a publicity campaign, and has, it is believed, made arrangements for the sale of about 9,000 H.P. Works are being projected, and apparently United Kingdom interests are investigating the possibility of erecting woollen mills. The general manager, in an interview with Mr. Milne, stated that there would be an increased demand in Tasmania for electrical fittings and appliances, and he suggested that the time was ripe for more active steps to be taken by our manufacturers of such goods to bring them to the notice of consumers. Firms in the United Kingdom can secure information regarding reliable firms in Tasmania who would be ready to undertake their representation, from Mr. Ashbolt, the Imperial Trade Correspondent, at 23, Old Wharf, Hobart, Tasmania.

AN 11,000-VOLT SUBMARINE CABLE.

The city of San Francisco is situated on the southern shore of the Golden Gate, the narrow entrance to the land-locked San Francisco and San Pablo Bays. Until recently, hydro-electric power has been supplied to the city from the Pacific Gas & Electric Co.'s power plants by a roundabout route extending from Cordelia sub-station, round the southern extremity of San Francisco Bay, and along the shore to the Martin station at San Francisco, a distance of 107 miles.

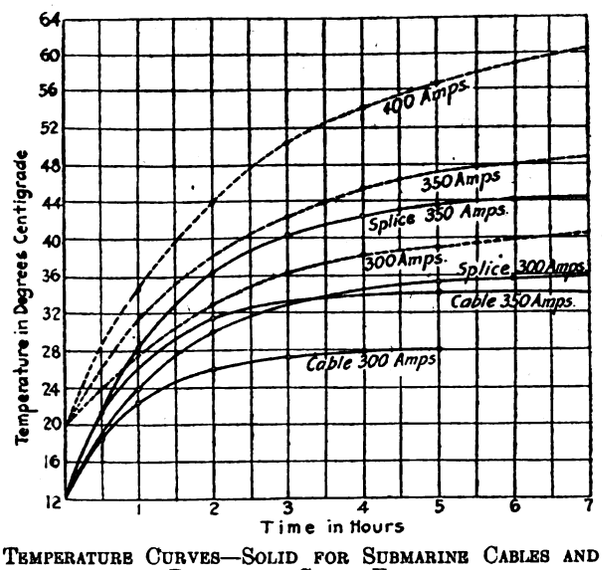
As the hydro-electric plants to the northward increased in number, it was considered desirable to provide a more direct supply route, as the San Francisco steam stations could then more readily serve as relays for the rest of the system. Quite recently a pair of cables were laid across the water from Oakland on the other side of the bay, which somewhat relieved the situation, but still left much to be desired, and in May, last year, it was therefore decided to make use of the 60,000-volt line from Cordelia to San Rafael, by constructing a connecting line to Sansalito, where a step-down sub-station has been erected; to connect this by means of a short pole line with the northern shore of the Golden Gate, and to lay two submarine cables across the latter, a distance of 13,000 ft., to the southern shore, and from a cable terminal house on the latter to lay four underground cables, a distance of 6,500 ft. to couple up to sub-station F of the San Francisco system.



Connections for Cable Testing.

The installation was designed to deliver 18,000 H.P. at a pressure of 11,000 volts, which is the H.T. distribution pressure at San Francisco.

The cables were laid across the "forbidden anchorage" area between the two shores, as the best route; consideration had to be given to the 6-knot tide, to the depth of water, which exceeded 200 ft., and to the question of repairs subsequently, as the strain on the cable itself when lifted from a 200-ft. depth would be excessive.



Temperature Curves—Solid for Submarine Cables and Dotted for Shore Ends.

It was therefore decided to use the messenger cable method of laying, in which a steel rope is laid from shore to shore and securely anchored, and acts as a guide line in laying the power cable. The messenger cable is picked up at the shore end and laid across a barge on which power cable reels are mounted; the former cable passes over sheaves and through a cable gripper in charge of an operator, who controls the movement of the barge while it is being towed across the water by a launch.

The power cable was attached to the messenger before paying out, and after a length of cable was laid, the barge was anchored to the messenger and another length spliced on, the four reels of cable carried representing about 5,000 ft. of cable.

The free end of the cable was then sealed and lowered overboard, the barge towed to shore (under-running the messenger), and reloaded with cable. The messenger was then picked up at the free shore end, laid across the barge, and under-run until the free end of the cable was recovered, when the

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splicing and laying were repeated as before. The messenger cable takes the strain, relieving the cable and joints from all tension.

The steel messenger cables are 1⅜ in. in diameter, each composed of 37 strands of galvanised steel wire, woven in one length of 14,000 ft. and having a breaking strength of 90 tons.

Each of the power cables consists of three stranded copper conductors, having an area of 350,000 circ. mil. at the shore ends and 250,000 circ. mil. for the deep-water sections; this represents a finished diameter of 4½ in. and weight of 22 lb. per foot in the former case, and a finished diameter of 4 in. and weight of 19 lb. per foot in the latter.

The conductors are insulated with rubber and varnished cambric, and enclosed in a 5/32 in. lead sheath; over this two layers of jute were applied to form a cushion for steel wire armouring, and the latter was in turn jute covered, and a final coating of sand and asphaltum applied for mechanical protection. Each cable contains a twisted pair of telephone wires, cambric insulated, cotton braided, and laid in the jute filler between the main conductors of the cable. These telephone wires are protected at the shore ends by telephone insulating transformers.

The cable-laying barge was 70 ft. long and 30 ft. wide, and of 125 tons capacity; for laying the messenger cable it was towed across the tide, but for laying the power cable it was towed sideways to minimise interference of the tide, a 50-H.P. launch being usually employed.

On the barge itself the messenger was laid across a 40-in. sheave on either side of the deck, a rigging preventing it from leaving the sheaves no matter what position the barge might take up. The power cable was fed from the reels round spools, and both it and the messenger were passed through a serving machine, driven by a petrol engine; this machine was used to bind the two cables together by a continuous winding of two galvanised wires, but every 20 ft. the movement of the barge was stopped by the grip, and a number of turns wound on at one point, in order to ensure connection at 20 ft. intervals. The speed when laying the cable was 8 ft. per minute.

To make the joint mechanically strong it was necessary to lap the armour about 15 ft., which involved cutting off 15 ft. of the cable projecting from the water; the armour was folded back and held in shape by rings.

The copper conductors were sweated together and insulated with rubber and cambric; the telephone conductors were spliced and insulated, the twisted pair being transposed between cores at each joint; finally, a 4½-in. lead sleeve was wiped to the main sheath, and the joint filled with "ozite" poured in at a temperature of about 460 deg. F., sealed, and lapped, and the armouring put back into place.

As the barge was held fast to the messenger during jointing operations, the serving machine was mounted on rollers, so that it could travel along while binding the wire over the joint. Every 12 in. the serving wires were soldered together to provide against unwrapping should the wire break.

The cable was not attached to the messenger for a distance of 8 ft. on each side of a splice, to allow it freedom of movement independent of the splice. There were 11 splices in each completed cable.

After the final splice was made, the cable and messenger were under-run to a point mid-way between two splices, when both were hoisted off the reels and lowered to the bottom by ropes.

Cable laying was commenced on September 26th, and the two cables were laid and tested by October 30th, the connection through to San Francisco being completed on November 5th.

Continuous megger tests were carried out during laying from the sub-station on the north shore, and full 22,000-volt tests were made on the splices.

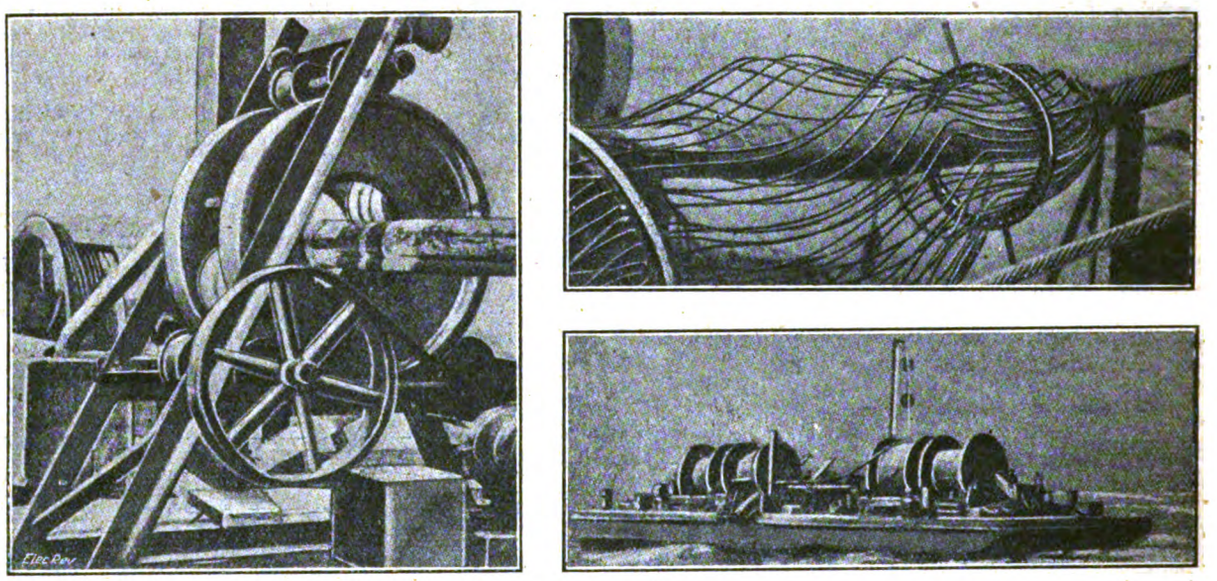
The opportunity was also taken to carry out heating tests on the submarine cables, on which little data has previously been available.

By means of a 650-volt 1,000-KW. direct-current generator and by connecting the cables, as shown, diagrammatically, it was possible to circulate current through the conductors of the submarine cable.

The telephone wires in the cable and on the San Francisco shore were used as pressure cables, and it was possible to determine the voltage drop for any given load. From observations the temperature curves shown on page 443 were plotted, the water temperature being 12 deg. C. Laboratory tests under similar conditions were arranged to determine the temperature rise in the splices, for which also curves are shown.

The shore ends of 350,000 circ. mil. cable are not entirely under water, and further tests were made on these cables, the dotted curves showing the temperature rise. As the life of the rubber insulation depends largely on the temperature to which it is subjected, it can be seen that the safe carrying capacity of the cables is approximately 350 amp., owing largely to the radiating capacity of the splices and the large size of the shore ends, although under emergency conditions the cables could safely carry 400 amp. The specification called for a test pressure of 30,000 volts for 30 minutes at 60 cycles between conductors and between conductors and ground at the factory. The telephone conductors were to withstand a pressure of 4,500 volts between conductors and between conductors and ground. On test it required 100,000 volts to puncture between conductors of the main cable and 46,000 volts between the conductors of the telephone cable.

In conclusion, we have drawn on articles recently appearing in the *Electrical World* and *Journal of Electricity* for much of the information here given.



Barge Serving Machine, Rings to Hold Armouring during Splicing, and View of Barge.

A LARGE BATTERY SUB-STATION.

The Metropolitan Electricity Supply Co. have recently completed a large battery sub-station in Eagle Street, Holborn, in order to increase the facilities for supply in that district. Provision is made in the building for four complete batteries, and one of these has been installed in the basement; it has been supplied by the Chloride Electric Storage Co., Ltd. The battery consists of 110 cells of their C.V.W. 26 type accumulator, in lead-lined pitch-pine boxes, and has a capacity of:—

1,200 amps. for 10 hours	to 1.8 volts per cell	= 12,000	A.H.
2,000 amps. for 5 hours	to 1.78 volts per cell	= 10,000	A.H.
3,800 amps. for 2 hours	to 1.7 volts per cell	= 7,600	A.H.
6,000 amps. for 1 hour	to 1.65 volts per cell	= 6,000	A.H.
8,000 amps. for 35 minutes.			
12,000 amps. for 1 minute.			
15,000 amps. momentarily.			

The normal maximum charging rate of the battery is 1,400 amps., and the maximum continuous charging rate 2,570 amps. The maximum charging voltage is 2.6 volts per cell.

The positive plates are of a special Planté type, in which the active material is in the form of pure lead rosettes, supported in a strong and rigid antimonial lead framework, which is unaffected by the chemical changes which take place during the life of the cells and retains its strength. The negative plates are of the cage type, each plate consisting of an antimonial lead cage in two halves riveted together; the face of the plate presents a smooth surface of perforated sheet lead,

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the intervening pockets constituting receptacles for the active material. The plates are separated by wooden dowels, which also act as supports to special wood diaphragm separators, and are held in the correct position by means of india-rubber rings. The plates are suspended on stout glass slabs, resting on and held in position by lead shoes. The positive and negative plates in adjoining cells are connected by means of massive channel bars. The efficiencies guaranteed are: amp.-hour efficiency at all rates, 90 per cent. Watt-hour efficiency, 75 per cent. at 5-hr. rate; 72 per cent. at 2-hr. rate; 70 per cent. at 1-hr. rate. There are 25 positive and 27 negative plates in each cell, the former 7/16 in. thick and the latter 5/16 in. thick; both plates measure about 16½ × 46⅜ in. The overall dimensions of one cell are 21¾ in. × 49⅛ in. × 65⅞ in., the height overall being 68¾ in. Sections of the cell are given in fig. 5.

The weight of the positive plate is 90 lb., and of the negative 41 lb., except the outside plates, which weigh 34 lb. each; the total weight of the plates in one cell is 3,452 lb., of the acid 1,700 lb., and of the complete cell 6,080 lb. The approximate weight of the complete battery, exclusive of the stands, is 298½ tons. Each cell is supported on 12 glass insulators of the "mushroom" type. The stands are of pitch-pine, and are supported on strong glazed earthenware insulators. The different rows of cells are connected together by means of flat copper bars bolted to copper take-offs, cast into the channel bars at the ends of the cells; each connection is composed of four bars, each .4 in. × ¼ in., air spaces being left between the bars. These bars are suspended from the ceiling by means of iron rods, insulated from the copper by globe strains and insulated turnbuckles.

The battery-room floor is of special construction (see fig. 6); metalline bricks are laid on edge, in rows of sufficient width to carry the glazed earthenware insulators for supporting the battery stands in grout; the rows are 9 in. wide, and stand directly on the cement screed of a concrete floor. A space of about ½ in. is left between the bricks, and is filled in with cement to a depth of about 1 in. from the bottom of the bricks. Acid-proof asphalt compound 1 in. in thickness is laid over the whole of the cement finish to floor; a fillet is formed

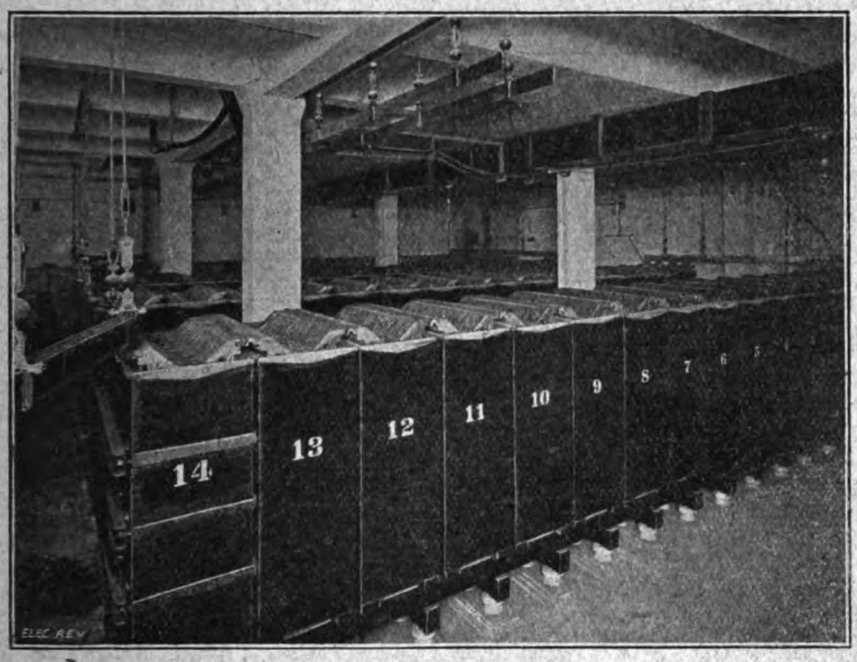

Fig. 1.—Part of Chloride 1,320-kw. Battery.

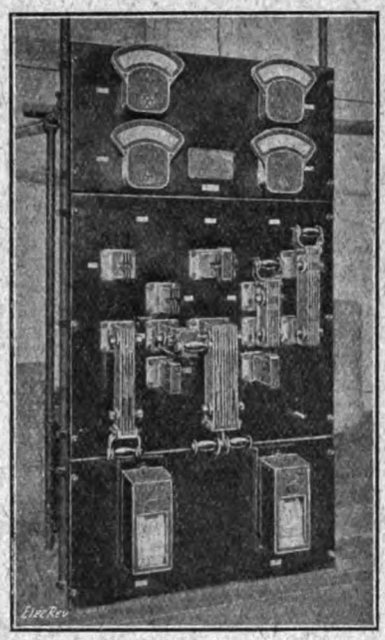

Fig. 2.—Negative Switchboard.

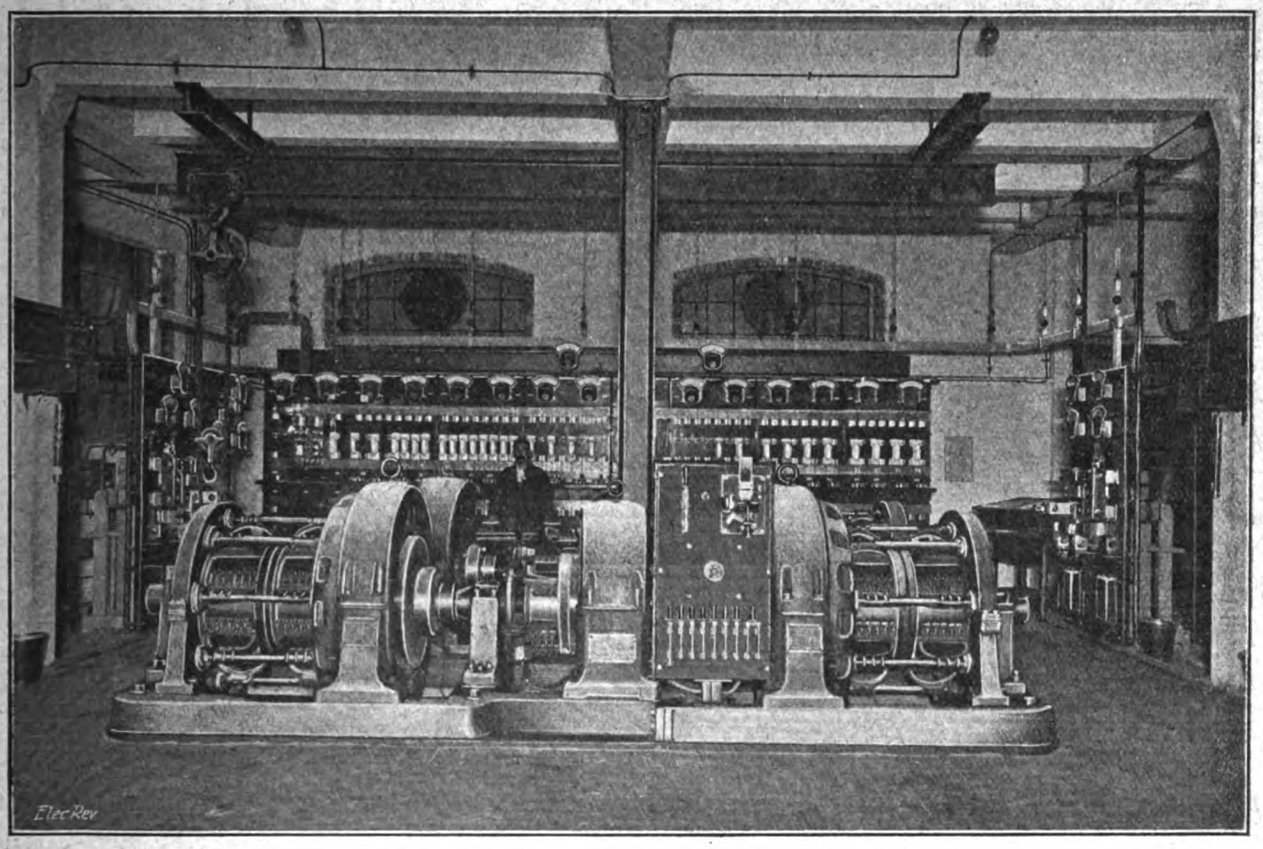

Fig. 3.—E.C.C. Boosters and B.T.H. Switchgear.

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round the bricks to 1½ in. above the level of the surrounding asphalt, and is ironed against the rough surface of the bricks. The ½ in. spaces between the bricks are also filled with this compound to the level of the top face and sides of bricks, thus forming an acid-proof floor and making a solid foundation for the batteries, which are illustrated in figs. 1 and 4.

Two motor-driven boosters have been installed to deal with the present battery; they were supplied by the Electric Construction Co., Ltd., of Wolverhampton. Each consists of one interpole motor of 115 B H.P., at 210/240 volts, 500 R.P.M., and two interpole boosters, the fields of which can be reversed

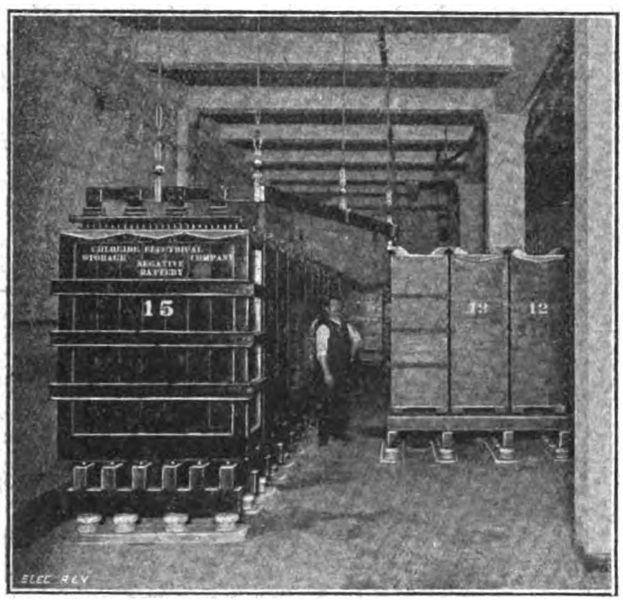

FIG. 4.—PART OF BATTERY.

so as to boost up or down; each booster is capable of giving 1,800 amps. at 16.7 volts continuously, 2,500 amps. at 12 volts for two hours, and 3,000 amps. at 10 volts for one hour. The boosters are separately excited at 210/240 volts, and each has a single commutator, which is ventilated through slots in the centre of the commutator between two steel rings, as shown in fig. 3. The machines, which are connected by Zodel-Voith flexible couplings, have four bearings on one combination bedplate, and are fitted with carbon brushes.

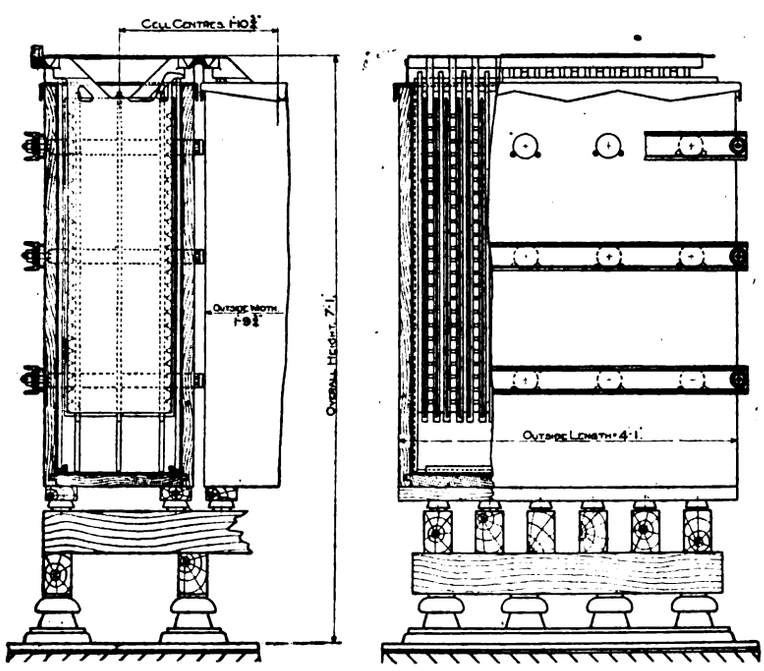

FIG. 5.—VERTICAL SECTIONS OF CHLORIDE CELL.

The efficiencies of each booster under the loads given above are respectively 69, 62, and 56 per cent. The efficiency of the motor is 91 per cent., with each booster giving 30 KW.

The switchgear for each motor is mounted on a panel fixed to the bedplate of the machine. The starting switch consists of nine interlocked slow-break knife switches, and the booster field regulators are of the pedestal potentiometer type. The boosters are shown in fig. 3.

A battery milking booster made by the Electric Construction Co. has also been installed, consisting of an interpole motor driving an interpole booster, which gives 1,500 amps. at 10 volts, 575 R.P.M. It is provided with four bearings and mounted upon a combination bedplate, together with the necessary switchgear. The booster is connected up to copper bars supported by globe strains under the ceiling of the basement as shown in fig. 1. Portable flexible leads are used for the connections from these bars to the cells.

The switchgear, which was supplied by the British Thomson-Houston Co., Ltd., consists of one main board for feeders, motors, and battery, one negative and battery panel, one positive and battery panel, and one instrument panel.

The main switchboard, shown in fig. 3, accommodates the battery connections, field and motor connections, and 24 triple-concentric feeders. It consists of six feeder panels, one motor and battery panel, and one panel carrying four 4,000-amp. switches for dividing the feeders into two sections, the neutral bar having a covering plate for this purpose. There are double positive and negative copper bus-bars, so arranged that feeders or battery and motors can be connected to either the top or bottom bus-bar, the battery through two 4,000-amp. switches in parallel on either pole, and the motors and feeders through switch fuses, each feeder having two fuses in parallel.

Twelve of the company's feeders forming part of the network in Eagle Street were cut, both ends of each feeder being brought into the station and connected to the bus-bars through neighbouring fuses. The feeders can, therefore, be boosted up as required, and the battery current is available in the feeders in either or both directions.

The negative and positive booster and battery switchboards

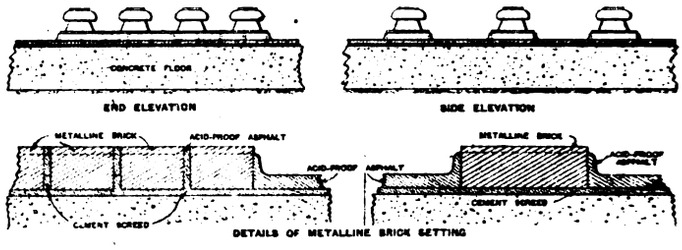

FIG. 6.—DETAILS OF FLOORING.

are at opposite sides of the machine room, as shown in fig. 3. The negative switchboard is shown in fig. 2. Mounted on it are two 5,000-amp. switches for No. 1 booster, two 5,000-amp. switches for No. 2 booster, and one 8,000-amp. switch for the battery connection, four voltmeters, one recording voltmeter, and one recording ammeter. The switches on the positive board are similar to those on the negative panel, the instruments being two voltmeters, one ammeter, and one charge and discharge Aron watt-hour meter. These switchboards are

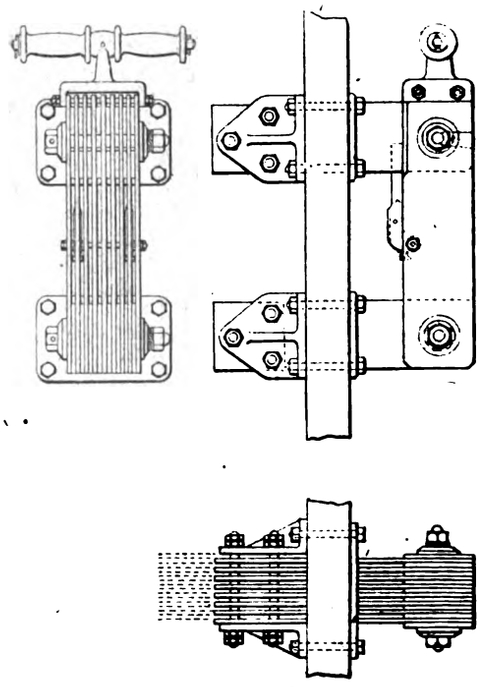

FIG. 7.—8,000-AMP. SWITCH.

arranged so that either the first or the second machine, or the two in parallel, can be connected to the existing battery or to a second battery. An instrument panel carrying five ammeters is fixed by the side of the positive panel.

The basement is ventilated by means of two fans, belt-driven from a motor. One is a low-pressure fan drawing air from outside, and discharging it into the basement through wooden trunks situated on the floor, and carried nearly the full length of the building at either side; a portion of one of these trunks is shown in fig. 1. The other is a high-pressure fan drawing air through a wooden trunk fixed to the ceiling

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of the basement, and discharging at the top of the building; a portion of this trunk is shown in figs. 1 and 4.

The building consists of a basement, ground, first, and second floors. The basement and ground floor were designed to carry each two batteries similar to the one now installed. The first floor was designed to carry all the boosters required for the four batteries, and also the necessary switchgear. For the present, however, the boosters and switchgear are erected on the ground floor, thus saving a considerable amount of copper.

The contractors for the building were Messrs. Geo. Andrews and Co. The steelwork was supplied by Messrs. Drew, Bear, Perks & Co., the architect being Mr. J. W. Stanley Burmester. The building and plant were erected under the supervision of the Metropolitan Electric Supply Co.'s engineers, to whom we are indebted for the foregoing particulars.

THE ELECTRICITY SUPPLY OF GREAT BRITAIN.

An important discussion took place last week at the Institution of Electrical Engineers on this subject. It was introduced by Mr. Ernest T. Williams, M.I.E.E., who in January submitted a paper dealing comprehensively with the present state of the electricity supply industry; the new conditions brought about by the war, and the urgent need for electrical engineers to work together for meeting the country's need for a cheaper and more extensive electricity supply; and a proposed scheme to meet this need.

The Council's decision to hold a general discussion on this subject made it desirable to reduce considerably the ground covered by the introductory paper, and for this reason the first two sections have been almost entirely deleted.

Mr. Williams pointed out that the time had now arrived when we must think of the supply industry not as a large number of independent detached schemes having separate areas, but for the country as a whole. If the policy of centralising generating plants in larger power stations had been economically sound, even though this involved transformation losses and additional mains, why should they hesitate in taking the next logical step of considering the eventual replacement of the large number of small, costly, comparatively inefficient electric supply stations by a few modern interconnected power stations for dealing with the electricity supply of the country as a whole?

Such a method of dealing with the problem would result in lower capital costs per unit of output and lower working costs per unit generated.

Against this must be set the increased cost of bulk distribution mains and transforming plant, and the loss in efficiency due to the transformation.

The area of Great Britain was comparatively small, but no country offered so great promise for a sound and economical electricity supply, if taken as a whole.

Technical considerations offered little difficulty, and financial issues could be dealt with under the guidance of present experience and knowledge. It was the basis of organisation which most urgently demanded attention, and the author had endeavoured to evolve a scheme on which the organisation might be based. It was imperative that the scheme should be formulated to draw in existing interests instead of acting in direct opposition to them.

The public control of electricity supply should be co-ordinated by a central body directly responsible to Parliament. Such a body should not be an existing Government department having various other interests; it should not be a Government department at all in the accepted sense of the word. At the same time, this central body must have all the weight of Government authority and be able to authorise or raise big loans on Government security at low rates of interest.

Such a body would have to be created with the necessary powers under a special Act of Parliament. It could be designated the Electricity Board, and its purpose would be the co-ordination, control, and development of the electricity supply of the whole kingdom for the public good.

He would assume that the whole country of Great Britain was divided into, say, six sections; an electrical engineer manager would be appointed for each district, where he would reside in a central position. On him would devolve primarily the responsibility of seeing that the best interests of the electricity supply for the public good were being developed and maintained, and in him would be co-ordinated the various electrical interests of the district, and the management of such portion of the electricity supply as might be directly handled by the Electricity Board.

One of the most interesting examples of a new quasi Government department was that of the Public Trustee, whose great and rapid success proved the value of having a faithful and sympathetic public servant available for certain purposes. The electrical engineer managers would act in a similar way in their own districts, whose electrical well-being would be their primary interest and endeavour, and these gentlemen holding well-paid and authoritative positions would be members of the Electricity Board and take part in all its deliberations.

Such public boards to be most efficient should be kept as small in size as possible. It was, however, desirable that they should be self-contained and fully representative of the departments of the Board—legal, accounting, financial, and Parliamentary. The heads of these four departments, like the electrical engineer managers, should be men of authority and repute in their several professions, so that the Board, constituted of these ten and two other members, would represent an efficient and responsible body of high permanent officials and recognised experts.

The President of the Board should be a man of wide knowledge and experience in public affairs, whose name carried weight and inspired confidence in the public and men of affairs. Like the other members, he should preferably be a paid official and expected to devote most of his time and interests to the work of the Board. Finally, the Board would have its permanent secretary, in whom—under the president—the organisation would be centralised.

To the Electricity Board proposed in the foregoing clauses all the questions relating to the electricity supply of Great Britain would be referred. It would become the authority—under Act of Parliament—on all the various questions and issues involved in the supply and application of electricity. Matters now dealt with by the Home Office, the Board of Trade, the Local Government Board, and by Parliament itself, would be gathered together under its control. The only reservation would be the right of appeal from the Board's decisions to the higher authority of Parliament.

Never before in the history of this country had it been so evident that they must conserve their capital and resources. Thus to launch forth on to theoretical considerations of the generation of electricity without using to the utmost the present sources of supply would be to court failure.

The suggested scheme would, therefore, at the outset interfere with present generating stations to the minimum extent. When, however, stations under municipal control reached the limit of their capacity, or desired to replace their obsolete plant, they would require to obtain the Board's authority for the expenditure. It would then be for the Board to decide in each case whether the interests of the district and of the electricity supply of the country as a whole would best be served by allowing such additional plant to be purchased by the Corporation and installed in the generating stations, or whether it would be better for the additional load to be supplied in bulk from a bulk network.

It would be for consideration whether limited companies should be brought compulsorily under this ruling or not, for they were placed under different conditions from municipalities and generally would prefer to purchase their current in bulk, if by so doing they could obtain it at a lower cost, than to sink further capital in their existing generating stations.

Several large stations in the country were highly efficient, modern, and capable of extension in large units; these would be the initial ones in the greater scheme which would be planned in order to embrace them. They would be interconnected by a bulk-supply network, to which they would supply their surplus power. Though additional new stations would be required from time to time as the demand increased, and it would probably be preferred for such stations to be erected and worked directly under the Board, it by no means followed that the control of the existing power stations which it might be decided to incorporate in the scheme should pass out of the hands of the present authorities, whether municipal or company owned.

Waste blast-furnace gas, surplus water power, and other sources of energy would be utilised.

The lower the price at which they could supply electrical energy, the greater would be the demand, and, conversely, the greater the demand the lower the cost at which they could supply. The result was thus cumulative, and if the cost could be brought low enough the demand would be so great as absolutely to dwarf the present load. The two chief items of generating cost at present were the capital charges and fuel, and it was very evident that under favourable conditions and with a sufficient demand these could be reduced to a small fraction of the present average generation costs throughout the country. With the diversity factor of such a demand the load factor on the stations would be high, and the plant factor, or proportion of time the plant when running was on full load, would be almost unity; this would be brought about by the interconnection of the stations.

The scheme would enable much greater freedom of departure from "cut-and-dried" methods to be embarked upon, due to the fact that a station could be laid out and built on a large scale at once, for, if it was to feed into a network to supply the whole country with a rapidly growing demand, the time would be comparatively short before the station would be required to give its full output. Thus early utilisation of the capital sunk in the station would remove one of the disabilities under which the designer of an ordinary large power station now laboured. More important, however, would be the fact that the failure of any new departure to obtain fully the anticipated results would not be the same serious matter which a similar partly successful experiment would be in an ordinary power scheme to-day. This was important, for development must be progressive.

A number of the stations would probably be arranged for running on gas-fired boilers with modern plant for the recovery of the by-products of the fuel in large quantities, and near such stations would probably be established chemical

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production companies making large demands for electrical energy for electrochemical processes.

The main bulk-supply network should be the property of the Board, which would have the right to carry its overhead or underground mains through any district. The subsidiary network might belong either to the Board or to existing undertakers, according to circumstances; for example, there appeared no reason why the power companies and the large municipal undertakings should not themselves supply current in bulk on their own mains, taking the supply from their own power stations, from the Board's bulk network, or from both.

The bulk network would have to be designed with a view to ensuring reliability of supply, so that if any one power station failed it would not affect the main supply, or if any one section of the bulk network was destroyed the supply of current would go on automatically to the subsidiary network. Reliability of supply was of the utmost importance, taking the premier place even before low cost. One of the strongest arguments for the new scheme would be its greater reliability, owing to the number of stations and the alternative routes of cables.

The question of giving a supply in any part of the country would require to be regarded not alone from the standpoint of whether it would pay to run the electric mains for the immediate demand, but also from the larger standpoint of whether giving such supply was for the good of the country as a whole. In this way many districts would be given a cheap supply of electricity, which under the ordinary commercial conditions of a company operating in a smaller area would not obtain.

The transformation and distribution of electricity to the small and medium-size consumer was well and efficiently filled by the present undertakings, and, with the exception of removing a few anomalies and arranging for developments to be on lines which would tend to greater uniformity throughout the country, the scheme would not interfere with the present arrangements. If those interested in the existing undertakings could clearly see that the scheme would not be detrimental to them, but otherwise, it would readily receive their support.

By leaving the local distribution under local control, the inter-departmental questions which arose, such as opening roads for laying mains, lighting roads, pumping water electrically, &c., would be more readily dealt with, and local control, whether municipal or company, would create a local interest in the question of electricity supply which would tend to its more rapid and favourable development.

In districts where there were no electricity supply authorities, the detail distribution would have to be carried out by the Board itself in order that no district in the country should be without its cheap electricity supply. This would not be a difficult matter, for undoubtedly under the new conditions all the railways, main line and suburban, would eventually be electrically operated, and this would carry the electricity supply wherever there was a railway, from which the supply would radiate to the country around. This desirable state of things would not be brought about in a day, and progress must go hand in hand with sound finance and common sense.

In the author's opinion, one of the indirect results of the scheme would be the resuscitation of our canal system. Hitherto, the question of electrical propulsion had been partly held back by the cost of the electric power system, but when power mains were running along canal routes for other purposes the problem would be simplified.

Similarly, the great agricultural interests of this country, which it was so important to revive, would receive a great stimulus from a cheap electricity supply. In other lands electricity was being largely adopted in agriculture; and much was to be gained by its aid for lighting, power, heating, and transport. Not only directly, but indirectly, must they assist agriculture by reducing the cost of artificial fertilisers, whether as by-products of generating stations worked with gas-fired boilers or through the cheap supply of current to electrochemical industries.

It was felt that the time was now ripe to launch this or a similar scheme on to the public notice. There was evidence on every side that men's minds were already actively employed in considering what could be done to enable the nation to support the burden brought about by the war. In what ways could the nation prevent waste and economise, and in what manner could production be increased? The electricity supply problem could play a leading part in both these departments, and because of this there had never been a more favourable time in which a united electrical profession could rapidly obtain public interest in and public support for its schemes.

There was too much said and written in these days which brought no results. Let them determine that it should not be so in this case.

When it was understood that these proposals could be brought into early operation by Act of Parliament without disturbing existing concerns, and that the policy of the proposed Board would be to become self-supporting at no distant date—ultimately neither requiring any financial assistance from the Exchequer nor operating for profit—it would probably receive the immediate support of all political parties, and a Bill could be rapidly passed through Parliament.

In a paper read before the International Engineering Congress, San Francisco, last summer, Mr. C. H. Mitchell demonstrated the wisdom and success of the policy of the Ontario Hydro-electric Commission. In this Commission was embodied, by Act of the Canadian Parliament, the control of the electricity supply of the Province of Ontario. Its aim was to enable electricity to be given at the cheapest rate to the people; and it supplied, without profit, electricity in bulk to various supply authorities, obtaining this supply largely from existing power companies and distributing it through the Commission's bulk supply mains. The costs of the Commission's operations were borne by the authorities to whom the supply was given. The formation of the Commission was considerably criticised. Its remarkable success spoke for itself, and should any further argument be necessary it would form a convincing one for the scheme herein outlined for Great Britain.

They should avoid large committees and voluminous reports, and by keeping the subject on concise and clear lines, and dealing with it in a businesslike manner, they would more readily attain their end.

It should be clearly understood that the proposed scheme was not for the nationalising of our electricity supply, nor was it for the municipalisation of that supply. Its true function was the co-ordination into one body of the control of the electricity supply, assisting existing undertakings whether municipal or company owned, and taking upon itself only those functions of generation and distribution which were essential to the furtherance of wise development and a supply at the lowest cost.

The scheme proposed no confiscation of the rights, privileges, and property of either electricity companies or municipalities, and in the event of its being recognised as essential in certain special cases to take any of these over, full compensation should be paid not only of the value of the actual plant, but of reasonable allowances for potential values.

The whole basis and policy of the organisation would be heartily to recognise what had been done by the existing authorities, whether public or private, and, instead of sweeping away, to conserve and build up, guiding future policy and co-operating with the present authorities for the well-being of the whole.

The author, having occupied responsible positions in Government, municipal, and private concerns, and having seen the inner workings of each, submitted the opinion that each had its proper sphere of action which it alone could best perform, and that the highest efficiency and greatest progress were only attained when these interests worked together in the common cause, none trying to usurp the place of the other, but all recognising that the success of the whole meant success of each in its own department.

The initial operations of the Board could be undertaken without huge financial operations, and the avoidance of drastic proposals for sweeping changes either in the ownership or control of existing undertakings would cause otherwise potential opponents to become adherents and advocates of the scheme, for all thinking men realised that something should and must be done to place the electricity supply of the country on a sounder basis.

Finally, these days of grave responsibility were also days of great privilege and opportunity. Never again would they find the same mental and moral attitude which was necessary to bring some such a scheme as here outlined to early fruition. Let it not be said of them that they failed.

Mr. C. H. Merz, who followed Mr. Williams, said he wished Dr. Ferranti had been there to take part in the proceedings, for he had no doubt as to the best arrangement for electric supply in Great Britain. It was worth while considering why the general idea outlined by Mr. Williams and others in the past had not made greater progress. Similar ideas had been proposed 20 years ago, and very numerous schemes of a similar character had been brought forward since, yet but little progress had been made, and he asked why. The author said organisation was the difficulty, but he (the speaker) differed. The reason, he suggested, was because the profession as a whole was not convinced that such a scheme was the ideal, and if that was so, they must face the fact and see whether the majority were right. They must make up their minds that what was right for other countries was not necessarily the right thing for this country. Argument was at a low level when it was urged that we must follow a certain course because another country did so; it was not the consideration which had influenced us in the past, and our aim should be to lead rather than to follow. As the electrical industry was not convinced, how was the question to be solved? The United Kingdom differed as regards its distribution problem from America and Germany, and they would be wrong in following the American idea of interconnected distribution areas. British areas were much more congested. The present war and general considerations had emphasised the importance of security of supply, and they had considerable areas solely dependent on one central station, which arrangement, if continued, would be likely to lead to trouble. The more these areas developed electrically, the greater the importance of not putting "all their eggs into one basket." As a remedy, such adjoining areas should be interconnected and worked conjointly, the linked stations being treated—as regards the size of generating units and proportion of spare plant—as one. Such an arrangement would lead to greatly reduced capital expenditure and improve operating conditions; he suggested that it was the only logical system on which electricity supply could be properly developed, and the most economical. With the larger units a coal economy of from 30 to 60 per cent. was

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possible compared with what could be done with independent stations. Every day it was becoming more apparent that small stations could not adopt the refinements necessary to high economy. The most important result would be the improvement of load factor, and, as an instance of the possibilities in this direction, he cited the load curves of the North-East Coast system, which showed that they were able to get up to 60 per cent. The first step was for the technical side to agree as to the right lines of development; he discounted the idea of Parliamentary assistance, especially if they were not agreed amongst themselves. It was important that they should promote a "fashion" for electrical engineers to deal with their distributing systems exactly as they asked their consumers to deal with their own plants, &c.

Mr. R. A. Chattock said he was interested to see that Mr. Williams was covering similar ground to that covered by himself in his presidential address to the Municipal Electrical Association two years ago, and that he had further developed the idea. However, sufficient emphasis was not laid on the justification for such a scheme, which turned on the necessity of attracting the consumer, and involved a reduction in the cost of energy. It was well to help the idea by creating a fashion, but a much more powerful incentive would be found if the manufacturer's pocket benefited. Price was the great attraction to industry, which looked forward to future reductions, and they must stimulate the idea, towards which Mr. Williams's scheme would help. There was enormous scope for development yet, but the hampering influence was the large number of small stations and too high cost of operation of some of the large ones. A scheme of the kind suggested should be run on broad-minded principles, not so much to produce large profits and, possibly, with a loss in sight for some years. But the loss should fall on the community as a whole, as the scheme would benefit industry at large. The scheme put forward was the logical development of our present experience. He did not quite agree with the idea of not interfering with existing stations; if they were inefficient plants they should certainly be dispensed with at once, and each subsidiary area should be treated as if it were a substation area. Probably the number of large stations necessary would be quite considerable, and probably we should come to the interconnected station idea, with plants of, say, 300,000-kw. capacity each, as lowering the price of electricity would bring an enormous demand. He quite realised that a bulk supply network would be an expensive and difficult thing to arrange, and that a great difficulty would arise in connection with wayleaves, for which drastic powers would be required if the scheme were not to be crippled. There was no reason why such a scheme should not be prepared now in readiness for the opportunity to develop it.

Mr. J. S. Highfield said it was most important that they should come to some agreement on the subject, but when the previous speaker suggested that they must spend money and expect no return for some time, it reminded him of the dreadful times when electricity supply was developing in London, and there was no profit at all. He considered it would be quite hopeless to raise the money with such prospects, and that the principle was all wrong, as there must be some hope of a return on capital. Such a scheme would not lead to any practical result. He considered that the existing supply over large areas of the country was very good; there were few towns where industry could not be satisfied electrically, and he thought it was unnecessary to belittle our present position. Probably in no part of the world were better results obtained than in the North-East Coast area. He thought if any one industry had suffered from legislation, it was the electrical industry, and pointed out that all the largest industries in the country had been developed by private enterprise, and that when Parliament stepped in trouble resulted. They did not want too much legislation. He believed that if the same opportunities had been given as in the case of the railways, the electrical industry would be in a much better position now. Mr. Williams suggested a board of control, which reminded him of the Water Board, but who were the board to be responsible to? He thought if they removed the commercial element from the proposed board, making it a technical board, he could agree with it.

Mr. H. Faraday Proctor said he differed from both Mr. Williams and Mr. Merz, believing that technical considerations should be dismissed, and the proposed board formed to get on with the work; if left to the Institution, the scheme would be stifled by the conflicting interests. The proposed scheme did not interfere with the existing concerns; he was afraid that Mr. Chattock's idea of scrapping existing plants would tend to delay matters indefinitely. He agreed that such a scheme would do more to cheapen supply than any independent effort. The proposal to use canal routes for transmission lines should be extended to railways, and one controlling body should supervise matters; until some such procedure was adopted we could not hope to get prices down to the desired level.

Mr. W. B. Woodhouse said it was important that electrical engineers should first agree what to do. Mr. Williams had put forward a scheme for electricity supply, but that was only a link in the fuel problem, for fuel economy depended on the realisation of electricity supply on a gigantic scale. On the broad principle of centralisation of supply, he hoped they were all agreed; they might differ as regards organisation, but if they agreed on the broad principle they had gone a long way. They must give security for capital, but the large schemes would necessarily be to some extent speculative. On the other hand, if the Government would advance the capital, it would be beneficial. He was afraid he could not agree as to the basis of organisation. To achieve success, the public must be educated to an appreciation of the dogma to be followed; they must tell the public about it, and keep on telling them before any progress would be achieved.

Mr. C. H. Wordingham said he had looked at the subject of electricity supply from all points of view; now he looked at it from a detached point of view, and, as a result of his experience, was quite convinced that a number of the power companies were in business from "purely philanthropic motives." He had been interested in Mr. Merz's remarks, but his suggestions that night represented something very different from the original ideas of promoters of power schemes, who asked for a single large power station. The real secret of economy was to get diversity. The linking-up proposal of Mr. Merz was admirable, but where was it to stop? The most successful power supply scheme had a large number of linked-up power stations. Turning to Mr. Williams's proposals, he deprecated any form of Government interference; the scheme must be run on commercial lines and show a financial return. No Government department could successfully conduct a commercial undertaking, and under Government control all the time would be occupied in receiving inspectors and making returns.

Mr. Madgen took exception to the description of the Ontario Hydro-Electric Commission's work; of all the bodies he had met with, none carried out its work in a more reprehensible manner. The Commission not only regulated the supply industry as a whole, but it also competed with other independent undertakings, resulting in the crushing out of enterprise. The consulting engineer branch was gradually disappearing! He thought in regard to the proposed board, that if it was divested of the business of operation it might do well.

Mr. Thos. Roles considered that the electrical profession was agreed on the right scheme of electricity supply, and that engineers would support the proposal put forward, especially if they happened to be on the suggested electricity board. The success of the proposal really depended on the human factor, and it was asking a good deal of the engineers of smaller undertakings if they were to efface themselves for the benefit of the country as a whole. The fate of the engineers of those undertakings which had been absorbed in the past was known. If all the engineers could be brought into the scheme, they would get a body of opinion in its favour; if they could safeguard the engineers, it would not be long before the engineers would convince their committees. But the talking should cease, and he thought the Institution was the right body to take action, as it would combine the widespread interests.

The President (Mr. C. P. Sparks) agreed that the stumbling block was the human factor, and cited the cases where engineers had rejected the idea of bulk supply to their undertakings. The real principle at the bottom was the conservation of fuel, which was more important than cheap power. He was sure that the Council would consider the views expressed during the evening.

THE BUSINESS SIDE OF SCIENCE.

At a meeting of the North-East Coast Institution of Engineers and Shipbuilders, on April 7th, Mr. T. C. Elder (of the British Electrical and Allied Manufacturers' Association) delivered an address on the part that would be played by science in the coming economic crisis. Referring to the conference recently summoned by the Royal Society, at which it was decided to form a joint board of scientific societies, to promote the application of science to industry, he remarked that in the past the relationship between these two parties had seemed to be based on a sort of mutual contempt; but the times had changed, old methods must be abandoned, and the business of industrial production and distribution must in future be carried on with greater efficiency—*i.e.*, on more scientific lines. As a result of the war, the capacity of British engineering works had been immensely increased; at the end of the war they must find outlets for their products, and this could only be done by the cultivation of the scientific habit and method in the economic system of the country. The accounts of manufacturing concerns were annually subjected to a minute investigation by professional experts, so that the true financial position should be disclosed; surely, if this had been found a salutary process, it ought to be extended to other departments. Competent men for such work, who could overhaul the purchasing department, revise the technical designs, appraise the efficiency of the machinery, or devise improved methods of promoting sales, were scarce and expensive, but he would suggest a practical solution of this difficulty. The principle of association was gaining ground, but there was a danger of associations becoming mere hindrances to progress: the kind of association that was wanted was one that would act as a persistent stimulus, not as a technical debating society. He looked to the manufacturers' associations for a method of pooling the experiences of members and providing the equivalent of a system of auditing for various departments. The great fault of most manufacturers

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who entered such associations was that they did not make full use of the powers so developed, but struggled to retain their own freedom. Such associations could generalise from a wider range of particulars than came within the purview of a single firm, and could help their members in respect of the purchase of materials, conditions of labour, the establishment of co-operative sales agencies in foreign markets, and so on. They should themselves be assisted in their attitude towards public policy by a board representative of the scientific and technical institutions, especially as regarded our unscientific and unbusinesslike system of education and our inefficient executive government. These associations should combine in a campaign of popular enlightenment, to demonstrate the importance of British engineering to civilisation, its immense earning power, and its social and economic possibilities. In brief, Mr. Elder urged that scientific institutions should jointly prepare plans for the reform of our educational system, combine with commercial associations to increase industrial efficiency (and, therefore, national prosperity) all round, enlighten public opinion on questions of industrial economy, showing the workers that it was to their interest to extend, rather than to limit, production, and find effective means of expression in Parliament. The public, having been protected by engineering from a ruthless enemy, should now protect engineering, and they should mix business not with revenge, but with patriotism, politics and science, so that those industries in particular which were indispensable to peace and prosperity should be given full freedom of development for the security and progress of the Empire.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Institution of Electrical Engineers.

I am one of many who feel that the I.E.E. yields a totally inadequate return for the annual subscription to the vast majority of its members. All they receive is a copy of papers submitted by their fellow members and the discussion thereon, which they can equally well obtain by subscribing to your paper.

The Institution should be representative of the industry throughout the Empire, and its work and standing such that this position is generally recognised. In Canada the position it should hold is held by the American I.E.E.; in South Africa it has no standing whatever; there is supposed to be a Local Section in Cape Town, but in practice this does not exist, whilst in Johannesburg (the centre of a large and active electrical community) an excellent independent Institution has been established. I cannot speak of the state of affairs in other Colonies, but I fear it is no better than in those I mention.

In discussing the situation in Johannesburg with a member of their committee, he said: "We had to give up all pretence of being a Local Section of the home concern, as they demand 75 per cent. (or thereabouts) of our income, for which we get little or nothing, and the balance was totally inadequate to carry on efficiently here," and this is true elsewhere.

It seems to me that the Institution, to serve its purpose, must:—

1. Be so strong that its influence carries real weight with the Government and other public bodies.
2. Take a lead in electrical research work throughout the Empire.
3. Take a lead in technical education throughout the Empire.
4. Take active steps to develop our electrical trade abroad and to increase our prestige generally. To these ends it should use its influence to place its members where possible, in the many responsible positions available abroad.
5. Have such a number of sub-committees as will reasonably represent the interests of the various branches of the industry (these committees need not necessarily meet in London; Manchester would, perhaps, be a convenient centre for the manufacturers' section; Sheffield for central-station engineers; Birmingham for education, &c.).

To develop properly these suggestions I think, in addition to its present staff, the Institution should employ at least one active, highly-trained, practical engineer of recognised standing. Then, the social side needs developing; the opportunity of meeting other engineers, including those outside the scope of our Institution, is very valuable. This, I think, may best be achieved by the formation of Engineers' Clubs, on the lines of that in existence in Manchester, say, in London, Newcastle, Glasgow, &c., with interchange of membership. These clubs, of course, should be self-supporting when once started.

All these objects need money, and the Institution has it, but, unfortunately, it is sunk in that great "white elephant" on the Embankment (incidentally, an eminent central-station engineer tells me that he has calculated the load factor of that place so far as our members are concerned to be between .040 and .045 per cent., but I am sure it is not nearly so high in the case of most members). This building should be sold, or other steps taken to reduce our rent charges in London to, say, £1,000 or £1,200. This would leave a considerable annual sum free for the above objects, including the treatment of members attached to Local Sections on equitable lines with the fortunate residents around London, who not only have the daily privilege of viewing the "white elephant," but are provided with a free annual conversazione, institution-aided dinner, &c., all of which the great majority of members are denied.

I have discussed these matters with many of our members, and with members of the "Mechanicals," many of whom hold similar views regarding their Institution, and it seems to me that much is to be gained by both parties (and, possibly, other engineering societies) by a close co-operation without in any way disturbing the integrity of each. Thus, by such co-operation, the question of housing accommodation in London and for the Local Sections could be put on a satisfactory basis, and also the development of the club idea suggested above; but, more important than all, a really "heavyweight" joint committee representing the allied branches of engineering could be formed.

Care should be taken in future that, as far as possible, the Council of our Institution contains a fair representation of the various branches of the industry. At present there is a strong tendency for members holding public or semi-public positions to predominate. I do not think one of our large general manufacturers is represented just now, unless through a Local Section, although, both in the matter of providing "papers" and adding to the discussions, they are a most active class.

In support of my opening statement, may I point out that, although we have been at war some 20 months, and the industry has badly needed a lead, all the Institution has apparently done during that time (apart from the reading of papers and adding to the discussions, they are a most active class.

M. I. E. E.

Decimal Coinage and the Metric System.

The enclosed printed copy of the report of the Decimal Association and your own strong and valuable lead in this matter must be my excuse for appealing to you for further attention. The Association propose the division of the shilling into 50 parts (cents). Surely this is wrong.

1. It is unjust to the great mass of the people. Why should the limit of justice remain at 2 per cent. when it is simple and easy to set the scales to 1 per cent.? Whether we like it or not, the shilling is the standard coin, and will remain so. The shilling should, therefore, be divided into 100 parts (cents), and so make an adjustment of prices possible within 1 per cent.

2. We are trying to introduce a sound decimal system; can the system be called sound which will make ten shillings consist of 500 cents?

3. We are trying to get into step with the other nations, who have long ago adopted the decimal system; can it be called getting into step if we take one to their two? Will any amount of persuasion make the French, the Belgian, the Italian, the Scandinavian, and other nations think of our shilling as 50 cents when their own corresponding and standard coin consists of 100 cents?

The two great stumbling blocks seem to be: (1) The desire to keep a coin as near as possible to our farthing as the comfort for the poor, and (2) the wish to divide the pound sterling into 1,000 as comfort for the richer. Undoubtedly the change to the decimal system can be made at the present moment much more easily than before the war, but let us keep in step with our Allies, even if our enemies are marching to the same tune.

C. Thorkelin.

[Provided that the system is decimal, we see no great advantage in making the shilling the standard unit. The only current coin of the same value is the German mark! The Russian rouble is equivalent to 2s. 1½d., the Chinese tael to 2s. 5d., the Argentine peso to 1s. 9d., the Brazilian milreis to 1s 4d., the Canadian and American dollar to 4s. 2d., the Dutch gulden to 1s. 8d., the Indian rupee to 1s. 4d., the Japanese yen to 2s., the Mexican dollar to 2s., the Peruvian sol to 2s., the franc and allied coins to 9½d.—where is the uniformity attributed to the shilling?—EDS. ELEC. REV.]

WAR ITEMS.

After the War in France.—The Conseil-General of the Department of the Seine has adopted (says a correspondent of the "Daily Telegraph") the conclusions presented in the report of MM. Sellier and Deslandres on the economic measures to be taken for the organisation of labour on the demobilisation of the armies after the close of hostilities. The programme of public works outlined comprises most important plans for railway extension, and an enlargement on a great scale of the canal system, as well as the general improvement of the seaports.

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Exemption Applications.—At the Stockport and East Cheshire Appeal Tribunal, a young man employed on the clerical staff of the Manchester Corporation Tramways Department stated that he had a conscientious objection to combatant or non-combatant service under the military authorities. He had resigned his position in the Manchester Tramways Department because he could not implicate himself by handling correspondence in relation to munitions. The decisions of the Tribunal were not made known publicly.

The Preston County Appeal Tribunal last Thursday heard an appeal by an electrical engineer, aged 26, who urged that his ability in his profession would be of more service to the country in a civil capacity than in the service of the Army. The appeal was dismissed, and the military representative was asked to recommend the man for service with the Royal Engineers.

At Douglas (Isle of Man), the tribunal has granted absolute exemption to Mr. Thomas Sheard, electrician in charge of the Government electrical plant at the Athol works.

At Poole, the Bournemouth Electricity Co. appealed for 12 employés. Mr. E. L. Ingram, for the company, said it was prepared to release two of the men who were in certified occupations, and withdraw two other claims. The appeals were for a stoker, two charge engineers, one works manager, two switchmen, and two motor-wagon drivers. Before the war the company had between 135 and 155 men, and at present the staff consisted of 85 men and boys, and they had over 75 men with the Colours, and were paying over £700 a year in separation allowances. The tribunal granted exemption to six men as being in certified occupations, and refused the appeals as to the motor-wagon drivers.

At Stroud (Glos.), Messrs. Edwards and Armstrong, Ltd., electrical engineers, appealed for 32 employés, who had attested, on the ground that they were in a reserved occupation. It was stated that time was needed to replace some of the charge men who were going to join up. Since the outbreak of war 30 men had left to join the army. It was arranged that nine men should be exempted for 14 days, and the remainder conditionally exempted until September 29th.

The Lowestoft Town Council has secured exemption for the remaining employés at the electricity works.

Dartford Rural Tribunal has granted two weeks' exemption to Mr. A. Brakefield, electrician to Mr. A. J. Hewings, of Northumberland Heath.

At the Newcastle-on-Tyne military tribunal, on Monday, an army captain, who has a business as an electrical engineer, applied for the exemption of his brother, in order to carry on the concern. All but two of his men had enlisted, while his other brother was in the Navy. They were both married men, and they had a mother to support. Conditional exemption was granted.

Conditional exemption has been granted to Mr. Charles F. Clayton, who is in charge of electrical plant at Stone (Kent).

At Salford a firm of electrical engineers appealed for a man engaged in armature coil winding, and stated that all the work was for public use or for places engaged on munitions. Fifty per cent. of their employés left early in the war, and women had been engaged to do light work. Exemption was granted conditional on the man remaining at his present occupation.

Before the Cheshire Appeal Court, the Military appealed against three months' exemption allowed the managerial secretary of the Weaverham Electric Supply Co., on the ground that he was not devoting the whole of his time to the work. Respondent said that the whole burden of the concern, except the engineering, fell upon him, and his duties required a great deal of technical knowledge. The appeal failed.

The Worksop tribunal has granted temporary exemption to the Station Superintendent at the Urban District Council electricity works, and also to two stokers, a cable jointer, and a fitter, all of whom are married, and until September 1st to the meter tester, who is single.

At Maidenhead Tribunal, the appeal of Mr. R. C. Walker, who had been refused exemption, was withdrawn by Mr. G. F. Craven, manager of the Reading Corporation tramways, Mr. Walker being medically unfit.

At Yarmouth, an electrician of two picture palaces was granted two months' exemption.

At St. Albans, Mr. A. Flower, electrical and motor engineer, appealed on the ground that he was in sole control of machinery engaged on Government work. The case was adjourned for 14 days.

At Brighton Tribunal, an electrician who had previously been granted 14 days' postponement for one of his men, appealed, stating that the man was the only one capable of undertaking any repairs that might come in. Two months' extension was granted.

German Dumping.—A political correspondent of the "Daily Telegraph" says that the statements with reference to great preparations for a dumping of accumulations of German manufacturers may be accepted too readily. They do not square with information in the possession of our Foreign Office and the Board of Trade. Any extensive German preparations would certainly have been heard of through neutral channels. The known state of German industries leads the Government to discount the statements.

German Dumping After the War.—The Exchange Telegraph Company's special correspondent at Stockholm describes the great dumping plan under which Germany, by exporting vast quantities of cheap goods now ready, is to pay for raw materials and to regain at a bound her lost markets. Manufacturers' associations of a new kind are being formed, which will aim at common action and prevent excessive production of some products, or insufficient production of others. They will also rule certain technical questions and questions of saleability arising out of the changing public taste. Makers of optical and surgical instruments, electrical machinery and machine tools are all working together. The amount of dump goods which is considered necessary is distributed for production among different factories on lines which ensure economy and division of labour. The production price has been cut so low that the 90 per cent. of sale value, advanced by the State to enable production to be carried on, has been reduced. In the campaign for economy factories and workshops are being standardised and specialised. Where two shops in a given area formerly produced indiscriminately two classes of goods, one factory has now taken over altogether one class and the other factory the other class. Sometimes machinery has been exchanged. There is no doubt that neutral States and, if they allow it, enemy States, will be badly hit by German competition, especially if, as Germans themselves predict, a period of industrial depression follows the war.—"The Times."

Nitrogen for Munitions.—A lengthy question was addressed to the Minister of Munitions by Mr. T. M. Healy in the House of Commons last week, with regard to the relations between his department and the Nitrogen Products and Carbide Company, which uses the Otswald process of manufacturing nitrate of ammonia and nitric acid. It was suggested that the process, which was purchased at the price of £652,108, had been superseded by the Harber process of the Bädische Anilin-Fabrik, that money provided by the Government had been used to erect works in this country for the treatment of nitrolim, and that the process had exceedingly injurious effects upon the health of the workmen employed; also that in the flotation of the company large blocks of shares were given free to certain persons and firms. In reply, Mr. Lloyd George stated that a contract had been placed with the company on favourable terms, under which the Government advanced, not £400,000, as alleged, but £50,000 at 5 per cent. interest, repayable by deductions from the price of the goods supplied; enemy shareholders held only about 2 per cent. of the capital, and the process had not been superseded by the Harber process, by which ammonia was manufactured, and not nitric acid or nitrate of ammonia. There were no deleterious effects upon the workmen employed, not a single case of disease having occurred through its use, although very large quantities of the material had been produced, and the persons named received no free shares, their holdings having been paid for in cash and by the surrender of equivalent shares in other companies.

Trading with the Enemy.—The Board of Trade directs the particular attention of all manufacturers and traders concerned to the need for scrupulous care in the transaction of their business abroad, in view of the fact that some traders in some neutral countries are making themselves agents for the supply of goods to and from enemy countries. Especial care should be taken in opening new accounts in neutral countries, and in relation to any orders or inquiries of an abnormal character. In any case of doubt as to particular firms abroad, business should be suspended pending reference as regards firms in foreign countries outside Europe to the Controller, Foreign Trade Department, Lancaster House, St. James's, London, S.W.; and as regards firms in Europe to the Chairman, War Trade Intelligence Department, Broadway House, Tothill Street, Westminster, London, S.W.—"The Times."

After-the-War Trade Policy.—In the House of Commons last week, in reply to a question whether Ministers were taking steps to formulate a trade policy to come into operation after the war, Mr. Asquith stated that a Committee of the Cabinet was appointed some time ago to deal generally with all questions of reconstruction, including those connected with commercial and industrial problems likely to arise at the close of the war. Investigations of particular aspects of the problem were being carried on by sub-committees. As to the most important, the Government were in communication with the Dominions.

Trade with Russia.—The Vice-Chairman of the Sales Managers' Association, Mr. William H. Beable, is leaving for Russia as the representative of various important British business firms to open up new trade with our Ally. He is going with the cognisance and approval of the Government, and his Majesty's diplomatic and Consular officers have been given instructions to offer him every assistance they can. His stay will be of not less than six or eight months.

Prohibited Trading.—The "London Gazette" for April 14th contains a schedule of additions to the list of persons and firms with whom trading is prohibited, in Argentina

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and Uruguay, Brazil, Cuba, Ecuador, Netherlands, Netherland East Indies, Persia, Peru, Portugal, and Sweden.

No Ministry of Commerce.—In reply to a question in the House of Commons, as to whether the Prime Minister would take early steps for rearranging the business at present dealt with by the Home Secretary, the President of the Board of Trade, and the President of the Local Government Board, with a view to creating, while the war is in progress, an adequate Ministry of Trade and Commerce, Mr. Asquith said that he was not prepared to adopt this suggestion.

Companies to be Wound Up.—The Board of Trade has ordered the following companies to be wound up:—Rhineland Manufacturing Co., Ltd., Wells Street, Oxford Street, London, W., importers of ball bearings for machinery, &c.; controller, L. F. Goodricke, 10, Coleman Street, E.C. Nitsche and Gunther Optical Co., Ltd., Hatton Garden, E.C., manufacturers of optical instruments, &c.; controller, B. E. Mayhew, Alderman's House, E.C.

Naturalised Aliens.—The Baltic Mercantile and Shipping Exchange, which has excluded from its premises not only all alien enemies, but also naturalised persons of enemy origin, except those over 60 years of age or having sons serving with the Colours, has further decided to ascertain by circular from the members whether the majority wish to exclude all persons of German origin.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Church Lighting with Concealed Sources.

The artificial illumination of a church is a problem which stands by itself, and calls for the soundest judgment and a cultivated sense of the artistic and appropriate qualities which are too often conspicuous by their absence from the scheme adopted. Indirect, or semi-indirect, lighting is seldom practicable, owing to the height of the roof and its dark surface, hence direct lighting must be adopted; but it does not follow that the lamps or their fittings should be visible. That satisfactory lighting can be secured with concealed light sources is proved by the scheme that has been adopted at St. Dunstan's Church, East Acton. This installation is of special interest, not only because the system employed is novel and most effective, but on account of the low cost for which it has been carried out.

When it was decided to replace gas by electricity for lighting the church, the funds available were somewhat limited, and allowed of but a small margin for the purchase of fittings after the wiring costs had been met. The contractors for the work, Messrs. Duncan Watson & Co., 62, Berners Street, Oxford Street, after

Fig. 1.—Example of Concealed Church Lighting.

consultation with the illuminating engineering department of the British Thomson-Houston Co., Ltd., hit upon the happy idea of dispensing entirely with fittings as usually understood, and of lighting the church by trough reflectors concealed between the mouldings of the arches at the points where the latter spring from the pillar capitals.

Three Mirolux extensive type trough reflectors, each equipped with two 60-watt standard Mazda lamps, are provided on the east side of the pillars on both sides of the nave. Persons passing up the church, therefore, can see neither the fittings nor the light sources, the illumination being thrown forward and distributed with remarkable evenness throughout the building. The lamps and fittings can be seen, of course, when passing down the building from the east end. The value of the illumination on the working plane, *e.g.*, on the top of the pews, averages between 2·5 and 3-ft. candles, which is well above the figure usually allowed for church lighting. This permits of the congregation following the service in comfort, even with books having the smallest type, a condition that prevails in very few churches, the light distribution usually being very uneven.

For the lighting of the chancel, a pair of similar reflectors, each with two 60-watt lamps, is placed on the east side, just above the lower capitals of the pillars supporting the main arch while light is thrown upon the altar by single trough reflectors placed within the reveals of the two side windows.

A telescopic standard carrying a conical reflector which conceals a standard lamp is placed behind the vicar's stall, and this also illuminates the book on the lectern alongside. The music on the organ is lighted by a tubular lamp, with an adjustable reflector. The circuits are so controlled that almost any variation in the light can be secured at will.

The installation was designed and carried out under the supervision of Mr. A. A. Blython, of Messrs. Duncan Watson & Co., the wiring being enclosed in heavy-gauge screwed barrel throughout. Although it has been run on the surface, especial care was taken to make the runs as inconspicuous as possible, and at a casual glance no evidence of the conduit is visible. Current is supplied from the D.C. mains of the Metropolitan Electric Supply Co., at 230 volts. The accompanying illustration has been reproduced from an untouched photograph taken by the unaided light of the fittings installed, and shows that no fittings are visible.

Electric Foot Warmer for Policemen.

Policemen on point duty, regulating traffic, &c., in cold weather are likely to suffer from cold feet in the literal sense. To cope with this trouble, the City Council of Pittsburgh, U.S.A., has adopted a device worked out in conjunction with Mr. Drew Johnston, of the Duquesne Light Co. It consists of a warming plate, 18·5 in. square and 1·5 in. thick, connected with an electric plug and switch on a pole at the curb. The intermediate connection is a flexible armoured conduit about 10 ft. long. The policeman, when he leaves his post or when the weather is not severe, carries his heater to the curb and pulls the plug from the socket. Mr. Johnston took the matter up with the experimental department of the Westinghouse Electric and Manufacturing Co., and the heaters were made by it. The switch controlling the heater permits of four temperatures, which can be changed to meet the rigors of the weather. At no time does the foot plate develop a temperature that will burn the soles of the shoes; the idea is not so much to warm cold feet as to keep the feet from getting cold. For all ordinary weather conditions the heater can be operated on less current than is required for two ordinary 40-watt lamps, such as are used in residence illumination.—*Elec. Review and W. Electrician.*

The Insulation of Joints in High-Tension Cables.

The extremely unfavourable conditions, such as limited space, damp atmosphere, &c., under which most high-tension cable joints have to be made have emphasised for a long time the desirability of improvements in joining methods and materials. Such improvements should, as far as possible, accomplish the following objects: (1) Minimise the time of exposure of the open ends of the cable; (2) facilitate the mechanical joining of the conductors by solder-

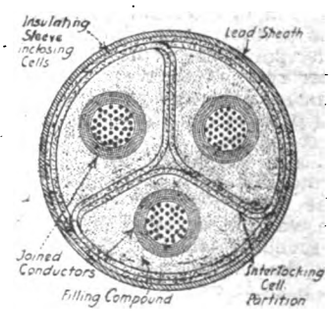

Fig. 2.—Cross-Section of Completed Joint.

ing all three at the same time, thus avoiding the necessity of bending the conductor ends away from their usual position; (3) eliminate the necessity of replacing insulation over the exposed section of the conductors by hand-wrapping; (4) provide insula-

Fig. 3.—Assembled Cell Partitions, Enclosing Sleeve, and One of the Conductor-Spacing Blocks.

tion in such form as entirely to eliminate the variations and uncertainties due to workmanship, and so design the insulation of the joint that it is reduced to a simple mechanical assembly of

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parts that when assembled must necessarily be in the proper position and uninjured.

To meet these conditions and produce a joint insulation which will equal that of the cable, the materials and joining method described below have been developed. The insulation, known as "Conducell," comprises a seamless outer sleeve of a material (micanite) of high dielectric strength, and three identical inner sections of such shape that they may be assembled singly after the three conductors are metallically joined. When the three parts are assembled there is an unusually long leakage path between conductors. Furthermore, the spacing around each individual conductor is elliptical, so that ample room is provided for the filling compound to flow freely into all spaces and leave no voids. The three inner sections when assembled interlock and present a uniform circular contour on their outer surface over which the seamless sleeve may be drawn. These insulating barriers are held in positive relation to the conductors by means of porcelain blocks like the one shown in fig. 3. The blocks ensure equal separation and amount of insulation between the conductors, as well as between them and the lead sheath. The length of exposed individual conductor is relatively short, resulting in materially reduced over-all dimensions of the joint.

The three inner sections, owing to their shape, may be placed between their respective conductors and brought into final position very readily. The operation requires only a few minutes, and no assistance from the splicer's helper. Besides reducing the cost of labour, this method of assembly minimises the length of exposure of the cut ends of the insulation to the atmosphere.

Tests on various sizes of commercial joints of this type have shown that they will withstand 200 per cent. normal pressure indefinitely and that the ultimate breakdown pressure is higher than that of the cable itself. A special compound has been developed for use with this type of joint.—*Electrical World.*

LEGAL.

Electric Switch Manufacturers and their Premises.

In the Shoreditch County Court, on Tuesday last week, before his Honour Judge Graham, K.C., Mary Ann Rowlandson, sued Messrs. Marbro, Ltd., of Hackney, electric switch manufacturers, to recover £12 10s., being two months' rent of the premises they occupied, and an order for possession. It appeared that the present company purchased the business of another firm, who had entered into an agreement as to the premises as far back as 1909. The present company contended that theirs was a yearly tenancy, so long as they paid the rent, and that they were actually in negotiation for another lease for three years when they got the notice to quit.

For the defence, Mr. Poyser said the notice to quit was dated March 10th, and the plaintiff had actually taken rent to April 10th, which quashed the notice to quit. Mr. Rowlandson admitted receiving a cheque, and also paying it into the bank, but pending seeing his solicitor he had not sent any receipt.

Judge Cluer said the paying in of the cheque was fatal to the plaintiff's case, as legally it was the acceptance of rent. There would have to be a verdict for the defendants, with costs. No doubt more would be heard of the case later.

Munitions Cases.

An interesting decision was given last week by the Oldham Munitions Tribunal, in a case in which a fitter employed by Messrs. Ferranti, Ltd., asked for a leaving certificate, so that he could take up a foreman's position in a new National shell factory. The case for the man was based on the fact that it was for the National advantage that his skill and personal qualifications should have wider scope than he had in his present employment, and Sub-Sec. 5 of Sec. 5 of the Munitions of War Act, 1916, was quoted. This Sub-Sec. states that in determining whether the grant of a certificate had been unreasonably refused the Tribunal should take into consideration the question whether the workman had left or desired to leave his work for the purpose of undertaking any class of work in which his skill or other personal qualifications could be employed with greater advantage to the National interests. Mr. Asa Schofield (A.S.E.), who appeared for the man, said he could get another man to replace him in his present job. His present wages were 46s. for a week of 53½ hours, and there was overtime, and at the new shell factory he would receive £3 10s. for a week of 54 hours, and overtime at a corresponding rate. On behalf of Messrs. Ferranti's, Mr. Whittaker said they would be glad to have twice as many men in the tool room as they had now. It was imperative that this man should remain, and they were prepared to take every tool maker the Labour Exchange could supply. Mr. Schofield said he was satisfied that the skill of the man would be better utilised in the new job and he would replace him with an efficient tool maker. The Tribunal decided to grant the leaving certificate asked for, and Mr. Whittaker said he would appeal to the Ministry of Munitions against the decision. Mr. J. F. Hodgson (chairman) said the case was of importance to both sides, and he would afford every possible facility for appealing.

A girl employed as an armature winder applied to the Manchester Munitions Tribunal, last week, for a leaving certificate, on the ground that her health was endangered by her employment. No doctor's certificate was produced, and the firm stated that the girl's work was very important. The Tribunal refused the application.

Lighting Regulations.

At the Police Court of a town in the North-Eastern counties on 13th inst., the assistant engineer-in-charge of an electric power station was charged with not obeying the instructions of the authorities to extinguish all lights. For the prosecution, it was stated that on a recent night, Zeppelins visited the county and dropped bombs. The police conveyed an official warning to the defendant, and the lights at the station were extinguished with the exception of those in the boiler house. These were allowed to remain lit from 10.38, when the order was given, until shortly after 11. Four bombs were dropped in a certain district, and at that time lights in the boiler house were on, but immediately after the report of these bombs, the lights were put out for the first time. Very shortly afterwards, two more bombs were dropped. The lights complained of were in a shed 150 ft. long, with a glass panel 6 ft. wide running along the roof, whilst in the side of the building there were six or eight windows 4 ft. square. The glass had all been whitewashed, but that was not sufficiently effective. The light could be seen for a distance of 400 yards on that particular night.—For the defence, it was stated that the lights were small and were left on to illuminate the water gauges. There were also four lights beneath the coal bunkers, and it might be that some degree of light escaped from these, though all the glass had been obscured with black paint. Defendant turned off the lighting current to the outside world, but unfortunately omitted to turn off the lights in the boiler house. When defendant heard the report of a bomb which was dropped four or five miles away, he woke up to his duties, pulled the switch and turned off the lights in the boiler house. It was a serious offence, and the defendant regretted it, but there was no wilful or felonious intent. The Chairman of the Bench, in announcing a fine of £10, together with £2 2s. solicitor's fee and £1 for witnesses, or 43 days' imprisonment in default, observed that at such a time a man in defendant's position should have been exceedingly careful, as it might have proved a serious thing both for himself and the people in the neighbourhood. However, the fact of defendant having lost his situation had prompted the magistrates to take a rather lenient view of the case.

Dispute About Springs.

In the City of London Court, on April 13th, before his Honour Judge Atherley-Jones, K.C., an action was brought by the Lion Spring Co., Ltd., Oldbury, near Birmingham, against the Carleon Electrical Co., Ltd., 13, Queen Street, E.C., to recover £39 for 25,000 percussion springs and 25,000 detent springs, supplied to their specification, at 1s. 6d. per gross, for the Government. It seemed that the defendants had a contract to supply the springs to the Government in May of last year. The work was carried out, and cash was to be sent on delivery. Defendants refused to pay on the ground that the springs were not made in accordance with the specification, as they were too weak, and some of them were returned. Plaintiffs said that the Government Inspector agreed to pay for the springs because they were made before the specification drawing was altered. The defence was that the springs had not been accepted by the Government, and therefore plaintiffs could not expect to be paid. The Government official, when called, admitted that his inspection was not final.

Judge Atherley-Jones said that that being so, the plaintiffs could not recover, and must be non-suited, with costs.

Judgment Summons.

In the Shoreditch County Court, on Tuesday last week, before his Honour Judge Graham, K.C., Messrs. R. Becker & Co., of 53, City Road, N.E., talking-machine electric motor manufacturers, sought to enforce the payment of a judgment debt of 12s. 9d., out of £5 12s. 9d., for goods supplied, from Wm. Saunders, of Cedric Works, Forest Gate. The defendant said the machinery at his place was not worth £100, but it might be worth £40 to £50; but all the same his business was in such a state that he was unable to pay 5s. a month. He used to have 22 men, but now had only four, as the rest had gone to the war; he was doing his best to keep his business going.

Judge Cluer: And you mean to say you cannot pay 5s. a month?

Defendant: No, your Honour.

Judge Cluer: Committed for five days, suspended for 10 days.

Krupp's Patents for Magnetic Separators.

On Thursday last, in the Patents Court, applications for licences to manufacture under these patents on the part of Messrs. Edgar Allen & Co., Ltd., were heard by the Controller of Patents. The previous hearing of the application of the Rapid Magnetting Machine Co., Ltd., was reported in our issue of April 14th. Sir G. Croydon Marks stated that Messrs. Edgar Allen & Co., Ltd., had an order from the Government for three Ullrich magnetic separators, which were urgently needed. They proposed to pay a royalty of 5 per cent. on the net selling price.

The Controller inquired as to the relationship between Messrs. Krupp and the patentee Ullrich, and it was stated that the patents were not the property of Krupp's.

The Controller granted both applications, the royalties to go to the Public Trustee; he said that the presence of an English machine already on the market took away any exceptional character which might be claimed to attach to Krupp's.

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IDEAS AND ACTION.

Though the Government restrictions on paper consumption form a very considerable handicap to journals whose object it is to encourage national trade and industry, they have not stopped the production of pamphlets and other literature concerning the trade and cognate problems arising out of the war. A number of these lie before us at this moment calling for attention. One writer,* in language giving no uncertain sound, argues against letting the Germans off easily, and states that a perfectly cold-blooded consideration of right and policy points to a relentless but impassioned treatment of a ruthless and unscrupulous enemy. The revulsion that is engendered by the horrors of war should, in his estimation, be the basis upon which our present and future attitude toward the German nation and the German individual should stand. The ineradicable dishonesty of the Germans in political and in economic affairs, their underhand intrigues, their organised hypocrisy, and their unscrupulous abuse of international hospitality, their use of their embassies and consulates as hotbeds of intrigue, are all summarised, once more leading up to the conviction that we must never again live with murderous thieves at large in our house. The bestialities and outrages on land and on sea, together with a review of the degeneracy of the people as revealed in German criminal statistics of peaceful life in their own land, are also produced by this writer to stamp the German people as "now and for ever beyond the pale," and our only way is to permanently deprive such a people of all power to impose their will by violence or intrigue. Until a new generation of Germans one day arises "we need not hate, but we must refuse to associate or to allow our people to associate with a nation rotten with a moral leprosy." Here the record ends—the sentiments are natural, we all hold them, we have expressed very much the same views ourselves a score of times, but the writer would have added to the value of his contribution if he had told us how all this was to be done, and how our international transactions as a whole would be affected if we were to decline to have relations with all the peoples of the earth whose standards of morality at home were different from our own. Moral depravity of a race has not generally been a bar to commercial transactions—we never should have made those early pioneering foreign trade relations to which we owe so much if we had first asked "for a certificate of marriage." Yet it is the Allies' duty to see that it is impossible for Teutonic commercial success to prepare the way for military measures in the future.

From this epistle of the hard-hitting quarantining apostle, whose sentiments we repeat, multitudes of men of British birth must share in these awful times, we turn to a second pamphlet in which Mr. A. W. Yeo, M.P., sends us his views on "Trade After the War." We agree with his prefatory note that a satisfactory commercial outcome of the war is only second in importance to our being victorious over our enemies in the field and on the sea. Mr. Yeo pictures the state of things when "immediately" the war is over five million citizen soldiers and workers on Army contracts will be clamouring for work. Nearly every one of our industries has been disorganised, and he dreads the interval between the cessation of war and the getting into our regular commercial stride, and he proceeds to give the advice already so frequently tendered, "Be Prepared!" He goes on to show how largely in our Home and Colonial domestic and industrial purchases, from toys to machinery, we have depended upon Germany, and holds out before us the prospect of benefiting British industry by keeping this trade to ourselves. Free Traders, he says, must be prepared for a modification of our policy, but he adds that together with such modification we must of necessity devise precautions against the avarice of manufacturers—"the State must absolutely prevent the manufacturers from becoming unduly rich at the expense of the retailers and consumers." We find what is working in Mr. Yeo's mind in the "object lesson in paper"—the case certainly powerfully appeals to our journalistic sympathies. The Government restricted the import of pulp; there were vast stocks of paper in the country which had already borne the full cost of production; yet the State did not prevent the holders of these finished stocks from raising their prices from 100 to 300 per cent. "absolutely without justification," and thus "the State made to these paper merchants a gift variously estimated at from three to five million pounds," and the journals which foster the trade of the country, among others, must stand the racket. This illustration Mr. Yeo uses as an argument against the State interfering with the laws of supply and demand, and to show that if such interference is necessary, "such scandals" must be prevented. He would rather see us leaving the manufacture of cheap toys to Germany, and employing our present reducing volume of labour on more useful and profitable lines—machinery, gas and electrical fittings and motors are among those lines. Mr. Yeo says that owing to the increase in the employment of female labour, which "has come to stay," we shall, when the war is over, have increased our productive workers by two million persons, who within three years would increase the value of our output of goods by £300,000,000. But to do this we "shall require machinery and plant costing some £40,000,000, and there's the rub!" A scheme has been put before the Board of Trade which finds a way for getting that money.

We do not think that Mr. Yeo can have the engineering industries in mind, for they have vastly increased their plant capacity. He appears to think that the report of the Advisory Committee on Key Industries was not worth the cost of printing, but we hardly think that those who sit in a certain office in Kingsway will entirely agree with him. The Board of Trade was urged a year and a half ago to study every one of our 250 trades in detail, and to carefully select for development such trades as are the "most necessary, most profitable, and most practicable." We ourselves did our own little bit of urging even at that early date, and we deeply regret that it is only now that a series of specialised trade committees are beginning their inquiries. Mr. Yeo is appalled at the prospect of the great German dump, which he puts at £500,000,000. We heard a manufacturer say in public the other day that it was £300,000,000. The difference is not material—only £200,000,000—it is the menace of the dump that is the haunting spectre. We do not know upon what good authority the estimate rests—Germany is scheming a great dumping operation which may or may not affect electrical and engineering industries, that is the thing that matters. But in presence of this menace which some people, including, we believe, the Board of Trade, regard as more imaginary than real, what does Mr. Yeo advocate? Unlike Mr. Ford, he does not want to "quarantine Germany," what he wants is that the British nation shall be prepared. We quote:—

> Inhumanly though she has acted, Germany is a country of seventy million people, and she must do trade in order to compensate Belgium. . . . I do not want to encourage German trade, but I know and feel that we really must have some of her wares as soon as the conflict ceases—as little as possible, but really there is much she produces, because of low wages and great skill, in which we cannot compete. It is foolish, then, to shout about doing no more trade with Germany. Surely, it is better to make such arrangements as will secure that we are top dog.

* P. J. Ford, "Quarantining Germany."

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The conclusion to which all this leads Mr. Yeo is that our prospects of trade after the war are magnificent, but they are remote because (a) we have not taken, nor are we arranging to take, the proper steps such as intelligent discrimination, &c.; (b) we are not preparing to provide ourselves with the machinery required for commercial development. We must at once alter our plans, failing which "there is ahead of this country a period of great destitution, ending only when we come to our senses."

Now before we proceed to the third stage in our consideration of these literary productions, let us note that while Mr. Ford left Germany in quarantine, Mr. Yeo leaves her people free to trade because it is natural and necessary to do so, but he wants the Government and "we," whoever may be meant, to be prepared to employ our increased labour by laying out £40,000,000 to assist British manufacturing, so that we do not buy anything from Germany that we could and should be making advantageously ourselves. Mr. Yeo is at least an advance on Mr. Ford, who simply left us strafeing.

We leave the "strafer" and the politician and turn to the philosopher.* Mr. Dunlop is nothing if not a philosopher, and though we confess that at times "much reading is a weariness to the flesh," we find his book on "British Destiny" on the whole a very interesting and profitable study, one that every thinking man in the industry, and out of it, too, would do well to study. We wish that we had more space to devote to it, for we agree with him that it is "ideas" that count in these anxious times when so many things are in the melting pot. He is unmoved by sentiment, makes us proud of our British civilisation, and sees reason to hope that we shall emerge from present disastrous happenings as a people refined in the fire, strengthened in character, more spiritual, drawn back to that high standard and tradition from which we were gradually falling until the clash of arms came, reminding us of our historic high moral standard as an example to the other nations of the earth. Mr. Dunlop leads us on through discussions on the equilibrium of society, the philosophy of co-operation, competition for quality, and the magic of industry, to a chapter on Free Trade or Protection. He has shown in an earlier chapter that a policy of reprisals is opposed to our lofty aims and traditions, and here he shows that in the matter of trade "time and energy will be wasted if we spend them in devising means of retaliation." "Methods of revenge will not promote our own national security—they will but perpetuate antagonism." "We must not be anti-German; we must be pro-British." Only a calm, collected, philosophical mind could traverse in thought with such a measured tread the bloody soil of Belgium, haunted by the abominations of terrible lust and outrage; or sail the Atlantic seas remembering the *Lusitania*; or travel among the wrecked cottage lanes of England, where babies and women were murdered by cowardly bomb-droppers, telling even the lofty British race not to be "anti-German." Pro-British yes, we will all be that, but let us be anti-German too—for a time at least. Who can help it—if he have a heart wherewith to love his friends and to hate the enemies of civilisation? But we must keep that "anti-German" spirit well in rein—that we rather imagine is what Mr. Dunlop would really ask of us. He is sufficiently anti-German—or, out of respect to him, we will say "pro-British"—to adopt a Protective Tariff as an instrument "required by present international conditions," and to be used wisely by a strong nation in order to establish reciprocity on equal terms between nations—"an instrument of negotiation"—and to finally prepare the way for international Free Trade. We presume that all the preceding chapters are intended to lead up to the scheme for Industrial Federation, which is outlined in the last. He advocates that the functions of many different organisations, each of them important in its sphere, should be co-ordinated without sacrificing or nullifying their individual work. The first step advocated is a conference of a few men with the co-operative spirit from each of the associations named, representing trade, employers, labour, scientific and learned societies, co-operative agriculture, and finance. They should establish a Federation, the general aim of which would be to preserve and promote national efficiency and the traditions and ideals which are the basis of the British Empire.

Now where do all these different writers lead us? Mr. Ford would put the enemy in quarantine until the national character is purged; Mr. Yeo says put your own house in order by encouraging essential industries; Mr. Dunlop leads us on to a high plane with noble conceptions of British destiny, and says assure that destiny by protective tariffs suited to the emergency and for the emergency alone, and by federating all the national forces of Capital and Labour, of science, industry, finance and agriculture, so as to make that destiny permanent and secure.

Do these things satisfy our industrial hunger? Are they food for men who have eaten humble pie too long, and who cast longing eyes toward an Economic Conference at Paris, who look for a compact between Great Britain and her Colonies and the Allies, who want to have more substantial relations with us in the near future? Ideas are all-important if they lead us on to right decisions when we descend to the deliberations of a practical conference of the kind that is awaited. It seems to us that one of the very first duties to be performed in connection with such a conference, or at any rate one that should follow it immediately, is an exhaustive inquiry by each of the nations engaged in it respecting their requirements in the matter of imports and their abilities in respect of exports. With such material at hand, together with some fairly reliable conjectures as to the possibilities of developing manufacture under the altered conditions that now obtain, and may probably obtain after the war, it ought to be possible to draft a practical scheme. But how can such material be ready in time unless it be now preparing?—the work would be of vast proportions. And how can such material be trustworthy unless it be prepared in part by industrial and business minds who know the factors? And how can it be well done if the Government policy be to "wait and see" until it is "too late"?

* "British Destiny: The Principles of Progress," by D. N. Dunlop, A.I.E.E.

THE SELLING SIDE OF ELECTRICITY SUPPLY.—VI.

In the first of this series of articles we devoted our space to suggestions which would be useful to those having the management of showrooms; there were a number of observations that we were inclined to make, but refrained from, as they appeared to be obvious; that they might have been made with advantage will be seen from the following account of a visit recently paid to a London showroom.

This showroom is in a good situation in a flourishing district, and a considerable amount must have been spent in fitting it out. It is a thousand pities that such outlay should be practically wasted as far as advertising the advantages of electricity is concerned. The windows were not used to any good purpose, for they only contained a few hot-wire radiators of poor design, none of them alight; the

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one radiator running was a six-lamp pattern; four of the lamps were on, the two that were not alight were black and dirty. Several table standards, with tarnished metal parts and shabby silk shades, were alight. The other uses of electricity were "advocated" by a toaster and a few kettles, all of which wanted a good cleaning. Much the same state of affairs was discovered inside. The walls were sparsely covered with candelabra, of which the candles were leaning at various angles. The electric kitchen consisted of one modern cooker and several obsolete ovens; all the metal parts were dull and the insides dirty. On a table stood a disk boiler; the white cloth it stood upon was scorched in a dozen places through over-heating of the legs. There was also a very discoloured nickel-plated iron without connecter or flex. Some vacuum cleaners were displayed; perhaps the dust on the floor and the cobwebs noticed on a fitting were being preserved for the time when a demonstration could be made. The only thing the writer fancied was a very nice sideboard. On a table, prominently placed, was a selection of publicity matter in which, amongst other claims for electricity, cleanliness was prominently mentioned. Comment is needless.

Unfortunately, this is not a solitary case. It were far better if showrooms were left out, than be so badly managed as to be a discredit to the whole service.

Those responsible for such exhibitions should disabuse themselves of the idea that the selling of electricity places them in a position of inherent superiority to other businesses. Merchandising electrical accessories and apparatus to be successful must follow ordinary commercial principles. Granting that our efforts are circumscribed by the shortage of many things owing to the war, there is no excuse for running what should be an up-to-date showroom as a museum or a curiosity shop. Rather than let stock accumulate and fall behind the times, there is no reason why a sale should not be held.

It is difficult to keep many of the nickel-plated and other metal finished apparatus smart. The best and cheapest way is to effect quick sales and a rapid turn-over of stock. Our remarks in previous articles as to frequent changes in the shop-window display were apparently unread, certainly not acted upon. We have at heart the improvement in methods and scope of the business-getting side of electrical supply, and an earnest desire to assist those engaged in this work. A showroom run on slipshod lines is an offence against the interests of the industry at large, and the undertaking to which it is attached in particular. It is clearly the duty of every profit-earning department to make that profit as large as possible. To allow the publicity department to be an unnecessary burden on the current revenue is to admit the arguments of those who take an adverse view of this enterprise in salesmanship.

There is no gainsaying the fact, whatever may be the causes, that our electrical showrooms in general make a very poor showing compared to the large well-fitted and well-stocked establishments of the rival industry. Let us, therefore, strive to remedy this; new departures may be out of the question for the moment, but there is nothing to prevent the showrooms already existing from making the most of themselves. A well-thought-out plan of operations should be determined upon. Dress the windows this month with irons, and offer a free trial; next month show vacuum cleaners at work; the following month, say, toasters and kettles—demonstrate them. Let your management be characterised by vigour, enterprise, and push. In salesman talk, don't be ashamed to express the faith which is in you. Believe in what you are saying if you wish your customer to believe it too. Yours may be only a small part, but play it for all you are worth if you want a larger. Never forget the rule: "What your hand findeth to do, that do with all your might," and you will eventually find yourself on top.

Application for Extension of Patent.—An application has been made by F. G. Creed, W. A. Coulson, and Messrs. Creed, Bille & Co., Ltd., for the extension of the term of patent No 22,653 of 1902.

BUSINESS NOTES.

Bankruptcy Proceedings.—J. T. Peddie, mechanical engineer, Exhibition Buildings, Aldwych Site, W.C.—A composition of 5s. in the £ is payable on April 18th at the offices of Messrs. Elles, Salaman, Coates & Co., 1-2, Bucklersbury, E.C.

Liquidation.—Messrs. H. A. Harvey & Co., Ltd. (in liquidation).—Mr. W. A. Henderson, the liquidator of this company, intends to apply for his release; any objection must be notified to the Board of Trade within 21 days of April 14th. The receiver for the debenture-holders, having now realised all the available assets of the company, can pay a dividend to the debenture-holders only; consequently, there will be no funds for the ordinary creditors of the company, or for the expenses of the liquidation.

Catalogues and Lists.—Messrs. Ed. Bennis & Co., Ltd., 28, Victoria Street, S.W.—Folder relating to their conveyors and elevators for handling coal and ash. A comprehensive catalogue will shortly be issued.

Messrs. Marshall & Plumtree, 20, High Holborn, W.C.—Leaflets describing the "Hold-heet" electric glue-pots and cookers, fitted with thermostats to keep the temperature constant at the right value, in various sizes, and the "Clearway" electric horn.

Book Notices.—"Elementary Strength of Materials." By E. S. Andrews. London: Chapman & Hall. Price 4s. 6d. net.

The *Wireless World* for April has assumed a new cover, on which is represented the latest type of mast arrangement for receiving stations; the contents have also undergone rearrangement, and include a variety of interesting articles, technical and otherwise. It is a very "live wireless" production.

The Caxton Translations Institute, of Caxton House, S.W., has issued a wall card giving brief but useful information respecting the different countries of the world—populations, imports and exports, ports, consulate address in London, &c.

We have received an advance copy of the Special China Number of the *Manchester Guardian*. A number of interesting articles serve to emphasise the greatness of the market and its opportunities for engineering and other traders.

Trade Announcements.—Messrs. F. Paine & Son, electrical and mechanical engineers, have removed to larger premises at 21, Old Road, Frinton-on-Sea.

Messrs. Austin Walters & Son have removed to larger premises owing to expansion of business. The new works at 57, Lower Mosley Street, Manchester, are five times as large as the old. A new department which has been fully equipped, regardless of expense, for the repair and rewinding of all types of armatures A.C. and D.C. has been opened, and the firm is specialising in traction work. The works have modern drying stores, and special attention is given to the careful test of all repair work.

LIGHTING AND POWER NOTES.

Accrington.—Plant Extensions.—At the General Purposes Committee, on April 13th, communications were read from the L.G.B., &c., intimating that sanction had been given to the scheme for the extension of the electric generating plant and the erection of a new chimney and flues in connection with the destructor. The new generating plant will cost £14,000, and the boiler, chimney and flues £7,000. It was decided to proceed with the work. The provision of a tubular boiler, at a cost of £3,000, was regarded as unnecessary, and has, consequently, been dropped for the time being.

Altrincham.—New Plant.—The Altrincham Electric Supply, Ltd., has successfully put into commission its first turbo-alternator set, which is one of 1,850 K.A.A., supplied by the B.T.H. Co., with a Cole, Marchent & Morley surface condenser and Rees-Roturbo pumps.

Argentina.—The Government of the Province of Cordoba has authorised Messrs. Trelsi and Rieeco to install and exploit an electrical service at Villa Huidobro, Department of General Roca.

Australia.—The gross revenue of the Melbourne City Council's electric supply undertaking for the year 1915 was £182,594, an increase over the previous year of £17,806; the expenditure was £82,745, leaving a gross profit of £99,849. The revenue derived from private and bulk supplies increased by £17,736; from private lighting the increase was £70. The increase in revenue from bulk supplies to adjoining municipalities amounted to £2,122, notwithstanding a considerable reduction in the price of current. Interest payments amounted to £22,219; and contributions to the sinking fund and depreciation and reserve fund absorbed £7,471 and £33,512 respectively. The net profit for 1915 of £35,569 was in addition to interest on capital and sinking fund charges, which together represented a return of over 10 per cent. on the £654,000 borrowed. The Electric Supply Committee in its report points out the desirability of forming a reserve fund for depreciation of machinery and non-remunerative expenditure, such as the storage of coal; £29,000 had been contributed to the town fund, including £2,200 deficiency in the lighting rate, the total contributions to the fund to date amounting to £108,645. The Committee proposes to transfer £165,394 from the depreciation and renewal fund,

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and to write down capital expenditure by that amount, thereby reducing it to £581,748, and leaving at the credit of the renewals fund £55,131.

Barton-on-Humber.—Street Lighting.—With reference to the dispute between the U.D.C. and the Electric Supply Co. over the public lighting account, the Council has decided by 10 votes to 6 to pay the amount claimed, less 10 per cent., without prejudice. The L.G.B., in declining to express any opinion on the matter, referred the Council to the remarks of Mr. Justice Low, in the Leiston case.

Continental.—Portugal.—A Bill has been presented to the Chamber of Deputies to authorise the Municipality of Amarante to contract a loan of about £17,500, to be devoted to a hydro-electric installation for the production of power for lighting and other purposes.—*B. of T. Journal.*

Spain.—The Ministerio de Fomento has granted permission to Don Tomás Garmendia to utilise the waters of the Reburdiejos and Sejos streams, in the district of Los Tojos (Province of Santander), for the production of electric power for industrial purposes.—*B. of T. Journal.*

Application has been made for a concession to put down a plant to utilise the water power of the river Mendo, near San Pedro de Oza, in the generation of electrical energy for lighting and power purposes in the town named and surrounding neighbourhood. A derivation canal about a mile and a half in length will be necessary in connection with the plant.

Gravesend.—Price Increase.—The T.C., owing to the continued advance in the price of coal, has decided to add 25 per cent. to consumers' accounts from the quarter ending March 31st, the increase to be reduced to the original advance of 10 per cent. when fuel costs less than 25s. per ton.

Ilford.—Street Lighting, &c.—The estimate in respect of public lighting for the ensuing six months, just approved by the Electricity Committee, shows an allowance of £1,000 for reduced lighting. The chairman of the Committee and the electrical engineer have been authorised to place orders for an additional 1,000 tons of coal for delivery over the next four or six months.

Ivybridge (Devon).—The local Electricity Supply Co. has leased Union mills for its undertaking.

London.—Poplar.—The Electricity Committee is of opinion that a temporary increase of prices for current for power and public lighting purposes is necessary, and has fixed the increase at 10 per cent. as from April 1st last. It is estimated that the proposed increase, after making allowance for probable decreased demand, will enable a surplus of not less than £5,000 to be earned, while if coal is obtained at 2s. 6d. per ton less than estimated, the estimated surplus would be raised to £10,000 for the ensuing year. An annual surplus of not less than the latter sum is required to meet all demands upon the undertaking, and maintain the policy of providing for the cost of new services, meters, &c., and the writing down of plant out of revenue. It is not considered desirable to increase the charges for private lighting. The Committee proposes to adopt, experimentally, the Cumberland electrolytic process on a Babcock boiler and economiser at the works, at a cost of £200. Should the process achieve the results claimed for it, the Committee anticipates that the cost of installation can be met within a year. The Council has been recommended to grant a war bonus to the staff of 10 per cent. on present normal salaries and wages (including emoluments) under £200 per annum; 7½ per cent. on £200 and under £300, and 5 per cent. on £300 and upwards. In the case of the electricity department, it is proposed that those who have received a war bonus, or increase due to the war, should have the amount made up to 10 per cent., and should a profit bonus be available at the end of the ensuing year, the aggregate amount paid as war bonus during the year, as proposed, will be deducted from each individual share in profits.

Islington.—The Lighting Committee has adopted the electrical engineer's suggestion that during the war certain arc lamps should be altered by substituting high c.p. metal-filament lamps in the globes. The annual saving, exclusive of energy, will amount to £85 per annum.

L.C.C.—The Finance Committee recommends the Council to sanction the borrowing by the Bermondsey B.C. of £2,773 for electricity purposes, being £978 for mains, £1,410 for house services, and £385 for meters; also that sanction be granted to the Stepney B.C. to borrow £3,000, being part of the cost of the two new boilers in connection with the electricity undertaking; and to the Woolwich B.C. in regard to £27,115 for plant, and £385 for mains.

Manchester.—Tenders in connection with the scheme to increase the output of the Stuart Street electricity station have been approved. Mr. Pearce, the electrical engineer, submitted at a meeting of the Sub-Committee the total estimated capital cost of the scheme at £30,000.

Middleton.—Street Lighting.—The town clerk gave notice, on the 13th inst., that the charge for current for lighting purposes has been increased by ½d. per unit, and that for power and heating purposes by 12½ per cent.

Radcliffe.—Year's Working.—It was reported, at a meeting of the U.D.C. last week, that there was every possibility of a small net profit resulting from the year's trading of the electricity department.

Swinton.—Price Increase.—The U.D.C. has decided that owing to the extra cost of current, the charge to consumers be increased by 12½ per cent. It was stated that a Sub-Committee is to review the conditions on which consumers are supplied, and where it is found that they were served at a loss steps would be taken to terminate the contract and make fresh arrangements.

Ulverston.—E.L. Scheme.—The R.D.C. has agreed with the Coniston Electric Lighting Co. as to the basis of the terms for electrically lighting the village of Coniston. No higher rate than 8d. a unit is to be charged, and the Council will have the option of purchasing the undertaking at any time after 10 years at the fair market value. The Council was also recommended that the proposed agreement shall contain a clause preserving the right of the Rural District Council or other local authority, or any company or person, with the consent of the local authority, to obtain a licence or provisional order.

Watford.—Proposed Loan.—The U.D.C. has applied to the L.G.B. for a loan of £3,300 for electrical supplies needed for war purposes.

TRAMWAY and RAILWAY NOTES.

Australia.—The half-yearly report of the Adelaide (S. Australia) Municipal Tramways Trust, to January 31st, 1916, shows that the net revenue was £63,401, the full statutory charges being £64,579, leaving a deficit for the half-year of £1,322. The gross revenue for the half-year was £160,463, or £7,180 more than in the preceding half-year, and £3,313 more than in the corresponding half-year ended January 31st, 1915. The capital cost of the revenue-earning portion of the electric traction system, excluding purchase money and stores, was £1,447,584. The surplus revenue over operation expenses (excluding the Port Adelaide horse-car account), was £63,401, and the percentage of working expenses to revenue was 60·333. The surplus revenue over operating expenses equalled 8·758 per cent. on the capital cost. The reserve fund for renewals now amounts to £97,426, and the insurance reserve to £7,926.

A motion by the Minister of Public Works, in the N.S.W. Legislative Assembly, that a bridge should be constructed to connect Sydney and North Sydney, at a total cost of over £3,000,000, was recently agreed to by 42 votes to 8. The bridge would carry a double electric railway track, double tramway track, vehicle and motor roads, and a footway.

Belfast.—At a meeting of the Tramways and Electrical Committee last week, it was intimated that at the present time there were 297 motormen and 298 conductors in the service of the Corporation. Of these 227 motormen and 182 conductors were in the service before the war, and 70 motormen and 116 conductors had volunteered into the Army—most of them for the famous Ulster Division. Only four unmarried men of military age have joined the tramway department since the war started, 52 under military age, and a number of over-age men, and some medically unfit and discharged soldiers.

It has been decided to give the new manager of the tramway system—whoever he may be—an annual salary of £800. The original figure mentioned was £700.

Croydon.—Strike.—On Monday, the T.C., by 34 votes to 17, refused an amendment to refer the matters in dispute with its tramway employés to arbitration. A further amendment, referring the matter to the arbitration of five local gentlemen, was lost by 26 votes to 22. There are 163 employés on strike, and 25 have remained loyal to the committee.

L. & Y. Railway Electrification.—The new electric train service between Manchester and Bury, on the Lancashire and Yorkshire Railway system, was inaugurated on Monday.

London.—The Holborn B.C. offers no objection to the application of the L.C.C. to the B. of T. for an extension of time for the construction of a junction line to connect the existing tramways in Clerkenwell Road with those in Farringdon Road.

Southport.—Female Labour.—The Trades Council has decided to send a protest to the Corporation against the employment of women as tramway drivers. One member of the Council stated that, as one who had driven a car, he could unhesitatingly say that the job was not one that was suitable for women.

Sunderland.—The Tramways Committee recommended: "That on and from the 1st inst. the war bonuses be payable to employés in the tramways department varying from 2s. to 3s. 6d. per week, and that no employé shall receive, by reason of such bonus, a sum in excess of 50s. per week, including emoluments, and that the wages of tramway inspectors be advanced from 7d. to 7½d. per hour." It was stated that the advances recommended would mean an additional wage expenditure of £78 a year and the temporary advance in respect of bonuses of £624 a year. An amendment that the bonus recommendations should be struck out was lost by 27 votes to 3.

Worsley.—The U.D.C. is petitioning the South Lancashire Tramway Co. for the provision of additional shelters.

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TELEGRAPH and TELEPHONE NOTES.

Australia.—Wireless telegraphy throughout the Commonwealth will in the future be under the control of the Navy, and all men employed will wear uniform and belong to the "Royal Australian Navy Radio Service." This is a new branch of the Australian Navy. At present there are about 120 employés, many of whom were taken over from the Postal Department by the Navy Department in October last. It is intended at a later date to appoint an engineer for radio-telegraphy for the Commonwealth. In the meantime, Engineer-Lieutenant F. G. Cresswell will be acting, and the Minister for the Navy has made arrangements with Mr. J. G. Balsillie for him to have a retaining fee as consulting engineer for six months.

Wireless by Gramophone.—At the suggestion of the Marconi Co., gramophone records are now being made which reproduce the Morse signals as they appear in the microphone of a wireless receiver. These records commence with the simple Morse code, pass on to dummy messages, including figures, fractions, Stock Exchange terms, and other items of business importance, and culminate with examples of "jamming."

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—May 24th. N.S.W. Government Railways and Tramways. 16/600-volt D.C. motors for tramway stores, Randwick.*

Melbourne.—April 26th. Victorian Government Railways. Car-lighting material—cables, switches, fuses, &c.*

May 1st. City Council. Meters and maximum-demand indicators. See "Official Notices" April 7th.

May 10th. Victorian Government Railways. Motor-generator set and accessories for battery-charging of baggage trucks.*

May 17th. Victorian Government Railways. One 2-ton electrically-operated goods elevator for Jolimont car-shed.*

New Zealand.—June 23rd. Oamaru Borough Council. Overhead mains and street-lighting equipment (Contract No. 2); power-station equipment (Pelton wheels, alternators, &c.) (Contract No. 3); service meters (Contract No. 4); line transformers and accessories (Contract No. 5).*

Salford.—May 8th. Electricity Department. High-pressure steel steam pipes and separator, also cast-iron pipes and valves. See "Official Notices" to-day.

Walthamstow.—April 26th. U.D.C. Water-softening plant for the Electricity Department. See "Official Notices" April 7th.

Warrington.—April 26th. Electricity and Tramways Committee. Boiler plant and economiser. See "Official Notices" April 7th.

West Hartlepool.—April 28th. Electricity Department. Two water-tube boilers with superheaters and mechanical stokers. See "Official Notices" April 14th.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Barnes.—The tender of the Pirelli General Cable Works, Ltd., has been accepted by the U.D.C., at £188, for 440 yards of three-core distributing cable.

Burnley.—B. of G. Electrical requirements: Messrs. F. Thornton & Co.

Dundee.—The T.C. has accepted the tender of Messrs. Venner Time Switches, Ltd., for time switches for the coming year, and that of Messrs. Chamberlain & Hookham, Ltd., for meters.

London.—L.C.C.—Seven tenders have been received for the construction of foundations, &c., for the third additional turbo-generator at the Greenwich generating station:—

W. Downs, Ltd.	(accepted)	£4,751
W. Manders & Co.		4,927
G. Godson & Sons		4,980
J. Jarvis & Sons, Ltd.		5,290
J. E. Whiter & Co.		5,449
James Ford		6,450
Charles Wall, Ltd.		6,863

Architect's estimate, £4,500.

The Stores and Contracts Committee recommends that the Committee or the chairman or the vice-chairman of the Committee be each authorised during the Easter recess to open tenders for the supply of electric traction glow-lamps for the Tramways Department.

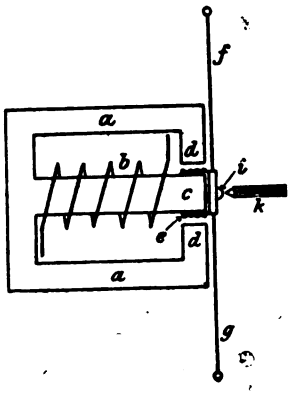
FORTHCOMING EVENT.

Belfast Association of Engineers.—Thursday, April 27th. Annual General Meeting.

A SENSITIVE RELAY FOR WIRELESS TELEGRAPHY.

Though a great deal of energy has been expended in devising relays to make possible the calling and autographic recording of wireless messages, there is still plenty of room for fresh devices, and the relay illustrated diagrammatically in the accompanying figure presents a number of interesting features. It is claimed that the new instrument is superior to Dary, Ducretet and Brown's relays in respect of natural frequency and sensitivity. As described by E. Leimer in the *E.T.Z.*, the instrument consists essentially of a separately excited pot magnet, in the narrow air gap *d c* of which there is a coil *e*, consisting of several hundred turns of No. 50 insulated copper wire, wound in one layer on a pot-shaped celluloid former, which is carried by fine metal wires *f*, *g*, serving also as leads. The celluloid former moving with small clearance on the centre pole *c* provides damping, and the wires *f*, *g*, terminating on torsion and tension screws, provide a free suspension adjustable for sensitivity and frequency. Either a third wire parallel to *f* or *g* (in which case torsion screws are unnecessary), or a fine wire spiral carries relay current to a platinum contact *i*, opposite which is an adjustable contact screw *k*.

The relay is in effect a thread galvanometer, and is connected in the detector circuit. It can be made to respond to 4 microamperes when adjusted to a natural frequency of 0·5 second. In normal



working, natural frequency and sensitivity are adjusted, so that certain relay contact is made with about 25 microamperes in the moving coil. Limiting the permissible heating of the coil *b* to 40° C. in half an hour, a field of about 18 000 gauss is obtainable in the gap *d*, *c*. Varying this field provides 1 : 1·5 or so variation in sensitivity, and the latter can be more than doubled again by the use of 0·02 mm. silver wire, instead of 0·03 mm. copper wire, in the coil *e*. Such fine silver wire can be insulated sufficiently for the present purpose by coating with a carbon-bisulphide lacquer, or by blackening in solutions containing carbon-bisulphide or sulphuretted hydrogen.

In this and similar relays certain precautions are necessary to prevent sticking at the relay contacts. The moving contact should be a domed disk of burnished platinum of very small diameter, and the stationary contact should be tipped with a fine platinum wire, pointed and polished. The whole instrument should be spring-suspended under a dust-tight glass bell, and the local current controlled by the relay contacts should not exceed 100 microamperes at 1·5 volts; this current may be used to operate a step relay actuating a Morse printer. The inductance of the step relay must be neutralised by a non-inductive resistance in parallel and by a condenser across its contacts. Only by this means and by removing the step relay, Morse printer and current-carrying leads as far as possible and by bifilar winding of the spiral connecting to the contact *i*, can the main relay be kept reasonably free from outside influences when set to maximum sensitivity. The sensitivity of the primary relay may be appreciated from the fact that it records the ringing of a house bell, whose circuit passes 25 ft. away from the wireless installation, and the starting and stopping of electric tramcars 500 yards away.

The relay is only suitable for use with electrolytic detectors; crystal detectors give no results. By using two or more electrolytic detectors in parallel the relay can be made to record signals which do not affect it when a single detector is used; telephone reception weakens as the number of detectors is increased. For example, a single electrolytic detector received eight microamps. from Clifden (780 miles), but five detectors in parallel and balanced among themselves by potentiometer adjustment gave 30 microamps. and good relay working, though with some elongation of dots. As few detectors should be used as will give good relay working.

A novel suggestion worth investigation is that a sensitive mirror galvanometer be used to throw light on or off the vanes of a "light-mill" or radiometer, the latter operating adjustable contacts, say, by magnetic effect.

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NOTES.

Australian Engineers for Australia.—According to the *Melbourne Age* of February 26th, a competitive examination, held by the Government authorities for the purpose of selecting an electrical engineer for the telephone branch in Adelaide, at a salary of £528 a year, has resulted in the appointment of Mr. R. Lawson, formerly assistant engineer on the staff of the chief electrical engineer. Nine officers competed, and Mr. P. Kennedy, of Western Australia, was second on the list. The examination was held as the result of a protest by the Professional Officers' Association against the appointment of imported officers over the heads of Australians. The Postmaster-General decided that the merits of all officers should be tested. Mr. Lawson is an imported officer.

Complaints are being made in Australia with regard to the appointment, it being alleged that imported candidates were favoured, to the detriment of Australians, in the examination. An impartial inquiry into the circumstances is demanded by Commonwealth engineers.

One Too Many.—Owing to our having to proceed to press two days earlier than usual, we are unable to include the following letter in our "Correspondence" columns:—

As "one of the speakers who is connected with the electrical trade" referred to by you in your last week's issue under the above heading, I was very pleased to read your article, which, though somewhat severe in its criticisms, I gladly welcome as written with that frankness and openness which cannot fail to assist our common aim, viz., to bring about a complete commercial as well as a military victory over our enemy.

Let me assure you that the "British Manufacturers' Association, 1915" should be entirely acquitted of any narrow or one-sided views such as the article in question imputes to them, and the absence of any reference to efforts emanating from other sources was not due to any petty jealousy.

The Association is not unmindful of such other movements as you refer to, but, to imitate your own perfect frankness, it fails to find in them that "substantial progress" of which you speak.

I entirely agree with your argument that one strong representative organisation is what is needed, and this is indeed exactly what I advocated, but it must be strong in business ability and determination to act, and must not rely for its influence and standing on an executive composed of men of title or mere party speakers—enlisted as such—apart from any fitness for the real objects of such an organisation.

It was with these points in view that the British Manufacturers' Association was formed, and it is more than ready to act in union with any movement, old or new, that will tackle firmly and imperially the position which confronts us.

I trust you will do me the favour of inserting this letter in your widely read paper, in the hope that it may elicit criticism and exchange of views, useful to all those who are willing and anxious to help in these times to secure Britain for the British.

ARTHUR BERKELEY, M.I.E.E.

London, E.C., *April 17th*, 1916.

Electrochemistry in the United States.—The Niagara Falls section of the American Electrochemical Society in February discussed the development of power from the Falls in connection with the electrochemical industries. According to *Metallurgical and Chemical Engineering*, complaints were made with regard to the restriction of power development at Niagara by the U.S. Government. It was stated that the Niagara Falls Power Co. generated 90,000 H.P., and the Hydraulic Power Co. 100,000 to 125,000 H.P., all the latter, except 15 000 H.P., being employed in the electrochemical industries. Mr. F. J. Tone said that the year 1915 had taught them that a nation must be economically and industrially independent and self-contained. Crude potash, formerly obtained from Germany, had risen from £7 to £80 per ton; ferromanganese, derived from England, had been placed under an embargo, and its price had risen from £7 6 to £25 per ton, while many commodities had become almost unobtainable. Few realised to what extent their great basic American industries depended upon electrochemistry, particularly the electrochemical products of Niagara power. Steel manufacture, the greatest of all American industries, was absolutely dependent upon Niagara power for ferro-alloys; ferrosilicon was an essential element in the production of 15 million tons of steel; ferrochromium, ferrotungsten, and ferrovanadium were indispensable to the manufacture of high-speed tool steel, while ferrochrome was the hardening element in armour-plate and armour-piercing projectiles, and electrical transformer steel was equally dependent upon the products of Niagara power. Artificial abrasives to the amount of 20,000 tons a year were produced at Niagara, and were indispensable to many industries; aluminium and calcium carbide were the largest of the electrochemical industries at Niagara; nitrogen fixation works had been established on the Canadian side of the river, but employed only 25,000 H.P., whereas in Europe over 300,000 H.P. was devoted to the production of nitrogen fertilisers. For the spectacle of Niagara they were paying the price of a million tons of coal a week.

It was stated that from 125,000 to 150,000 H.P. was transmitted into the United States from the Canadian side, and that the continuance of this supply depended upon permits revocable by the Canadian Government. The generation of large quantities of additional power at Niagara on the American side was the only way to avoid a "frightful dislocation of American industry." The development of the electrochemical industries had been the salvation of Germany, and should equally be undertaken by the United States as a matter of preparedness in national defence.

Late Legal.—READ *v.* STELLA CONDUITS CO.—The Court of Appeal, composed of the Master of the Rolls, Lord Justice Phillimore, and Mr. Justice Sargant, have delivered their reserved judgment on the appeal by the plaintiff in the action of Read *v.* The Stella Conduits Co.

The action was brought for an injunction, damages, and the usual ancillary relief for the alleged infringement of Letters Patent No. 18,375, of 1905, granted to James William Brooks and Albert Edward Read for "an improved means for connecting tubular electrical conduits together, and for connecting the said electrical conduits to the fittings without screwing."

Mr. Justice Joyce held that the gripping arrangement was a well known and common one, and that as there was no invention in the patented appliance the patent was invalid. He therefore dismissed the action, with costs, and the plaintiff appealed from this decision.

The arguments upon the appeal concluded upon March 30th, when their Lordships reserved judgment.

Mr. Justice Sargant, who read the judgment of the Court, said that apart from one small variation the plaintiff's appliance was the same whether it was used for connecting a tube and a fitting or connecting two tubes, and, in the latter case, whether the two tubes were of equal or unequal diameter. What, therefore, was the invention as claimed by the plaintiff? So far as each function taken by itself was concerned, the method described in the plaintiff's specification was undoubtedly old. No doubt, however, in view of that fact the refreshingly short and intelligible claim in the plaintiff's specification was not for a method or appliance for effecting a simple single junction or connection of this nature with one tube, but for an appliance for connecting together the ends of two tubular electrical conduits or fittings in the manner described. Did this double connection, as distinguished from a single connection, disclose sufficient subject matter or sufficient invention to support the plaintiff's letters patent? In the opinion of the Court it did not.

The judgment of the Court below was therefore right, and the appeal must be dismissed, with costs.

On Monday an action by the Pritchett & Gold and Electrical Power Storage Co., Ltd., against Hamble, River, Luke & Co., Ltd., with reference to a contract for an electrical installation at the premises of a Mrs. Currie, began hearing before Mr. Justice Sargant. The hearing was adjourned.

Fatalities.—An inquest was held at Eston, on Wednesday last week, touching the death of Charles Morgan, an electric crane driver, who succumbed to injuries sustained at the Cleveland Steel Works of Messrs. Bolckow, Vaughan & Co., Ltd. John Steel, a crane driver, stated that he examined deceased's crane immediately after the mishap. Morgan had apparently stepped out of the cabin on to a beam, and had not taken the precaution to switch off the current. He had then evidently come in contact with a live wire, the resulting shock causing him to fall a distance of 40 ft. to the ground. William Anderson, electrical engineer, said the wires conveying current to the cranes could not be covered, and there was an alternating pressure of 440 volts. Dr. J. Steel deposed that Morgan's case was hopeless. Death was due to the shock from the fall, although it was very probable that the electric shock alone would have caused death. Verdict, "Accidental death."

Arthur Henry Booker, an electrical engineer employed at Messrs. Cammell, Laird's works at Sheffield, was recently killed owing to a plank, which fell from scaffolding on the roof of the power station, striking him on the head. At the inquest the verdict was "Accidental death."

Zinc Smelting in Norway.—H.M. Minister at Christiania states that the electrical refining of zinc has been developing on a gradually increased scale at Trollhattan for some years past, and has now reached an output of over 6,000 tons of refined zinc per annum. The ore is first smelted in the raw-material furnaces, and the ordinary spelter thus produced is then re-distilled in the refining furnaces. Refining is also being carried on at Sundlokken. For some time past plans have been discussed for increased facilities for smelting the ore, and it has now been decided to secure the necessary water power from the Glomfjord waterfalls, situated in Nordre Helgeland, in Nordland. These falls have been purchased by a company formed for the purpose, and when fully harnessed are calculated to yield 125,000 H.P. The works are expected to be completed by 1918, and the hydraulic power obtained will be used for smelting the ore and the refining process connected therewith.—*Board of Trade Journal.*

American General Electric: Bonus to Employés.—The General Electric Co., U.S.A., has announced that all employés in the service of the company for a period of five years or more will receive a bonus of 5 per cent. of a year's salary, payable in two instalments. This will mean a distribution of over $1,000,000 per annum to employés. The first instalment will be payable on or before August 1st of this year, and will be a sum equivalent to 5 per cent. of the individual earnings for the six months ending June 30th, 1916. By the arrangement of two payments many employés, who would not be entitled to participate in the distribution if all were paid in one instalment, will share in the second distribution, having completed the five years' service between June

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30th and December 31st. The distribution, as stated by officials of the company, is being made by the company to signify its appreciation of the services of the employés who have been with the company for a term of years, and is a result of a desire to promote long, faithful and efficient service by its employés.—*American Electrical Review.*

L.C.C. Tramway War Bonuses.—The Rolling Stock Conciliation Board has considered the claims of the several grades of men in the rolling-stock section of the L.C.C. tramways to the war bonus of 4s. a week, and finds that the moulders belong to a class dealt with by a decision of the Committee on Production dated April 17th, 1915, and that the other grades belong to a class dealt with at the conference on April 21st, 1915, and the Board therefore awards them the advance of 4s. per week as war wages.

A question having arisen as to the grades included in the memorandum of the conference of April 21st, 1915, the matter was submitted to the London and District Association of Engineering Employers and the London, Erith and Southall District Allied Engineering Trades Joint Committee. Having considered the replies of these two bodies, the Conciliation Board has decided that an advance up to 4s. a week, to be regarded as war wages, shall be paid to the undermentioned grades of employés in the rolling-stock section :—

Armature winders, wiremen, magnet and coil winders, armature banders, controller testers, body-makers, coach-painters, brush-hands, solderers, light and power attendants, controller repairers, machinery greasers, car greasers, stokers, plough repairers, locomotive drivers, crane drivers, steam lorry drivers, plough changers, controller and motor cleaners, assistant brakesmen, truckmen, brakesmen and re-wheelers, writers, carpenters, wheelwrights, coach-trimmers, shunters, labourers (wood-working, electrical and mechanical), leading labourer (mechanical), tool-store attendants, traversermen, gate constable and patrol constable.

Except as regards armature winders and wiremen, the payment of the advance is to be made as from the first pay-day in March, 1916.

The payment of the advance to armature winders and wiremen is to be made as from the first pay-day in September, 1915.

Australian Electrical Contract Conditions.—With reference to the note appearing under this title in our issue of January 7th, Mr. R. H. Butler, secretary of the Australian Electrical and Allied Contractors' Committee of Melbourne, writes correcting the statements which we reproduced from an Australian contemporary. Mr. Butler says that the whole of the information is quite erroneous, and that his Committee "undertook the work of preparing conditions of contract to be applied to electrical and engineering contracts in Australia, and having drawn up a set of conditions, submitted them to the Federal Council of the Electrical Association of Australia, which body approved of them with slight amendments. The report of the *Australian Mining Standard* reverses the origin of these conditions by attributing them to the Electrical Association of Australia, and stating that they had been approved by representatives of electrical contractors."

The Royal Mint Report.—The Deputy Master, Sir Thomas Elliott, in his report for 1914, shows that the activities of the Mint were such that the previous record production of coins in 1913 was exceeded by more than 28 millions. Of the total coinage of 213 millions in 1914, 188 millions were for Imperial, and 25 millions were for Colonial issues. The Imperial coinage consisted of 19 million gold, 92 million silver, and 77 million bronze pieces.

The memorandum of Sir Edward Rigg, superintendent of the operative department, states that over 2,300 tons of metal were converted into coinage bars, this figure being more than double the average of the previous 10 years. In the machinery branch, the staff has been considerably supplemented and employed since August in the year under review on special work undertaken by the department. The electrical plant has been subject to a steady increase in the demands made upon it. Motors in use number 106 (gross H.P. 950), as compared with 102 (gross H.P. 877) in 1913. The extended use of high candle-power incandescent lamps has led to a reduction in the number of arc, flame, and silica lamps from 64 to 57. The number of incandescent lamps in private residences in the Mint—121—remains unchanged, but those in official use have been increased from 1,151 to 1,298, mainly in consequence of the local lighting requirements for new machine tools in connection with the special work referred to above. The average monthly output of the Mint generators for the year—39,917 Board of Trade units—is 5,600 units above that for 1913.

In the Inland Revenue department, 1 copper, 173 nickel and 232 steel-faced electros were grown, in connection with the preparation of postage stamp plates and dies for postcards and wrappers. The work of preparing master plates and electros of the prisoners' inscriptions in the Tower of London (see ELEC. REV., October 13th, 1914, page 566) has been completed. In all, 458 electros and 66 master plates were produced, the total area of the former amounting to 3328 sq. ft.

Sir Thomas Rose, chemist and assayer, in his memorandum, refers to the question of electrolytic refining of gold. The main drawbacks to the process at present are the length of time occupied, and the consequent impossibility of bringing the metal in a refinery to account daily. From experiments he has made in the department, he states that it would appear that by the use of an electrolyte containing 20 per cent. gold in the form of chloride, and 30 per cent. free hydrochloric acid, a current of 5,000 amperes per sq. metre can be employed, instead of the 500 to 1,000 amperes now used with weaker baths. With this heavy current the percentage of silver in the anodes is of comparatively little importance, and the silver cells can be dispensed with in most cases, and, in addition, 80 or 90 per cent. of the time required in the gold cells can be saved. Under these conditions, the rough gold can be refined and brought to account within the limits of each working day.

Mr. A. Ventris, superintendent at the Perth branch, reports that on account of the extended use of compressed air for other purposes than the original one in connection with gold refining, a 10-H.P. motor has been fixed in place of one of 5 H.P. originally employed. An automatic controller, for regulating the speed of the motor-driven blower, has also been installed in the melting-house office. A hand regulator was formerly used in the blower room, but proved unsatisfactory, as the resistance units were destroyed by the action of chlorine. The new apparatus, which was made locally, has given good results, and maintains a uniform air pressure in the main, irrespective of the number of furnaces used.

In the memorandum of the assayer of the Ottawa branch, Mr. R. Pearson, it is stated that a trial has been made of the gold-plated silver hooks and strips referred to in the previous report (see ELECTRICAL REVIEW, October 23rd, 1914, page 566). The strips were found to be quite as efficient as those made of fine gold. That portion of the hook which passes through the hole in the end of the anode (and is virtually a part of it), is only ½ in. distant from the warm electrolyte. The moist hydrochloric acid fumes condense there, and, under the influence of the current, in about one month dissolve the gold plating, and the silver becomes coated with silver chloride, thus increasing the resistance to the passage of the current. It is intended to use plated strips in place of fine gold in future.

Institution and Lecture Notes.—Institution of Electrical Engineers.—The annual meeting of the NEWCASTLE-ON-TYNE LOCAL SECTION of the Institution was held on the 10th inst., Mr. P. V. Hunter presiding. The report of the Committee stated that the membership had not been greatly affected by the war except in the Students' Section. The average attendance of members had been slightly better than in the preceding session. With regard to the Tees-side Section, the report stated that owing to the war no meetings had taken place. The following were the officers elected for the ensuing session for Tees-side :—Chairman, Mr. M. G. S. Swallow ; vice-chairmen, Messrs. H. G. A. Stedman and J. Pigg ; Committee, Messrs. L. F. Haslam, R. M. Longman, J. R. P. Lunn, C. E. Taylor, J. Wright, and G. N. Wright ; joint secretaries, Messrs. P. S. Thompson and C. O. Bretelle. Many members of the Newcastle Local Section and associated Sections hold commissions in H.M. Forces, or are otherwise engaged in the prosecution of the war, and the Committee regretted to announce that one member of the Local Section, Second-Lieut. W. Winkworth, had already laid down his life for his country. The officers elected for the next session were as follows :—Chairman, Mr. H. W. Clothier ; vice-chairmen, Messrs. A. H. Marshall, A. P. Pyne ; Committee, power supply undertakings, Messrs. W. F. T. Pinkney, G. L. Porter ; manufacturers and contractors, Messrs. T. Carter, W. Cross, W. G. Gunn, J. H. Holmes, M. G. S. Swallow ; Post Office, Mr. F. G. C. Baldwin ; technical colleges, Mr. W. T. MacCall ; borough electrical engineers, Messrs. H. S. Ellis, C. Turnbull ; consulting engineers, Messrs. J. R. Beard, R. W. Gregory, W. C. Mountain, G. Stoney ; North-Eastern Railway Co., Mr. H. Henderson ; hon. treasurer, Mr. C. Vernier ; hon. secretary, Mr. J. R. Andrews ; assistant hon. secretary, Mr. G. L. Drury ; hon. auditors, Dr. W. M. Thornton, Mr. E. Fawsett. Dr. Thornton afterwards delivered a short technical address.

Ipswich Engineering Society.—At a meeting of the Society last month, Prof. A. Humboldt Sexton gave a lecture on fuel economy and gaseous fuel, in the course of which he emphasised the extreme importance of economy in the use of coal. He recommended water-gas as the best fuel gas obtainable, and looked forward to the time when the domestic use of coal would cease, and the smoke nuisance would disappear.

Royal Institution.—Recently Dr. Strahan, Director of the Geological Survey of Great Britain, lectured before the ROYAL INSTITUTION on the search for new coalfields in England. He pointed out that much progress had been made in developing the concealed coal measures of Yorkshire, Nottinghamshire, Denbighshire, and Kent. The latter was peculiar in that it was concealed everywhere. Referring to our happy-go-lucky methods of coal mining, under which it was not necessary to publish any record of borings, he mentioned that for a time the only published account of the Kent borings appeared in a German publication, and to-day some of the boreholes are not described anywhere else.

Homerton Sawmills.—On page 390, in our article on Mr. Sherry's sawmills, an error occurred in the specification : for "50 per cent. overload for an hour and a half," read "50 per cent. for half an hour."

Municipal Loans for Storage Batteries.—The Local Government Board has, on an application made by the B.E.A.M.A., extended the period for the repayment of loans in respect of storage batteries from seven years to ten years, satisfactory guarantees being given.

Appointments Vacant.—Engineer-in-charge (45s. to 50s.), for the Northern Command, Catterick Camp ; shift engineer, for the Northampton Corporation tramways. Belfast Corporation is to appoint a new general manager of the tramways, at a commencing salary of £800 per annum ; "An Irishman Preferred."

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Australian Preference.—At a meeting of the Sydney City Council, in February, the following proposal was discussed :—"That during the present war a 30 per cent. preference be given to goods manufactured by British companies on the price *ex* works, and a 10 per cent. preference be given to goods manufactured by allied companies."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—Sydney City Council has been discussing the appointment of a deputy-manager of the electricity supply department. The proposal to appoint Mr. P. T. DAVIES, of Montreal, to the position was referred back by 12 votes to 11. The qualifications of Mr. S. J. MALING, of the Melbourne electricity department, have also been reported upon.

Mr. J. P. CROWTHER, electrical engineer to the Worksop U.D.C., has enlisted in the Electrical Corps of the Royal Engineers.

The Ashton-under-Lyne T.C. has agreed that the salary of Mr. HOLT, the tramways manager, be increased from £200 to £260 per annum, the amount paid to his predecessor.

Mr. HARRY PILLING, manager of Accrington Corporation Tramways, appears in the list of nine selected candidates for the general managership of Oldham Corporation Tramways.

Second-Lieutenant JOHN SEEAR GIBSON, A.M.I.E.E., Royal Sussex Regiment, charge engineer at the Tunbridge Wells electricity works, was married to Elsie May Dean, of Maidstone, Kent, on April 15th, 1916, at Sutton.

General.—Referring to notes which have previously appeared in this column, Mr. CHARLES H. BEST, of Bradford, writes :—My attention has been called to a paragraph in your issue of April 7th, which refers to the relations between Mr. Charles Pullan and myself. I do not for one moment suppose that these relations are a matter of serious interest to your readers, still I cannot allow Mr. Pullan's statement to pass unchallenged. My connection with Mr. Pullan came definitely and finally to an end on February 4th. He knows this perfectly well, and I cannot imagine what purpose he thinks is served by the publication of a statement to the contrary. It is a question of legal fact, and not a question of anybody's opinion. Mr. Pullan is still consulting engineer to one or two existing village supply schemes, which he and I have jointly carried through, but, in the case of all the new schemes in which I am interested, I am seeking the assistance of other consulting engineers. He has no interest whatever, in any of my work in connection with these new schemes since February 4th. I shall be very much obliged if you will kindly give the same prominence to this letter as you did to that of Mr. Pullan.

Mr. T. M. CAREY, until recently electrical engineer at the Golden Horseshoe Mine, Boulder, W.A., has been appointed electrical engineer to the Perth (W.A.) City Council. Mr. C. A. UNBEHAUN, electrical engineer, G.P.O., Adelaide, South Australia, has retired after 39 years' service.—*Commonwealth Engineer.*

Roll of Honour.—Sergeant JAMES MAGUIRE, of the Manchester Regiment, formerly employed in the Manchester tramways department, who was recently awarded the D.C.M., has been killed.

Private JOHN WILCOCK, of the King's (Liverpool) Regiment, who was formerly employed at the works of the Chloride Electrical Storage Works, Clifton Junction, has been killed.

The Distinguished Conduct Medal has been awarded to Lance-Corporal W. A. GOODE, Royal Engineers, who was formerly in the switch shop of Siemens Bros. Dynamo Works, Stafford. He joined in September, 1914, and gained the D.C.M. for voluntarily repairing, under heavy fire, telephonic lines of communication.

Private ALBERT HILL, of the King's (Liverpool) Regiment, who has died from wounds, was formerly employed at the British Westinghouse Works, Trafford Park.

Private L. BROWN, of the Manchester Regiment, who has been killed in action, was formerly employed in the Manchester electricity department, at the Dickinson Street station.

The Military Cross has been awarded to Lieutenant A. C. SPARKS, R.E., A.M.I.E.E., "for conspicuous gallantry and initiative when taking part with some infantry in a raid on the enemy's trenches. With a small R.E. party he made a very successful reconnaisance of the enemy's trenches, and then exploded charges in two concrete structures."

The following have been mentioned in dispatches (according to the last issue of the I.E.E. *Journal*) :—

Major A. S. ANGWIN, A.M.I.E.E., Lowland Signal Service, R.E.

Captain H. CAREY-THOMAS, A.M.I.E.E., London Army Troops, R.E.

Major L. EVANS, A.M.I.E.E., R.E.

Lieutenant R. K. MORCOM, M.I.E.E., Divisional Engineers, R.N.D.

CITY NOTES.

Marconi Wireless Telegraph Co. of America. The report for 1915 states that before allowing for reserve, the net income was $288,994, as compared with $271,888 in 1914. Income from investments amounted to £104,932, and, after setting aside reserves, the net profit was $177,316, an increase of 18.3 per cent. on 1914. This has been added to the surplus, bringing it up to $541,887 at December 31st last. The reserve at the same date amounted to $373,415. Nearly 500 ships are fitted with Marconi apparatus managed by the company; a contract for standard installations on 36 large power barges for the Mississippi River has been secured, and since the beginning of 1916, 35 ships have been equipped. There has been no change in the commercial status of the trans-Atlantic stations, the high-power equipments remaining closed to business on account of the war. The British Admiralty still holds for Imperial Government use the English plants constructed to operate with the company's Belmar and New Brunswick duplex stations, and thus far, because of the war, it has been impossible to open similar direct service with Norway and Northern Europe through the newly completed high-power stations at Marion, Mass., and Chatham, Mass. Reliable and rapid service has been maintained between stations in California and Hawaii, and the volume of traffic shows steady improvement. The Hawaiian stations are known as two-way stations, being constructed so as to work with California and Japan simultaneously. The Japanese Government recently notified that its new wireless stations at Funabashi and Otchisi, near Tokyo, are complete and tests are now being made daily with a view to early inauguration of a public service, spanning 5,600 miles of the Pacific. Negotiations on traffic regulations are now in progress with the Japanese Government Department of Communications, and it is expected that by means of the Japanese Government cables the service will be extended to China, Manchuria, and other Far Eastern countries. The new circuit connecting the United States with Alaska was opened in August, 1915. All of the year's production of the factory at Aldene, New Jersey, has been rented, sold to patrons, or installed on steamships, in addition to which a number of sets have been manufactured on special order for the United States Government.

South Wales Electrical Power Distribution Co.—The report states that the business of the company shows a material increase during the year, the units sold amounting to 28,967,656, as compared with 26,510,198 sold in 1914. After payment of all working expenses and interest on prior lien debenture stock, and making provision for depreciation of new plant, the surplus amounts to £6,756, as compared with £5,347 in 1914. The indebtedness of £13,500 to certain members of the Treforest Co. for extra charges having, as stated in the last report, been provided for, this surplus has enabled payment to be made of the interest on the old debenture stock for the half-year to December 31st last—£5,000—leaving £1,756 to be carried to suspense account, and making, with the balance to the credit of this account at the end of 1914, a total of £3,999.—*Financier.*

Great Northern Telegraph Co., Ltd.—At the general meeting, which will be held at Copenhagen on May 6th, the board will propose to pay a total dividend and bonus of 22 per cent. for the year 1915, including the 5 per cent. already paid, and to transfer to the reserve and renewal fund (reduced by £233,202 on account of depreciation of securities) and to the pension fund the following amounts, namely, £138,889 and £22,222 respectively. It is, further, proposed to transfer an amount of £27,778 to the renewal fund for cable steamers, and to set aside £83,333 for extraordinary income taxes.

Dawlish Electric Light and Power Co., Ltd.—The war considerably affected the undertaking during 1915, but though there was a standstill in consumers and in revenue for current supplied, and a great increase in cost of coal and stores, the gross profit was very little less than in 1914. £200 has been put to depreciation fund for investment in 5 per cent. Exchequer Bonds. The net revenue balance applicable for dividend was £205, and, after paying a dividend of 1¼ per cent., free of income-tax, on the ordinary shares, £121 is carried forward.

Reading Electric Supply Co., Ltd.—The accounts for 1915 show that, after providing for interest charges and setting aside £3,500 for depreciation, a credit balance of £1,262 brought in was reduced to £153.—*Financial News.*

Anglo-American Telegraph Co., Ltd.—Interim dividend for the quarter ended March 31st, 1916, of 15s. per cent. on the ordinary stock and £1 10s. per cent. on the preferred stock, less income-tax.

Vickers, Ltd.—Final dividend of 1s. 6d. per share, or 7½ per cent., free of income-tax, making 12½ per cent. for the year.

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Telephone Co. of Egypt, Ltd.—Including £164,276 brought in, the accounts for 1915 show a profit of £232,143. A further dividend of 6 per cent. is recommended on preferred and deferred shares, making the usual 10 per cent. for year, carrying forward £193,469.

La Plata Electric Tramways, Ltd.—The accounts for 1915, including £6,614 brought in, and after providing for debenture stock and other interest, show a credit balance of £12,142, which is to be carried forward.

Brazilian Traction, Light and Power Co., Ltd.—A dividend of 1 per cent. on the issued ordinary capital stock, is announced.

STOCKS AND SHARES.

SATURDAY AFTERNOON.

As usual at the Easter season of the year, publishers' exigences render it necessary to write well in advance of the usual day of the week. The only reason for drawing attention to the sub-heading of this column is that quotations may have altered before the middle part of next week, and therefore it is advisable to point out that these notes are being written on Saturday afternoon.

Dramatic rises have occurred in the shares of the telegraph companies. This is due to the fact that the two Eastern undertakings and the Western Telegraph have all increased their dividends from 7 per cent. to 8 per cent. for the year, a surprise that was as pleasant as it was unexpected. The effect has been to stiffen quotations for other telegraph issues; and the difficulty is to get hold of any stocks in this market.

The position as a whole in the Stock Exchange is decidedly good; and although business fell away to some extent as the Easter Holidays approached, there is still sufficient to keep a fair proportion of its members profitably occupied. A steady rise in the price of the War Loan created a good impression upon all the investment markets. Practically every section dealing with industrials is in a thoroughly healthy condition as regards prices, and some of them are remarkably busy. The feature amongst Home Rails is a recovery in Metropolitans and a further rise in Underground income bonds.

Metropolitans spurted to 25½, being a rise of ¾ on the top of their previous advance of 1¼. At the present price, the yield on the basis of last year's dividend of 1 per cent. is under 4 per cent. on the money, so obviously there must be some further reason than yield to be sought for the rise. This reason has not yet become apparent, although there are various rumours current to account for it. Underground Electric incomes have again improved, this time to a small extent. In Districts there is not much doing, and some of the buyers who got in just before the three-points rise are evidently not unwilling to take their profit.

The three telegraph companies alluded to above have all declared dividends of 8 per cent., against their previous 7 per cent. This is the first time that the Eastern has made a change for 18 years, and the Eastern Extension for 27 years; while the Western has paid 7 per cent. for the past quarter of a century. The immediate effect upon prices was to send them up with a leap, and to render stock almost unpurchaseable. We know of one case in which a buyer was lucky enough to get stock at 137, which he sold, within an hour 4 points higher up. The companies are to be cordially congratulated upon their achievements; and the intensely conservative character of the boards is ample guarantee that the change would not have been made unless the directors felt entirely convinced that the increased distributions could be maintained.

Other telegraphs are better in sympathy. Great Northerns and Indo-Europeans are both somewhat nominal, inasmuch as the offer of shares is wanted and there is no supply. Globes rose to 11. The American group is not affected. Marconi shares eased off to 2 3/16 sellers on the appearance of the report of the American company, which is not as good as some people had hoped it would be, having regard to the recent buying of the shares from the United States.

The manufacturing shares of the telegraph group have not yet sympathised with the rise in the cable companies' issues, but it is taken for granted that they are pretty sure to do so. Iron and Steel concerns, and those connected with chemical companies—*e.g.*, Castner-Kellner—are showing marked strength, with demand eager not only from the provinces, but from London, too. British Westinghouse preference are conspicuously good, securing a gain of 1/16 on top of the deduction of 3s. dividend.

The electrical supply shares are steady, without exhibiting any particular alteration. Indeed, this section of the industrial market is still almost the quietest of them all. There is, of course, nothing to attract popular attention just now; while the advent of summer affords an additional reason to those already familiar for the market quietude. Nevertheless, the good yields obtainable from the principal shares are not lost upon investors with sufficient patience to investigate their proposed purchases in advance. South Metropolitan ordinary are better at 14s., but no shares have changed hands for the last two months.

Most of the Mexican stocks and shares have given way, upon what looks like a joining of forces between Villa and Carranza, in opposition to the United States. This novel turn of the kaleidoscope seems to have disturbed the Americans rather badly, although it was not wholly unlooked for by London observers of the situation.

The report of the Mexican Northern Power Co. throws interesting light upon conditions in the country. Between last October and December the Villa currency had no purchase value whatever. During this period the company continued to issue Villa money up to 25 per cent. of the pay roll, but redeemed all money so paid out by various temporary devices, the principal of which was the establishment of a butcher's shop. So ingeniously were payments of wages arranged that the result, says the report, was that "the labour cost per unit of work done was only about one-half of that which it had been in normal times." Brazil Tractions are a little easier at 54, and the Argentine department is inclined to be heavy.

The most active part of the Stock Exchange is the rubber market, where, notwithstanding a fall in the price of the raw stuff, an extraordinary amount of buying continues day by day. For this the issue of the spring reports is mainly responsible, because they show that the leading companies, and many of the younger producers, are earning extremely handsome profits, while the big dividends now being declared are likely to be exceeded by those to be paid in respect of the current year.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price April 18, 1916.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	10	6¾	—	£7 8 2
Charing Cross Ordinary	5	5	8½	—	7 18 10
do. do. do. 4½ Pref.	4½	4½	8½	—	6 18 6
Chelsea	5	4	7¾	—	6 8 1
City of London	9	8	11⅝	—	6 14 9
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	11½	—	6 16 7
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	9	7	5	—	7 0 0
London Electric	4	8	1	—	9 0 0
do. do. 6 per cent. Pref.	6	6	4½	—	7 5 5
Metropolitan	3½	8	2⅜	—	6 4
do. 4½ per cent. Pref.	4½	4½	8	—	7 10 0
St. James' and Pall Mall	10	8	5¾	—	6 16 2
South London	5	5	2¾	—	8 18 10
South Metropolitan Pref.	7	7	1⅞	—	6 14 0
Westminster Ordinary	9	7	5½	—	6 1 9
TELEGRAPHS AND TELEPHONES.	Dividend 1914.				
Anglo-Am. Tel. Pref.	6		93½	—	6 1 10
do. Def.	33/6		21½	—	7 19 3
Chile Telephone	8		6¾	—	6 5 6
Cuba Sub. Ord.	5		7⅝	—	6 9 0
Eastern Extension	7		14	+ ⅛	*8 14 4
Eastern Tel. Ord.	7		140	+ 9	*5 14 4
Globe Tel. and T. Ord.	6		11	+ ¼	*5 9 1
do. Pref.	6		10	—	6 0 0
Great Northern Tel.	22		86	+ ½	6 2 3
Indo-European	13		52	+2	6 5 0
Marconi	5		2 5/16	— 1/32	4 11 4
New York Tel. 4½	4½		100½	—	4 9 4
Oriental Telephone Ord.	10		1⅝	—	£6 8
United R. Plate Tel.	8		6	—	*6 13 4
West India and Pan.	1		1 1/16	—	9 10 6
Western Telegraph	7		14	+ ⅛	*5 14 4
HOME RAILS.					
Central London, Ord. Assented	4		67½	—	5 8 6
Metropolitan	1½		25½	+ ¼	8 19 2
do. District	Nil		19¼	— ¼	Nil
Underground Electric Ordinary	Nil		1⅛	— ⅛	Nil
do. do. "A"	Nil		6/-	+6d.	Nil
do. do. Income	6		87	+ ½	*6 18 0
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6		4¾	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½		8⅜	—	7 6 8
do. 2nd Pref.	5½		8⅜	—	8 3 0
do. 5 Deb.	5		78	—	6 8 2
Brazil Tractions	4		54	— ½	6 9 8
Bombay Electric Pref.	6		10½	—	5 17 3
British Columbia Elec. Ry. Pfce.	5		58	—	9 8 8
do. do. Preferred	—		87	—	Nil
do. do. Deferred	—		33	—	Nil
do. do. Deb.	4½		62 xd	—	6 17 1
Mexico Trams 5 per cent. Bonds	—		40	— 1	Nil
do. 6 per cent. Bonds	—		12	— 3	Nil
Mexican Light Common	Nil		20	—	Nil
do. Pref.	Nil		33	—	Nil
do. 1st Bonds	—		39	— 2	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	14		23	—	£5 1 8
British Aluminium Ord.	5		22/- xd	—	6 7 3
British Insulated Ord.	15		104	—	£7 2 10
British Westinghouse Pref.	7½		2½ xd	+ 3/16	7 1 2
Callenders	15		11½	—	6 10 5
do. 5 Pref.	5		4¾	—	£5 17 3
Castner-Kellner	20		8¾	—	6 8 0
Edison & Swan, £3 paid	Nil		7/-	—	Nil
do. do. fully paid	Nil		1¾	—	Nil
do. do. 5 per cent. Deb.	5		57 xd	—	£5 15 3
Electric Construction	6		15/6	—	7 14 1
Gen. Elec. Pref.	6		9½	—	6 6
Henley	20		15	—	*6 13
do. 4½ Pref.	4½		4	—	£5 12 6
India-Rubber	10		9½	—	*10 10 6
Telegraph Con.	20		85½	—	*6 13 4

* Dividends paid free of income-tax.

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ELECTRICITY IN MINES.

The Report of the Chief Inspector of Mines (Sir R. A. S. Redmayne) for the year 1914, Part II, deals with the Report of the electrical inspectors.

It appears that on the outbreak of war Mr. Nelson, who was the Electrical Inspector of Mines, took up military duties, and his work was taken over by two junior inspectors, Messrs. W. E. T. Hartley and W. J. Charlton, the former taking Scotland and the Northern divisions, and the latter the four other divisions.

The following table shows the aggregate horse-power of electric motors in use above and below ground for the various divisions :—

Division.	Surface. H.P.	Underground. H.P.	Total. H.P.
Scotland	30,183½	106,972½	137,155½
Northern	78,936¼	90,875¼	169,811½
York and North Midland ...	65,857⅛	57,790⅞	123,648
Lancashire, North Wales and Ireland	13,117½	22,502½	35,620
South Wales	93,832½	100,443½	194,276
Midland and Southern ...	12,164½	41,105½	53,270
Total	294,092	419,689	713,782½

The following table shows the increase in 1914 over the figures for 1913, which is very satisfactory, and shows that electricity is steadily making headway in mines :—

	1913. Horse-power.	1913. Per cent. increase on preceding year.	1914. Horse-power.	1914. Per cent. increase on preceding year.
Surface	256,675½	32·24	294,092	14·58
Underground ...	371,421½	17·29	419,689	13·00
Total	628,097½	22·97	713,782	13·64

The number of electrically-driven coal-cutting machines in use at the end of 1914 was 1,415, an increase of 108 over the number in use at the end of 1913.

During the year 1914 there were in all nine fatal accidents, definitely due to electricity, investigated by H M. Inspectors of Mines, causing nine deaths.

Of the nine electric-shock accidents above referred to, five took place on the surface and four below ground. The figure for electric-shock accidents below ground, which last year had begun to show an upward tendency, has decreased considerably as will be seen below :—

Number of persons killed by electric shock below ground in coal mines—1907, 10 ; 1908, 12 ; 1909, 13 ; 1910, 15 ; 1911, 9 ; 1912, 7 ; 1913 and 1914, 4.

The figure for 1914 by comparison with 1913 is very satisfactory considering that the horse-power of electric plant in use below ground increased by 13 per cent. during the year. We have previously given details of these accidents.

In regard to machine mining, the following table gives the number of machines in use and the quantity of mineral obtained by their use.

Division.	Number of collieries where machines are at work.	Number of Machines.	Worked by Electricity.	Worked by Compressed air.	Mineral obtained. Tons.	Number of face conveyors at work.
Scotland...	230	913	747	166	9,195,645	128
Northern	92	702	156	546	3,571,3 2	68
York and North Midland	117	725	350	376	7,134,139	116
Lancashire, North Wales and Ireland	95	399	34	365	2,089 57	27
South Wales	58	131	44	87	634,82	63
Midland and Southern..	60	223	84	139	1,647,02	6
Total in 19.4	652	3,093	1,415	1,678	24,274,51	408
Total in preceding yea	676	2,897	1,307	1 590	24,609,958	377

The following table shows the number of mechanical coal-cutters in use in the various Inspection Divisions :—

Kind of machine.	Number in use. Scotland.	Northern.	York and North Midland.	Lancashire, North Wales and Ireland.	South Wales.	Midland and Southern.	Total.
Driven by electricity :							
Disk	515	58	157	7	3	35	775
Bar	216	83	87	19	38	20	413
Chain	12	64	104	8	3	29	219
Percussive	2	2	—	—	—	—	4
Rotary heading ...	2	—	2	—	—	—	4
Total	747	156	350	34	44	84	1,415
Driven by compressed air :							
Disk	119	61	175	117	1	14	487
Bar	7	15	60	34	50	6	172
Chain	—	8	35	5	7	20	75
*Percussive	40	451	99	209	29	94	922
Rotary heading ...	—	11	6	—	—	5	22
Total	166	546	375	365	87	139	1,678
Total in 1914	913	702	725	399	131	223	3 093
Total in preceding year	876	665	673	393	115	175	2,897

* As these machines cannot be driven by electricity, the table really shows that out of 1,678, 922 *must* be driven by compressed air, whilst the remainder, 756, *might* be electrically driven.

In regard to shot-firing, it is interesting to note the usefulness of electr city in this dangerous undertaking. The following table shows the amount of explosive used and the number of shots fired by electricity, fuse, and squibs, from which it will be seen nearly half the total were fired by electricity.

Division.	Quantity of explosives used. lb.	Estimated number of shots fired. By electricity.	By fuse.	By squibs.	Total.
Scotland	7,170,725	1,741,643	8,498,409	643,971	10,884,023
Northern... ...	9,051,904	7,012,173	1,094,354	8,538,275	16,644,784
York and North Midland ..	1,894,810	3,606,070	504,681	900	4,111,657
Lancashire, North Wales and Ireland	1,948,654	4 930,902	242,390	—	5,173,292
South Wales ..	2,401,728	2,918,872	985,759	269,475	4,174,106
Midland and Southern ...	3,053,277	2,624,364	2,167,89	309,52	5,101,784
Total in 1914 ...	25,521,098	22,834,030	13,493,488	9,762,128	46,089,646
Total in preceding year	26,335,195	23,179,841	14,608,72	11,045,720	48,834,286

The use of electric safety lamps is also extending, as is shown in the following table :—

Division.	Total number in use.	Method of locking. Lead rivet.	Magnetic	Screw.	Other.
Scotland	3,365	290	3 047	4	24
Northern	6,987	4,510	2,469	—	8
York and North Midland	38,035	5,516	32,443	—	76
Lancashire, North Wales and Ireland	2.398	1,532	851	—	15
South Wales	23,066	1,195	21,866	—	5
Midland and Southern ...	1,856	744	1,096	—	16
Total in 1914	75 707	13 787	61.772	4	144
Total in preceding year...	37,823	14,604	22,756	219	214

The figures show that nearly 40,000 electric lamps replaced a similar number of oil lamps. The total number of oil lamps in use during the year 1913 was 740,001, which was reduced to 679,572 in 1914.

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THE EFFICIENCY OF LABOUR.

By E. E. HOADLEY, M.I.E.E.

An oft-quoted definition of an engineer is "A man who can do for eighteenpence that which any fool can do for half-a-crown"; in other words, an engineer is a man whose duty it is to make the most out of anything and to use material and labour to the greatest advantage.

In the domain of Central Station Engineering (to which the writer only intends the present article to apply), it has been his impression, gathered from a large number of central stations that he has visited, that in some of them, at any rate, greater efforts are made towards economy in material than towards economy in labour. The word economy is here used in its best sense and has no connection with parsimony.

At times such as the present, when conditions in the labour market are about as bad as they possibly can be, and when mighty happenings in the relations between capital and labour are being conceived in the brains of the leaders of labour, it behoves everyone who is in a position to do so, to help in however small a way in drawing employers and employed more closely together and convincing them that after all, and in the widest sense, their apparently divergent interests are in the main identical.

The writer wishes to make it quite clear that this article is intended to be absolutely non-political and non-socialistic, and that he is merely putting on paper his convictions, the result of many years' experience, as they apply to electricity supply.

In any manufacturing works, economy in the cost of output depends to a certain extent, either greater or less, on the way in which the workers perform their allotted jobs.

It may be urged that an electricity generating station is not a manufacturing works, in the usual acceptance of the definition, but I think it will be agreed that the conditions are sufficiently alike for the goodness or badness of the labour employed to have a very decided effect on the financial results.

The methods and means by which labour in an electricity works can be employed most profitably are management and supervision—management being the brains that so apportion and arrange the work that each man is working efficiently; supervision, seeing that those arrangements are being carried out. But, in spite of good management and good supervision, the best results cannot be obtained unless the men themselves have their hearts in the work and are made to realise by some means or other that in doing their best for their employer they are also doing the best for themselves.

For many years past bonus schemes or profit-sharing schemes have been in operation in electricity supply stations, but until quite recently conditions have not been stable enough to enable a satisfactory scheme to be got out which should at the same time be simple, equitable, and easily understood by the men.

The writer has evolved several schemes of this nature, and one or two have been put into operation, with more or less satisfactory results, but owing to various causes they have all died a natural death.

It is much easier in a company-owned concern to draw up a scheme which shall be to the advantage both of the men and of the company, than it is in a municipally-owned undertaking; the reason being that in a company-owned supply the primary object is admittedly the making of profits in order to pay dividends to the shareholders, which at once gives the basis of a satisfactory scheme. In a municipally-owned undertaking, the first aim of those responsible is, or should be, to give a supply at the lowest possible price consistent with keeping the undertaking in a sound financial condition, and not the making of large profits. This complicates any system of co-partnership based on profits.

The author has tried a system based on cost per unit sold, but here again the constant alteration in conditions, brought about by the installation of more economical plant, finally brought the scheme to an end.

After carefully reviewing the various schemes which have been and are in operation in municipally owned undertakings, and after giving much thought to the problem, the writer is strongly of opinion that a scheme of this nature makes for the best interests of the undertaking and of the men themselves.

The next question is—How shall it be worked out and on what shall it be based? Here again, after much argument and weighing the pros and cons of the various bases for a scheme, the author considers that at the present time most supply stations are proceeding along more or less regular lines, and it is possible to estimate with fair accuracy the revenue and costs for twelve months' ahead. It is, or should be, possible so to arrange the charges for the supply as to ensure the total costs being covered and a margin of a predetermined amount left over and above these, this margin being net profit.

With these premises it is not difficult to draw up a scheme, having as its base profit-making, giving to the staff a certain precentage of the profits and increasing the percentage on all profit made over and above the estimated amount.

The method of dividing up the bonus due to the staff has had a good deal of consideration, and in the end the author considers the simplest and fairest method is to divide up the total amount in the proportion of the total annual earnings of each man as wages.

The writer is about to put a scheme drawn up on the above lines into operation in the station of which he has control, and it will be interesting to see how far his hopes and ideals are borne out in actual practice.

There is, in addition to the general bonus scheme outlined above, another special bonus scheme on which the writer sets great store, and which he has had in operation for some years with much success. This is a bonus payment to the stokers, based either on the lb. of coal burnt per unit generated or on the lb. of water evaporated per lb. of coal burnt. The details of such a scheme are easily worked out for the local conditions pertaining to each station, but in the writer's case 10 per cent. of the saving in fuel costs below a certain fixed figure is divided among the stokers. The figures for each quarter are fixed beforehand and posted in the boiler house.

This coal bonus to the stokers should be worked in addition to the stokers participating in the general bonus scheme, as in all but the largest stations the work of the stokers has a large influence on the costs.

The above schemes are, in the opinion of the writer, well worthy of consideration; that they are open to improvement is beyond doubt, but time and future circumstances will enable these improvements to be made. In the main, however, any arrangement such as the above must do a certain amount of good, as it convinces the men that they are working for the best of all masters—themselves; in so doing they realise that any saving they can make is for their benefit as well as that of their employers, and the general body of the men will not tolerate for long a man who is a slacker and not doing his best.

In settling the amounts to be paid as bonus to the men, the writer considers that the amount it is possible for each individual to earn should be substantial, and enough to make the man try his best, yet it should not be sufficiently large to be looked on by the man in the same light as wages.

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In conclusion, the author would express his thanks to Mr. Bowden, of Poplar, Mr. Hall, of Burton-on-Trent, and Mr. Seabrook, of Marylebone, for help and suggestions received.

SWITCH CONTROL FOR AUTOMOBILES.

(Communicated.)

The great popularity at present enjoyed by automobile electric lighting and starting sets is to be traced in no small degree to the ease of control available, a simplicity of arrangement, however, which has unfortunately resulted in a lack of investigation on the part of designers and others most closely concerned. The advantages and conveniences of electric light may be enormously increased by an intelligent appreciation of switch control, for this is a matter which, in the hands of a few, has undergone even more wonderful changes than the design of the electrical fixtures themselves.

The correct disposition of the light units and the advantages of an electrical supply are but two of the points to consider when an electrical installation has been decided upon.

The third, and equally important point, is the switching arrangement adopted. Given a clear grasp of the latter, then, and only then, can the manifold advantages of an electrical supply be fully appreciated.

The matter is one which is closely allied with that of the furtherance of the motor industry in this country.

The American sets are nearly all standardised, and, having decided upon a particular method of control, the same is incorporated as a fixed unit of a standard machine. In our country it is almost safe to say that the choice of the electrical equipment and control thereof is left to the individual taste and requirement of the customer. The result is lack of standardisation and a corresponding increase in the cost of the set provided.

There should be a standardised method of control adopted for each particular case requiring consideration. The necessary switch-gear is available, and by a closer co-operation between the various interested parties a step in the direction of standardisation of electric sets for car purposes would be taken.

In the following notes some brief control outlines are indicated, and while not claiming originality for the same, the author is of the opinion that consideration and criticism may lead to a more intelligent appreciation of the advantage and ease of electrical control taking place.

Improved Controls Available.—The interior lighting of cars is usually left in the hands of the occupants. Improvement is possible by arranging a dual control, a two-way circuit, with one switch inside and the other outside near the driver, enabling the latter to switch on when the car is about to be occupied, or to switch off if the late occupants should have forgotten to do so.

It is possible also to arrange for the control of electric heaters in much the same way. A heater should be controlled by a pilot switch and a pilot lamp fitted in a conspicuous place, independent control being given to the driver if a two-way circuit is used with the pilot lamp.

Automatic step or foot-board lighting is easily arranged for by the insertion of a spring-on switch let into the door jamb, and the convenience of this form of control should lead to its universal adoption for all enclosed cars, at least.

The usual method of signalling to the driver is open to objection, and frequently it is impossible in traffic to make oneself heard from the inside of the car. Silent communication by means of coloured lights is, however, a perfectly sure and safe method at all times of the day or night.

All that is required is two small dash lamps and a switch inside the car. The "Twinob" switch, to quote one example, arranges for the operation in the following way: Right-hand lamp on—Turn right. Left-hand lamp on—Turn left. Both lamps on when running—Stop. Both lamps on when standing—Start.

In this way all communication dangers, which are always present, especially in traffic, are avoided, and a simple standardised method of control is adopted.

The elimination of unnecessary switches and the corresponding simplification of the wiring are points that should appeal to all who are interested in the furtherance of the motor-car industry.

In many cases a single switch may be made to perform numerous operations, such as putting both head and side lamps in parallel or series for full or dim running, while at the same time providing a control for the tail light.

Other combinations can quite easily be arranged, as it is merely a matter of stating the requirement and then choosing the switch capable of performing the necessary operation.

The whole point is that the improved controls are available, and that far from being in any way mysterious they are the simplest pieces of mechanism, and are merely the results of pushing electrical considerations to a logical conclusion.

What is needed is co-operation between those interested in the sale and utilisation of electric sets and those manufacturers who have studied the means of utilising the current to the best advantage. In this way quite unnecessary cost and complication can be eliminated. The system can be reduced to the simplest one possible, satisfying the necessary requirements, and a standardised method of control arrived at. Intelligent co-operation is the secret of the whole matter.

REVIEWS.

Wireless Telegraphy. By Dr. J. Zenneck. Translated from the German by A. E. Seelig, E.E. London: Hill Publishing Co. Price 17s.

This book is not, as the author is careful to explain in the preface, merely an abridged edition of his original German publication. In adapting it to keep pace with the progress of the subject it has become essentially a new work.

As one of the foremost German authorities on the theory, if not also the practice, of wireless telegraphy, the book possesses great interest as a disclosure of the theory and practice as it is viewed in Germany at the present time. In the first chapter on condenser oscillations there is evidence of thoroughness and clear grasp of principles in many directions which make the usual slip-shod text-book explanations appear feeble. As an instance, in referring to the energy losses in the spark gap, the author is careful to term the effect concerned "gap decrement" and to explain the precise factors involved in this quantity rather than to talk in a loose and misleading way of the resistance of the spark gap, as though it were a fixed and definite, instead of a highly variable, quantity. The degree of ionisation of the spark gap, and, therefore, its conductivity, necessarily varies with the current passing at any instant; the resistance therefore suffers a large cyclic change in each half-period of the oscillations, and a full appreciation of the magnitude of this change and the various factors controlling it is necessary to a proper understanding of spark gap effects, especially quenched spark gaps.

A useful part of the second chapter is that dealing with the theory of series capacity and inductance inserted in linear oscillators or antennæ. In developing the explanation of these cases the author does not appear to have expanded the treatment to cover the effect in receiving. This is important in view of a proper perspective being obtained with regard to the selectivity of such antennæ, and in view of the fallacious methods of obtaining selectivity which hold at the present day in this country and elsewhere. Reading between the lines, the author is probably quite alive to the weakness of the premises on which many methods in practice are based, but he refrains from any direct criticism of them.

In a very clear exposition of the effects of resistance, capacity, and self-induction in high-frequency circuits some room is left for a fuller explanation of the many elusive effects

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of self-capacity of coils, especially where idle windings of many turns are concerned. The chapters devoted to the discussion of coupled circuits and resonance curves are of a highly informative character, and deal largely with investigation and measuring work. Useful practical hints as to means of obtaining accuracy and checking results of tests are given; thus the means of eliminating errors due to eddy currents occurring in the coatings or plates of condensers forming part of an oscillatory circuit are explained. In this connection, however, the student might very usefully have his attention drawn to a source of error which is often very serious in large transmitters, namely, losses due to the degree of proximity of the ground, walls of building, his own body, or any material substance which is neither a perfect conductor nor a perfect insulator, and which is within reach of the oscillating electro-magnetic field. Mention is made of an interesting method of completely suppressing one of the wave components of a coupled transmitter giving a double wave, the suppression occurring so far as the measuring instrument is concerned. The author is no doubt alive to the bearing of this method in other directions which he does not specify. In a chapter devoted to the antenna, the author gives special consideration to the important question of grounding and its equivalent, as in the counterpoise method. In his analysis he appears to have overlooked at least one very important consideration, to which it may be as well not to refer specifically in present circumstances, though the omission may be intentional.

Much of the interest that will be felt in this work will no doubt turn upon the comparisons between quenched spark and unquenched spark systems, the former representing standard practice in Germany. In appraising the quenched spark method, both with the Wien type spark gap and the mechanically-quenched gap which Marconi claims to be using in high-power stations, sufficient attention is not paid to the impure character of the wave emitted during the period prior to quenching, representing considerable energy waste. It is necessary to have regard to the fact that the antenna oscillations have grown to their maximum amplitude when the primary spark is quenched, and that the radiation taking place during this period is practically wasted. Probably the really effective radiation only commences after the primary circuit is quenched. As a general proposition, in spark systems a wave train is impure to just the extent that decrement or increment exists in the train. An absolutely pure wave is, therefore, unattainable; but the nearer the amplitude reaches uniformity the purer and more efficient the radiation. It is, therefore, just a question whether it is better to make the wave increment very large and the subsequent decrement small, as in quenched spark methods, or to keep both the increment and the decrement small, as in lightly-coupled unquenched systems. This cannot be fully elucidated theoretically, as practical limitations are concerned.

In the theory of wave propagation much prominence is given to the so-called surface wave theory of Sommerfeld. Essentially, however, this theory is merely an elaboration of a very early theory first published in the Electrical Review in A.D. 1900. As rendered by Sommerfeld, it is rather in the nature of an artifice to resolve wave propagation into two parts which can have no separate existence, but which resolution renders the propagation more amenable to analytical treatment. One part is treated as a wave following the contour of the earth's surface, and the other as a free space wave. It is not clear that this point of view results in any very marked elucidation of most of the observed facts of long-distance transmission. A point of criticism in reference to this part of the work is that the student is apt to be led to overestimate largely the effect and importance of the conductivity of the ground at a large number of wave lengths' distance from the source of the waves. It is never explained to him that the resistance of the annulus of surface occupied by the base of an advancing wave becomes progressively less as the wave expands. Hence, the effect of the specific resistance of the soil may become practically negligible.

A separate chapter is devoted to detectors, from which much valuable information may be gleaned. By a somewhat remarkable oversight, the author appears to regard the simple rotating magnet form of magnetic detector as a practicable instrument. It is also rather surprising in a German book of this character to find no reference to the anti-coherers of Neugschwender and Bela Schafer, though that of de Forest is fully described. There are some questionable statements with regard to coherer methods and appliances. Here the author distinctly does not shine, for he is repeatedly caught depicting the Morse circuit tapped off through choking coils from the terminals of the coherer—a disastrous proceeding in practice. Marconi is given undue credit for the initiation of the receiving transformer as used with the coherer. For the development of it, such as it was, he is entitled to the credit, but he received the first suggestion from the British Post Office. The chapter on receiving-station arrangements contains one or two doubtful assertions, such as the statement that a high receiving aerial is at a disadvantage because it re-radiates the energy too quickly. Such a statement is distinctly open to challenge, at least in respect of the reason advanced. In the matter of resonance curves, the author follows the usual course of basing his conclusions as to the degree of selectivity attained between a pair of stations on the curves obtained by wave meter methods. If a method of tracing out the curves *at the receiving station* be used it will be found that, in the case of spark transmitters at least, the merging of wave lengths by the receiver so entirely swamps any ordinary differences in sharpness of resonance exhibited by the transmitter, from such causes as changes of coupling, that double wave emission is no longer traceable. This means that undue stress has hitherto been laid on the need for highly-tuned spark transmitters in order to avoid interference.

In the theoretical treatment of wave reception there is a rather remarkable and serious omission which calls for comment. The theory of arrest of waves by the receiving antenna and mode of extraction of wave energy from surrounding space, together with limitations concerned in the process (that is, the reverse of the actions which occur at the transmitting antenna), are not touched upon. Other omissions of a more excusable character are in respect of later developments of systems (German and other), developments of vacuum tube amplifiers and transmitters. Neither does the book contain precise information as to difficulties met and results given by long-distance communications, of which a considerable number have now been established for some time. Indeed, the degree of secrecy observed by all commercial undertakings in this matter carries with it a strong hint of disappointment.

In general, also, the perusal of the work gives the impression that whereas Prof. Zenneck is a reliable authority on transmitters and transmission effects, he is much less so with regard to receivers and receiving effects.

The book contains a vast amount of useful information, though many of the quantitative results of measurements are not yet ripe for full acceptance. They will bear much cross-check, by the application of entirely different methods, for their full confirmation.

Though some criticism has been made in the foregoing, there can be no doubt that neither engineers nor students can afford to ignore this work if they are to make the best use of available knowledge and improve British practice in many needful directions.

Useful tables, data, and a valuable bibliography of some 355 references to original papers and publications complete the work in a fitting manner. There is a number of minor slips or misprints in the letterpress, illustrations, and tables, many of which are, however, sufficiently obvious.—J. E. T.

The Telephone and Telephone Exchanges: Their Invention and Development. By J. E. Kingsbury. London: Longmans, Green & Co. Price 12s. 6d. net.

Twenty years ago Mr. Kingsbury said "it was quite impossible to deal with any question of early telephone history without quoting Mr. Lockwood." Henceforth, it may safely be said, no one dealing with telephone development generally can avoid reference to Mr. Kingsbury.

In the introductory chapter the earliest attempts at the transmission and amplification of sound are summarised, and we are led from the Otacousticon exhibited at the Royal Society in 1668 to the views of Sir Charles Wheatstone on the subject of molecular transmission of sound waves. There, however, the matter remained until the advent of the Bells, father and son, when electricity was called upon to aid in the transmission of speech; and in this connection it is interesting to read the letter of Graham Bell, written in 1875, to his parents, describing an interview he had had with Prof. Henry, in which he states that he frankly admitted to Henry that he did not possess the electrical knowledge necessary to overcome the difficulties which he saw before him, and got for answer the laconic reply, "Get it." The world little knows how much it probably owes to these two words, spoken at a time when Bell was living in an atmosphere of blank discouragement. To-day we read (Elec. Rev., January 7th, 1916): "Dr. A. Graham Bell conversed with his assistant of 1876, Mr. T. A. Watson, over 3,400 miles of line between New York and San Francisco"!

Nine chapters are devoted to the development of the telephone and its eventual employment for commercial purposes. Chapter IX deals with the inception of the telephone exchange, suggested in the first instance by Dumont, of Paris, who took out a British patent in 1851 for the interconnection of telegraph lines through a central office. In 1881 the first Post Office exchange in this country was opened at Swansea.

The evolution of the variable resistance transmitter and microphone is dealt with, and the work of Hughes, Edison, Blake, and Hunnings in this field is adequately summarised.

Passing over the sections on Philip Reis, call bells, switchboards, &c., we come to that which deals with the advent of the telephone in Europe, the commercial developments of which "were initiated by American patentees assisted by a few influential and far-seeing people in each country."

Pages 207-11 are of peculiar interest inasmuch as they depict the official attitude in this country towards the telephone in 1879. In that year Sir Wm. Preece—then Mr. W. H. Preece—giving evidence before a Select Committee in the House of Commons, in answer to Lord Lindsay's question, "Do you consider that the telephone will be an instrument of the future which will be largely adopted by the public?" answered "I do not." This was the view of the Electrician to the British Post Office, and though it is always safe to predict after the event, yet had Preece recognised the potentialities of the instrument, and had the Department purchased the Bell patent which was then offered it, how differently might not its policy have been affected in the years that were

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to follow. But Preece's opinion appears to have been formed from a consideration of the inductive troubles to which the instrument was subject, and which at that time appeared insuperable, and remained so until Brooks, in 1881, patented the metallic circuit and solved the problem.

Chapters on multiple switchboards, line construction, the evolution of the dry core cable, and early exchange systems are followed by a chapter on telephone engineering on a scientific basis, in the course of which Mr. Kingsbury refers to the acute diversity of opinion which obtained in 1896 on the merits and demerits of the vertical and horizontal switchboards. We recall that in the discussion of Mr. Dane Sinclair's paper, the author and Mr. Preece were the two most prominent opponents of the flat board; but Mr. Kingsbury studiously avoids any reference to Mr. Preece's moral objection, or to Mr. Sinclair's effective rejoinder!

Fairly long chapters on branching systems and the common battery system lead up to the "Automatic," the treatment of which, on account of its brevity, will prove disappointing to many of our readers; but as Mr. Kingsbury says, "It has been preferred to give in greater detail particulars of the earlier work and to discuss the general principles involved in the later developments," and, in connection with the controversy still being waged on "Auto" *versus* "Manual," he adds, "results cannot be recorded for some time yet, and any definite forecast is to be deprecated."

An echo of another famous controversy is to be found on page 433, where we have retold the duel between Mr. Preece and Prof. Silvanus Thompson on the essential elements in long-distance transmission.

In pages 430-35 Preece's K.R. law and Heaviside's biting criticism of the same are brought under review. Pupin's practical application of loading coils to telephone circuits is discussed, and in this connection it is interesting to read (page 441) of the demonstration given by Sir W. Slingo to members of the technical Press last year, of the transmission of speech over a loaded underground cable 660 miles long. No cross-talk was observable from the other wires in the cable, and immunity from disturbance was absolute and complete.

An interesting chapter is devoted to the first Anglo-French telephone cable, designed by Mr. H. R. Kempe, late chief electrician to the Post Office, and is accompanied by a unique illustration of the late King Edward speaking his congratulatory message to the President of the French Republic. Our older readers will have no difficulty in identifying the various personalities forming his *entourage* on that memorable occasion.

The concluding chapters deal with instruments, rates, economies of the telephone, and the telephone and Governments.

Mr. Kingsbury is to be congratulated on the production of a book which, we do not doubt, will take the place in its own sphere that Sir Charles Bright's work occupies in submarine telegraphy.

A word of praise is also due to the publishers, Messrs. Longmans, Green & Co., on the general excellence of production which characterises the work throughout.—A. F.

Mechanical Technology. By PROF. G. F. CHARNOCK, M.I.C.E. London: Constable & Co., Ltd. Price 7s. 6d. net.

There is an interesting flavour even about the title of Prof. Charnock's book. It seems to suggest, by analogy with chemical technology, a wide and comprehensive field full of all sorts of attractive possibilities. And that suggestion is found to be borne out when we come to investigate this 635-page treatise "on the materials and preparatory processes of the mechanical industries." The reader is not likely to be disappointed in the author's attempt to bring together in one volume "a connected and systematic account of the chief operations underlying mechanical trades and handicrafts." Of course, the book is not exhaustive, nor is it intended so to be; but it is quite sufficiently encyclopædic for the average work-a-day engineer who wants to know briefly and quickly the "why and wherefore" of his materials and processes.

A workmanlike plan is adopted by the author in the arrangement of his matter. Thus the chapters comprising Part I discuss "the production and properties of the chief materials of construction," a big field, admittedly, since it covers iron, steel (including electro-thermic steel), alloy steels, non-ferrous metals and alloys, timber, stone, leather, and rubber, to mention but a fraction of a list of the things with which engineers have to deal.

Next comes Part II, where "preparatory processes depending upon the property of fusibility" are detailed. Here we find described the foundry, methods of moulding, production of castings, defects in castings and their remedy, this section being followed by a final one (comprising Part III) devoted to "processes depending upon the properties of malleability and ductility." These processes include forging, stamping, rolling, tube drawing, and the manipulation of sheet metal. Last of all, the author gives us a bibliography which makes it possible to see what books to turn to if fuller information than that given by the author is required. Altogether, we can strongly recommend Prof. Charnock's volume to all but the most advanced workers; and it is to be questioned if even they would not have to admit that a perusal of the book, and of its numerous and excellent illustrations, had taught them many things that they did not previously know, so extensive is the ground covered by the author.—G. S. S.

IGNITION MAGNETOS.

IN *La Revue Electrique* for March 3rd, Messrs. D. Nobili and G. Campos (engineers of the Italian "C.G.S. Co.") refer to the article of M. Armagnat, which was abstracted from the same journal in the ELECTRICAL REVIEW of October 15th and 22nd, 1915, and describe some experiments which they have recently made to determine the energy output of magnetos.

It being necessary to avoid wattmeter methods, and generally every method based upon the use of circuits directly connecting the high-pressure terminals in any way whatever, the authors adopted a direct method of measurement of the energy of the spark, with the help of a calorimeter. The instrument employed for this purpose (fig. 1) had a bulb filled with nitrogen at atmospheric pressure, containing a spark-gap with platinum points and a spiral of resistance wire, the latter being connected to an independent circuit and serving to calibrate the instrument with direct current. To any given height of the mercury column there corresponded a definite expenditure of energy, derived either from the heating of the spiral wire or from the spark passing between the platinum points. The speed of operation or rotation of the magneto gave the number of sparks per second.

The conditions of working of a magneto in connection with the calorimeter are obviously different from those under which the ignition spark passes in the cylinder of an internal-combustion engine, where the discharge takes place in inflammable gas under pressure; it is possible, however, not only to compare the performances of different magnetos by this means, but also to obtain results in all probability not greatly differing from those which correspond to the actual conditions of operation, for it is evident that the amounts of energy stored up in the magnetic circuit are equal in both cases. In fact, tests made with widely differing lengths of spark have given results not greatly discordant.

Measurements carried out with four snap magnetos for aviation motors at various speeds gave the results shown in fig. 2; other tests, made on magnetos with rotating armatures, are shown in fig. 3. These curves indicate that, at any rate in the case of the types of magneto experimented on, the energy per spark remains practically constant from low to high speeds, or, in some cases attains a maximum at a particular speed.

The authors state, also, that the minimum and maximum values obtained for the energy of the sparks are included between the limits calculated by M. Armagnat for the energy available in the magneto; they are, however, far removed from his maximum

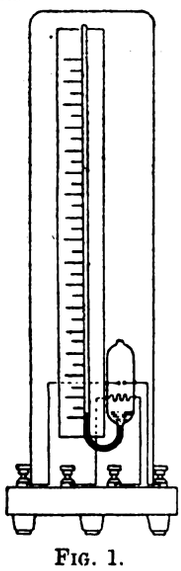

FIG. 1.

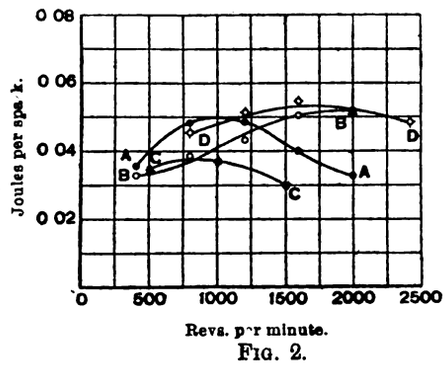

FIG. 2.

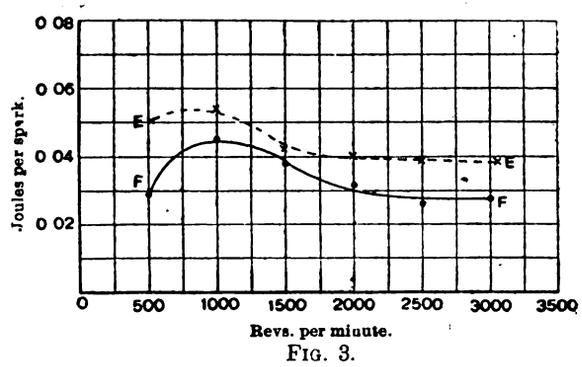

FIG. 3.

EXPERIMENTS ON IGNITION MAGNETOS.

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limit, showing that the apparatus has a low electrical efficiency. This is not a serious drawback, owing to the small quantity of energy that suffices for the ignition of even large engines; nor is it surprising, seeing that in the case of such a generator of electrical discharges, which are probably oscillatory, a large proportion of the energy is dispersed in the metallic masses.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

URUGUAY.—A Presidential Decree, dated January 25th, amends Articles 211-13 of the Consular Regulations, concerning the manifests of goods shipped to Uruguayan ports. Manifests must conform to the model annexed to the Decree, and must contain the following particulars:—

1. The class, flag, and name of the vessel, the name of the master, the ship's registered tonnage, the port of departure, and the Uruguayan ports for which bound;

2. The numbers of the bills of lading, the marks, numbers, quantities, kind and contents of the packages, the gross weight or measurement of the packages, and the net weight of each package;

3. The name of the shipper and of the person to whom the goods are consigned, or an indication that the bills of lading are "to order";

4. Country of origin of the goods (except for goods declared "in transit"); total value of the goods (if possible, expressed in Uruguayan gold pesos); freight rates (except in the case of goods declared "in transit"), and amount of freight paid.

Four copies of each manifest (instead of three, as previously) are to be presented to the Uruguayan Consular Agent, at least two of which must be drawn up in, or translated into, Spanish. Two copies of the manifest are to be "legalised" by the Consular agent.

In cases where Consular agents cannot obtain from shippers the particulars as to freight (see under 4 above), they are to calculate the figures at the rates current in their place of residence during the week in which the shipment is made.

Annexed to the Decree is a model of the certificate of origin which Uruguayan Consuls are empowered by the Decree of September 13th, 1915, to issue in respect of goods destined to be imported into Uruguay.

The provisions of the Decree came into force on April 1st, 1916; and the complete text of the Decree, and of the forms of manifests and certificates of origin annexed thereto, may be seen at the Commercial Intelligence Branch of the Board of Trade.

BRITISH INDIA.—*New Import Duties taking effect on March 1st.*—The general 5 per cent. tariff is raised to 7½ per cent. Certain classes of machinery and railway material, which were formerly free, are now subject to a duty of 2½ per cent., and motor lorries, formerly free, now pay 7½ per cent.

JAPAN.—A Government Bill has been introduced into the Diet proposing to modify the Customs duties on various articles imported, among which are the following. Proposed additions to the text of the Tariff are indicated by italics.

	Rate of duty. Present. Yen. Per 100 kin.	Proposed. Yen. Per 100 kin.
Brass and bronze bars and rods—		
(*a*) *For steam turbines*	7.55	16.00
(*b*) *Others*	7.55	7.55
Gas engines, petroleum engines, and hot-air engines—		
Other (each weighing more than 2,500 kilogs.)—		
Each weighing not more than 10,000 kilogs	5.00	5.00
Each weighing not more than 50,000 kilogs.	5.00	4.50
Each weighing not more than 100,000 kilogs.	5.00	4.00
Other	5.00	3.50
Dynamo-electric motors, transformers, converters, armatures, *and alternating current variable speed electric motors*	Rates unchanged.	
Dynamos combined with gas engines, petroleum engines or hot-air engines—		
Other (each weighing more than 5,000 kilogs.)—		
Each weighing not more than 10,000 kilogs.	5.80	5.80
Each weighing not more than 50,000 kilogs.	5.80	5.50
Each weighing not more than 100,000 kilogs.	5.80	5.20
Other	5.80	4.90

[Yen (100 sen) = 2s. 0½d.; 100 kin = 132.277 lb.]

GREECE.—In the issue of the REVIEW of March 17th particulars were given of a Decree providing for the duty-free importation into Greece of certain tools, machinery, instruments, and utensils of agriculture and the branches of industry connected therewith, *when imported by Agricultural Associations*. A further Royal Decree has now been issued providing that *all* the articles in question are exempt, on importation into Greece from abroad, for a period of four years from January 1st/14th, 1916, from State import duty, and from harbour, communal, municipal, or other tax.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

4,837. "Electrical batteries." E. A. BAYLES, F. J. BRISLEE AND BRITISH INSULATED & HELSBY CABLES, LTD. April 3rd.

4,853. "Electric fuses." H. B. PRENTICE. April 3rd.

4,859. "Sparking plugs for internal-combustion engines." W. TAYLOR. April 3rd.

4,865. "Sparking plugs for internal-combustion engines." J. J. CERASEY. April 3rd.

4,901. "Electric heating devices." L. HELLER. April 3rd. (Germany, July 16th, 1914.)

4,938. "Electric time switches." A. M. COATES. April 4th.

4,940. "Spur gearing." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.). April 4th.

4,942. "Automatic or semi-automatic telephone exchange systems." L. C. BYGRAVE & RELAY AUTOMATIC TELEPHONE Co. April 4th.

4,959. "Electrical means for producing musical notes." L. DE FOREST. April 4th. (U.S.A., April 24th, 1915.)

4,962. "Electrical driving, particularly for motor vehicles." H. CROCHAT. April 4th

4,981. "Electric diaphragm horns." W. R. CARTER. April 5th.

5,009. "Magneto-electric machines." C. L. BREEDEN & J. H. CHAMBERS. April 5th.

5,038. "Arc lamps." F. M. LEWIS. April 6th.

5,039. "Portable electric torches, &c." W. A. JACOBS & P. POLLARD. April 6th.

5,061. "Telephone instruments." E. A. PETITHORY. April 6th.

5,069. "Electrical hand lamps." S. FILDES. April 6th.

5,070. "Ships' telegraph, &c." A. FERGUSON & MECHANS, LTD. April 6th.

5,085. "Magneto-electric machines." M. COLLARD & J. W. MILLER. April 6th.

5,091. "Electrical circuit systems." E. C. R. MARKS (American Model and Instrument Co.). April 6th.

5,092. "Electrically bonding rail-ends." J. C. LINCOLN. April 6th.

5,163. "Electrically indicating presence of saline, alkaline, or acid impurities in feed-water for steam generators, &c." BROMELL PATENTS Co. & W. C. CROCKATT. April 8th.

5,171. "Electric fittings." J. GRAY & J. WILKIE. April 8th.

5,175. "Holders for arc lamp carbons, &c." A. W. BENNIS. April 8th.

5,194. "Accumulator cells, &c." C. C. RATTEY. April 8th.

PUBLISHED SPECIFICATIONS.

1915.

2,697. ELECTRIC MAXIMUM CUT-OUTS. G. J. Van Swaay & H. I. Keus. February 19th. (Convention date not granted.)

3,841. SYSTEMS OF ELECTRIC SHIP PROPULSION. British Thomson-Houston Co. (General Electric Co., U.S.A.). February 22nd.

4,138. ELECTRIC CONDUCTORS, CABLES, AND THE LIKE. Herbert Terry & Sons, Ltd., and C. Terry. March 16th.

4,230. WINDING MACHINES FOR WINDING ELECTRICAL COILS. H. Wade (J. R. Leeson). March 17th.

4,285. AUTOMATIC TELEPHONE EXCHANGE SYSTEMS. C. A. W. Hultman. March 18th. (March 18th, 1914.)

4,483. FUSIBLE ELECTRIC CUT-OUTS. F. B. Dehn (Schweitzer & Conrad). March 22nd.

4,595. PROTECTION OF ALTERNATING-CURRENT ELECTRIC SYSTEMS. British Thomson-Houston Co. & E. B. Wedmore. March 24th.

4,664. MAGNETO-ELECTRIC MACHINES. British Thomson-Houston Co. & A. P. Young. March 25th.

4,675. MINE AND OTHER ELECTRIC SIGNALLING SYSTEMS. Sterling Telephone and Electric Co., Ltd., F. G. Bell & H. W. Barclay. March 25th.

4,738. PROTECTION OF ALTERNATING-CURRENT ELECTRIC SYSTEMS. British Thomson-Houston Co. & E. B. Wedmore. March 26th.

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THE
ELECTRICAL REVIEW.

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INDUSTRIAL FATIGUE.

ONE of the most interesting and important classes of scientific investigation that have attracted attention in recent years is that which relates to the psychological and physiological conditions of labour, and their bearing upon the output and physical well-being of the worker. The subject has been studied from various aspects—from the points of view of the works manager, the professional psychologist, and the social economist—and many valuable deductions have been made from the data accumulated by experiment and experience. Mr. F. B. Gilbreth, an American engineer, was early in the field with his extended researches into the elimination of wasted effort, the results of which were embodied in his classic work on "Motion Study," a book which ought to be in the hands of every works manager and foreman; particularly in view of the supreme necessity with which we are now confronted, of economising labour and increasing output to the utmost, is it desirable that the lessons taught in this book should be laid to heart and carried into practical effect by every manufacturing firm, and we should be glad to see instructional classes established for the promulgation of the ideas which Mr. Gilbreth has developed. The point of view of the psychologist is admirably set forth in "Psychology and Industrial Efficiency," by a German-American, Prof. Hugo Münsterberg. This author studied the application of psychological experiment to the service of commerce and industry; whereas Gilbreth was concerned with the movements of the limbs and body of the workman, Münsterberg investigated the operations of his mind, the mental qualities and peculiarities of individuals, and the fitness of each person for his chosen vocation, together with the numerous problems arising out of these researches. This, again, is a work with which every manager should be familiar.

Within the past year the Health of Munition Workers' Committee has made a study of the causes and effects of industrial fatigue, the fruits of which have been embodied in a Memorandum that has recently been issued, and in this case not only the production of the workman, but also its reaction upon his person have been considered, with scientific thoroughness. We are taught that industrial fatigue is a nervous not a muscular phenomenon, and that by the proper organisation of periods of work and rest the nervous system may be so trained as to attain far higher efficiency than could otherwise be reached. It is to this aspect of the industrial problem that we wish to direct particular attention.

The bodily sensations which suggest to us the onset of fatigue have in fact little to do with the question; real fatigue "is shown and is measurable *by the diminished capacity for performing the act that caused it.*" The fundamental condition for maximum efficiency—that is, maximum output combined with the maximum of comfort and health to the worker—is the proper alternation of work and rest periods. This is one of the conditions laid down by Mr. Gilbreth also.

Rest should not be deferred until symptoms of muscular fatigue appear, for nervous fatigue commences to show its effects before the former by an unobserved but measurable slackening of speed.

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Moreover, if the fatigue is allowed to progress too far, its effects cannot be dispelled by the normal period of rest, but will be felt during the following work period. Hence such conditions of working are wasteful and should be avoided.

In the report before us, emphasis is laid upon the fallibility of mental impressions as to output and upon the necessity of measurement in order to obtain reliable guidance; this is a very significant circumstance, for it reveals the fact that empirical methods and guesswork are being replaced by scientific methods of investigation. Accurate measurement is the foundation stone of all branches of science; some subjects of study cannot readily be subjected to measurement, and have consequently remained to this day in what Lord Kelvin used to call the "natural history" stage of development, whilst others, more amenable to measurement, have long been on the "natural philosophy" plane. The fact, therefore, that measurement is now seen to be essential to the securing of reliable results in the study of industrial fatigue indicates that great progress has been made towards its scientific treatment.

We have not space here to quote freely from this valuable report, but may say that results described as "astonishing" have already been gained *in other countries* by the application of experiment; that reduction of working hours and the adoption of a week-end rest have been proved to increase the output of workers to an extraordinary degree. Not only is slackness—or rather staleness, for it is observed in the most willing workers—an inevitable accompaniment of long hours and lack of rest, but also the effect upon the physical condition of the workmen is deplorable.

It is stated in the report that management based upon the experimental science of industrial fatigue is far less common in this country than in the factories of America and Germany; this is a grave circumstance urgently demanding a remedy, and we earnestly commend the document to the attention of all works managers, in the hope that they will profit by its teachings; we cannot afford to be handicapped in the industrial conflict which is impending. The subject has also been dealt with by a committee of the British Association, and references to publications bearing upon it will be found in our "Notes" to-day.

BUSINESS-GETTING ABROAD.

It is an extremely difficult matter at the present time to gauge the general industrial situation. There are certain sections of manufacturing, including parts of the electrical branch, which, if rumour be trustworthy, are experiencing a slight falling off in orders from the Government, while others report a drop in Colonial and foreign demands. The former, it is thought, may be due to the new Government munitions factories being now ready to assist materially in meeting the needs of the Forces, thus rendering private works less indispensable than they have been. If it be correct it may be only temporary—but who outside the charmed circle can say? If it is not temporary it means that the released factories, or part thereof, may be freer to undertake ordinary manufacturing business, assuming that sufficient suitable labour remains available after the Government draughts for the Forces and the Factory have been satisfied. The falling off in Colonial and foreign demands—if there be such a drop—may be due to the growing impression abroad that British manufacturers are unable to handle export business, or that the available shipping facilities are insufficient; it may be due to a definite fall in requirements owing to works being deferred; but it is little use trying to guess the causes until we know for a fact that there is an actual drooping of electrical export demand, for information from some of the Colonial markets and from Russia shows clearly that the shelves of the electrical stores are empty and that supplies of certain classes of goods are sold before they arrive; traders want all that they can get. The electrical export values for the last few months ought to be known in all our markets, to show purchasers how well we are maintaining such business. The shipping difficulty is undoubtedly a great one, and our trans-Atlantic cousins, whose assistance we appreciate, have not been slow to observe the adverse effect upon us, and the favourable effect upon themselves, of the great delays that have been involved in obtaining export permits from our Government departments. If export trade helps us to finance the war, the granting of permits should be speeded up. Indeed, everything that is possible should be done to convince the outer markets of our ambitions to supply their needs. Reference to speeches delivered at one of the cable manufacturing companies' meetings shows that the trading of the past year has raised the serious question whether refusal of orders under the stress of war conditions will mean loss of goodwill ultimately. In normal times it is easy enough to lose export connections; we remember the times when a good foreign connection having been made, a happy and prolonged relationship followed; there was little foreign competition in those days—the world naturally turned to England. Recently, even in peace-time, a foreign connection had to be continually nursed. In war-time, connections have had to be sacrificed, not at the bidding of competitors, but at the snorting of the war-horse. Can such connections be regained? What will happen in that matter will depend upon the hold that other manufacturing nations are able to gain while we are otherwise engaged, and upon whether such a service will be given at such a price that there shall be no inducement to change again. Of the activity of these other nations in pursuit of current business there is in our mind no doubt whatever. Reports from the different markets are a fairly safe guide, though we are interested to gather from an article in the *Daily Telegraph* that Mr. Edgcumbe Brighten, who has lately returned from the United States, finds that American business men are too concerned in reaping the harvest of the present trade boom to concern themselves with preparations for capturing overseas trade after the war. The present activities—apart altogether from anything special which may follow—must, however, be reckoned with, and British manufacturers cannot afford to allow any wrong impression regarding their future intentions to gain currency. We are told to-day on one hand that our engineering manufacturing capacity has been so greatly increased during the last twenty months that we shall have little difficulty, allowing for due adaptation, in meeting an enormously increased demand. This view was supported recently by Mr. G. Sutton in expressing his views regarding the future of the cable manufacturing industry, and he, as an experienced leader of the electrical industry, is entitled to our listening ear when he suggests as one possibility of such increased capacity, a cutting of prices between cable-makers. That is of course assuming that there will not be enough business available to keep all the works fully occupied. Mr. Sutton is a man who knows the world—we mean he is as capable as anybody of judging the prospects for future business in other countries, having, to his company's credit, among other things, the booking, just prior to the war, of perhaps the biggest export orders for electric power and traction cables—for Australia and South America—ever received in these islands. There is another view that is put forward, namely, that so huge will be the demand from the British Colonies and Dependencies,

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from Allied countries and from neutral markets, almost immediately the war concludes, that we shall be unprepared to meet it satisfactorily. And between these two views there interposes the uncertainty as to the position that Germany and Austria will be permitted to occupy as electrical exporters after the war. Now if Mr. Sutton's view respecting the cable trade holds good in regard to other branches of electrical and engineering industry, one of the most urgent of all demands upon us is to take every precaution to strengthen and extend the selling organisation and keep ourselves well to the fore—even in these days, when we can only with difficulty meet the demand—in those parts of the world where we desire to trade. We may thus be ready to secure an increased demand which shall help to prevent the need for competitive cutting. If next we consider the interposing factor—possible resumption of German competition in some Colonies and present satisfactory neutral markets, we see again the necessity for following up our industrial organisation at Home with a boldly conducted campaign of salesmanship and publicity so that British ability and British quality shall be common knowledge among purchasers everywhere. Or, again, if we consider that the industrial menace of Germany will be broken at Home and in the Colonies and Allied countries so that the demand upon the new England's factories will be almost overwhelming, we shall still do well if we see to these important commercial aspects of our affairs. The British manufacturer needs to do more to impress the buyer abroad. The latter wants to know who's who; where he can buy this and that; and something about the suppliers and their works and ways. Our readers will think that we are reiterating a very old piece of our own trade advice. We do so because the present situation seems to us to call imperatively for a most spirited and energetic salesmanship and publicity policy on the part of the greater part of the industry. Our co-operative schemes are excellent—as far as they have gone; our discussions as to what we want, or ought, to do, or what somebody else ought to do, have been good, and we hope that their influence will spread; but we have yet to be convinced that there is an earnest, well founded, and general effort being made with a view to assuring that the Colonial and foreign markets shall yield us such a volume of business as shall make it possible to utilise to the full all the added factory capacity, after the war. What *is* the use of talking further about a Ministry of Commerce and other matters of the same class and *waiting*? We have got to help ourselves, and a strong self-help policy throughout the industry would mean definite action now to draw definite business later. Why not use part of the war profits now being earned, on this very reasonable expenditure? The war has disorganised ordinary business; to place it on a proper footing again certain measures of reorganisation will be essential; those measures will involve higher commercial activity, the cost of preparing for which can surely be treated as a legitimate working expense!

The Electrical Trade After the War.

An important announcement has just been issued by the President of the Board of Trade. The Committee which is to consider and report upon the position of the Electrical Trades after the war, with special reference to international competition, and is to indicate what steps, "if any," are necessary or desirable in order to safeguard that position, has been appointed. Sir Charles Parsons, F.R.S., of turbine fame, and of C. A. Parsons & Co., Ltd., of Heaton Works, Newcastle-on-Tyne, is to be chairman, and the other members are:—Mr. J. Annan Bryce, M.P., Chairman of the British Westinghouse Electric and Manufacturing Co., Ltd., whose views on our trade relations with the enemy after the war, expressed at the annual meeting of that company, and reported in our issue of April 14th, page 431, assume an added interest by reason of his appointment; Mr. T. O. Callender, managing director of Callender's Cable and Construction Co., Ltd., who is also connected with several leading electric power companies and other undertakings, and who, by his long practical experience of the industry, is pre-eminently fitted to assist in these important trade deliberations; Mr. James Devonshire, A.I.E.E., managing director of the London United Tramway Company, who, as a director of a number of other power and tramway undertakings connected with the B.E.T. group, is well versed in matters relating to finance; Mr. Bernard M. Drake, M.I.E.E., chairman of the well-known business of Drake & Gorham, Ltd., and of the D.P. Battery Co., Ltd., who has known the electrical industry intimately for a very lengthy period; and Sir John Snell, a past president of the Institution of Electrical Engineers, and member of the eminent consulting engineering firm of Preece, Cardew, Snell & Rider. All communications for the committee should be addressed to the Secretary, Electrical Trades Committee, 7, Whitehall Gardens, S.W. Our only comment at the moment is that we hope that the committee have power to add to their number.

Lead.

The position of lead has continued to be the subject of considerable interest. Between the restrictions imposed upon trading by the new regulations and the growing scarcity of supplies consequent upon the general small arrivals for some time past, the market has been quickly affected by the least sign of buying or selling pressure, which is only natural at the rather dangerously high level of prices. Fundamental conditions, however, have remained quite strong. The outlet for the manufacture of war munitions is certainly as big as ever, against which there is as yet no indication of freer supplies from the chief producing countries. War requirements in Allied countries, such as France, Italy, Japan, and Russia, being to a notable extent covered direct, this tends to restrict the tonnage diverted to home ports, and with America having but little to spare for shipment to this side, it is hardly likely that the big deficit in our imports so far this year as compared with last, will be made good for some time at any rate. The absence of a free market for the commodity due to the drastic action on the part of the authorities intended to restrict operations to bonâ-fide business, had at the same time proved a serious drawback for lead manufacturers. The latter, indeed, now find considerable difficulty to cover themselves by forward purchases against new forward contracts for their products. Dealers do not care to make forward sales which might be regarded as speculative and involve them under the Defence of the Realm Act. "Hedging" operations of this kind on the part of manufacturers are as a rule of frequent occurrence, but they are now almost impossible, so that trading in manufactured products is likewise suffering. After a renewed rise recently up to about £35 10s. for early shipment with a fair amount of business, the market just prior to the holidays reacted to well below £35, but there has been no great pressure to sell, although fair quantities of metal near at hand came on the market. There has been no material change in the American position, which remains firm, although prices have eased to well under 8 cents per lb., and the equivalent of prices realised in America continues pounds a ton above those ruling in this market. There has been very little American lead shipped to this side for some time past against old contracts. Operations in Mexico are virtually at a standstill, and the position in Spain is still anything but satisfactory.

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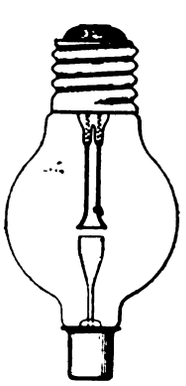
GAS-FILLED RECTIFIERS.

In the *General Electric Review*, for April, an account is given of recent progress in connection with the hot-kathode argon gas-filled rectifier, by Mr. G. S. Meikle, of the Research Laboratory of the General Electric Co., U.S.A. The kenotron and the Coolidge X-ray tube, which have been described in the Electrical Review, employ the phenomenon of electronic emission, or "thermionic current," in bulbs from which all residual gases have been eliminated; in these high-vacuum types of apparatus the current is limited by the "space charge effect," of the nature of a back E.M.F., which is manifested by a drop of voltage in the kenotron, used as a rectifier, of the order of 100-150 volts, so that this device cannot be used on low-voltage circuits, though it is capable of supplying rectified currents up to 250 milliamperes at pressures up to 100,000 volts. The "space charge" is due to the electrons emitted from the hot kathode, which produce an electrostatic field around it which limits the motion of electrons towards the cold electrode; but in the presence of positive ions the space charge is more or less neutralised. By introducing minute traces of gas into the kenotron under certain conditions, a sufficient number of positive ions may be formed to neutralise the space charge completely, thus greatly reducing the voltage required to set up a given current. The nature of the gas is important; oxygen, whether free or combined, cuts down the emission of electrons from a pure tungsten kathode, but inert gases have no such effect. But with minute traces of gas present the positive ions acquire a very high velocity, and, striking the kathode, bring about its rapid disintegration. When the pressure of the gas is increased, the velocity of the ions is diminished, but their number is so much greater that the effect of their bombardment may be even more disastrous than with minute traces of gas present. Investigations covering a period of several years have revealed the conditions that must obtain in order to prevent kathode disintegration and other detrimental effects; by proper adjustment of the pressure of a suitable gas, disintegration has been eliminated, and it has also been found possible to secure conditions under which the emission of electrons from the kathode has been sufficient actually to cool it, when rectifying excessive currents. As a result of these investigations, in fact, it has been demonstrated that "a rectifier filled with gas at pressures within a more or less definite range can be designed to rectify currents from a few milliamperes to exceedingly high values, at voltages varying between several volts and several thousand volts."



Figs. 1 and 2.—Low-Current Rectifier.

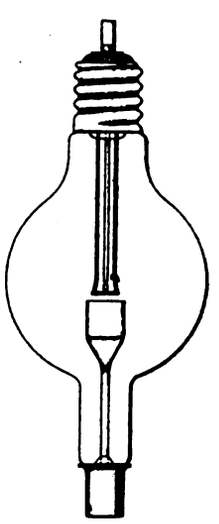


Fig. 3.—High-Current Rectifier.

Fig. 1 shows a sketch of a rectifier in which the kathode consists of a filament of small tungsten wire coiled into a closely wound spiral, and a tungsten anode of relatively large cross-section, with a comparatively smooth surface. The filament ends are welded to heavy tungsten wires, while the anode lead is swaged from, though still a part of, the anode. All leads are sealed directly through the high heat-resisting glass into 3-in. spherical bulbs of a similar glass. Although the anode of the tube shown consists of tungsten, other materials have been used with good results.

The rectifier shown in fig. 2 differs only in the shape of its parts. The kathode is shown as a straight filament of small tungsten wire, which, if properly proportioned and mounted, consumes a minimum of energy for a maximum number of electrons emitted. The anode is shown in the form of a thin disk, made large in diameter, to give a big radiating surface, which is found to be desirable when such metals as copper are used.

Fig. 3 illustrates a gas-filled rectifier designed to rectify high currents at low voltage. Two kathodes are shown; one is in filament form identical with that shown in figs. 1 and 2, and is used for starting; the other is a tungsten rod kathode with beaded tip (the middle rod), used during the operation of the tube. The constriction between the bead and the lead suffices to prevent conduction of heat from the tip. The object of using such a kathode is to secure a long operating life. Any disintegration, unless very severe, has no appreciable effect upon the life and operation of a rectifier of this design. A graphite anode mounted on a heavy tungsten lead is shown, as graphite has been found to be a very desirable anode material for rectifying high currents. All leads are sealed directly through the glass, and, for currents between 20 and 45 amperes, into a 5-in. spherical bulb.

All tubes are carefully exhausted and filled with gas in a high state of purity. Certain impurities, even though present in small quantities, produce a very rapid disintegration of the kathode, and also have a very marked effect upon the voltage characteristics of the rectifier. It is advisable in certain types of gas-filled rectifiers to introduce substances which react chemically with such impurities as are introduced with the gas, or are given off by the parts during the operation of the rectifier. The reaction which occurs keeps the gas in a pure state. It is found convenient in certain types of the low-current rectifier to introduce the purifying agent in the form of an anode. As the impurities are distilled from the anode or kathode, or from the over-heated glass parts, the arc drop increases. The increased energy consumption automatically causes evaporation of the anode material until the high state of purity is re-established, when the evaporation ceases. In figs. 1, 2, and 3, the purifying agent is shown as a coil wound around one of the leads.

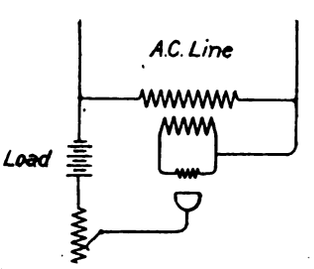


Fig. 4.—Connections of Half-Wave Rectifier.

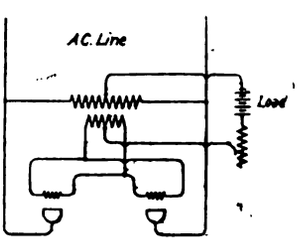


Fig. 5.—Two Half-Wave Rectifiers Connected to Rectify the Whole Wave.

During ageing it is evaporated, and re-deposits on the sides of the bulb, carrying with it the impurities in their respective chemical combinations.

The experimental work with argon indicates that rectification is possible in all pressures of gas. With an increase in the gas pressure the potential at which the arc is established increases. At the higher pressures, the temperature of the filament is also a factor in determining the starting voltage. After the arc is formed, the arc drop increases very gradually for big increases in gas pressures. For the low-voltage tubes a pressure of argon between 3 and 8 cm. (measured cold) gives very good results and is therefore used.

The half-wave type shown in figs. 1-3 has the advantages of simplicity of construction and installation. A typical circuit, consisting of a 40-watt transformer for filament excitation, a load, and a regulating resistance, is shown in fig. 4. If high efficiency is necessary, the line voltage is transformed to a value which enables regulation to be dispensed with. Two half-wave rectifiers can be connected as in fig. 5, thus using the whole of the alternating current; the compensating transformer is designed to transform the voltage to the desired value and to supply current for exciting the filament. Where the load can be divided, as in battery charging, the half-wave rectifiers with their individual loads can be connected up so that half of them are rectifying one loop of the wave, and the other half the other loop, thus attaining the same result.

Fig. 6 shows the full-wave gas-filled rectifier, with two anodes and a common kathode, which is used with the circuit shown in fig. 7.

The rectifier illustrated in figs. 1 and 2 has the advantage of being self-starting. In the low-current rectifier the kathode filament is excited continuously during operation, though the tube would continue to act as a rectifier when the arc was formed without external excitation, the balance of advantage resting with the former method; in the high-current rectifier, however, the filament is used only for starting. A three-pole switch closes the filament circuit, and also connects it with the anode; the gas is immediately ionised, and current begins to flow to the operating kathode, which is acting temporarily as anode. When the latter

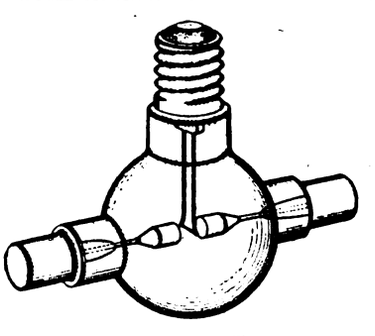


Fig. 6.—Full-Wave Rectifier.

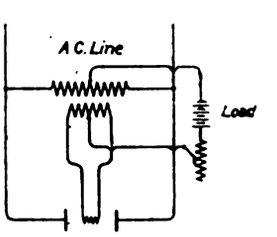


Fig. 7.—Connections of Full-Wave Rectifier.

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becomes hot enough to emit electrons, the rectifying arc is established between it and the anode. The tube can be made to start automatically by placing a D.C. relay in the rectified-current circuit, which opens the three-pole switch when the arc is formed.

When constant purity of the gas can be relied upon, the filament is used both as a starting and as an operating kathode, even in the high-current rectifier. Rectified currents as high as 80 amperes have been drawn from a tungsten filament 20 mils in diameter for short periods, without injury to it. But, in general, it is advisable to use the point kathode.

The persistency of ionisation in argon seems to be particularly marked, and this makes it possible even without filament excitation to use the rectifier for supplying current for very low frequencies. For the same reason, it is possible to operate the tube on very low current when the kathode is not externally excited.

No auxiliary starting load is required when beginning a battery charge. The supply switch is closed and the charging current picks up immediately, giving a slightly tapering charge as the battery voltage increases. On a resistance load, the current is very constant, due to the fact that the kathode spot does not wander.

The efficiency of the tube depends upon the supply voltage, increasing with it as the voltage become higher, and upon the energy consumed in the arc, indicated by the voltage drop. The arc drop of the low-current low-voltage rectifier, in which the filament is externally excited, is between 4 and 8 volts, measured on a direct-current circuit. The power consumed in keeping the filament kathode hot enough to produce initial ionisation is less than 40 watts. Therefore, for a 6-ampere tube the energy consumed by the arc and filament is equivalent to that of a rectifier having an arc drop of 10·66 to 14·66 volts. The actual drop in this tube without filament excitation is, however, somewhat higher than indicated by these values.

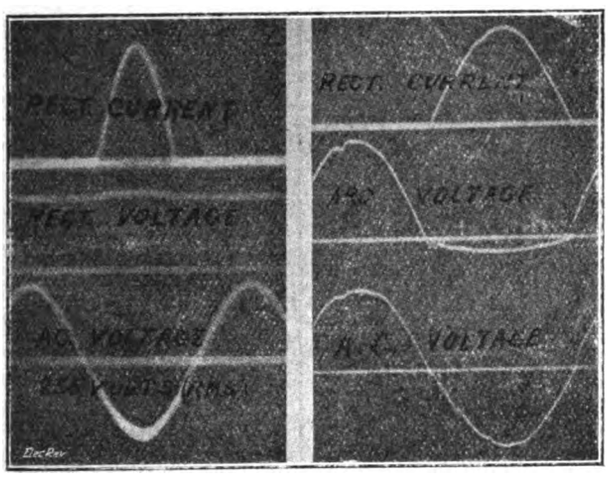

Fig. 8. Fig. 9.

Fig. 8.—Rectifier Charging Ignition Cells; 6·1 Amps.

Fig. 9.—Rectifier Containing Purifying Agent; 29·6 Amps.

The tube operates satisfactorily on current ranging from a fraction to many amperes. With a properly excited kathode, the rectifying arc is started on alternating-current supply voltages as low as 20 volts and is maintained on voltages as low as 14 volts.

The life of the low-current low-voltage rectifier, upon which the greater part of the work has been done, varies from 900 to over 3,000 hours. Some of the high-current half-wave tubes have a life of over 1,000 hours, and many of 500 hours. Many of the low-current tubes have been in actual service for over 18 months charging batteries at central stations. In a case that is cited, a rectifier was charging 89 cells at 6·2 amperes; the D.C. voltage was 224 volts (average value) over the cells, and 236 volts (average) over the cells and regulating resistance; the A.C. voltage was 236 volts (root-mean-square value). A larger number of cells could have been charged by reducing the resistance to zero.

Fig. 8 shows oscillograms obtained from a rectifier charging a battery; the upper curve represents the rectified current (6·1 amperes D.C.), the middle curve the voltage across the battery terminals, and the lower curve the A.C. voltage. In fig. 9, from a rectifier containing an active purifying agent, the top curve represents the direct current (29·6 amperes), the middle curve the voltage across the arc (inverted), and the bottom curve the A.C. voltage. It will be seen that rectification in each case was perfect.

Magnetic Survey.—According to a telegram received by the U.S.A. Department of Terrestrial Magnetism, the *Carnegie*, under the command of Mr. J. P. Ault, arrived at Port Lyttelton, New Zealand, on April 1st, having successfully completed the circumnavigation of the globe between the parallels 55 degrees south and 60 degrees south. Errors in the existing magnetic charts to the extent of 12 to 16 degrees were found.—*Science*.

METER ERRORS IN PARALLEL SUPPLY OF FLUCTUATING LOADS.

Though complete electrification of factories and workshops, using central station supply, has become almost standard practice so far as concerns new installations, there are still a number of works in which such a considerable amount of mechanical driving equipment or electrical generating plant is installed and working with such high efficiency, that the problem of providing for further power requirements becomes one of special difficulty. On a simple basis of fuel and working costs, the central station engineer can generally show a material saving to the works' owner in purchased as compared with home-made electrical energy, but the question of capital cost of conversion is a serious item, particularly in a large works where the existing plant is still in good condition. It is easy to prove that extending the private generating plant would be poor policy in most cases, so that the only alternative to immediate and costly scrapping is to use purchased current for all extensions of load, and keep the existing plant working till analysis of costs shows that it would be cheaper to replace it by purchased energy.

During the intermediate period, when purchased current is being used to supplement home-made mechanical or electrical energy, the two sources of supply are connected in parallel—either electrically, by connecting the public and private mains to a common bus-bar; or mechanically by using, say, the private steam engine and an electric motor supplied from the public mains to drive a transmission system which is mechanically continuous. Under such circumstances the works would look after its own prime mover and generator (if any), and the central station would charge for supplementary energy supplied. In practically all cases this supplementary supply would be sold by meter on a sliding scale,

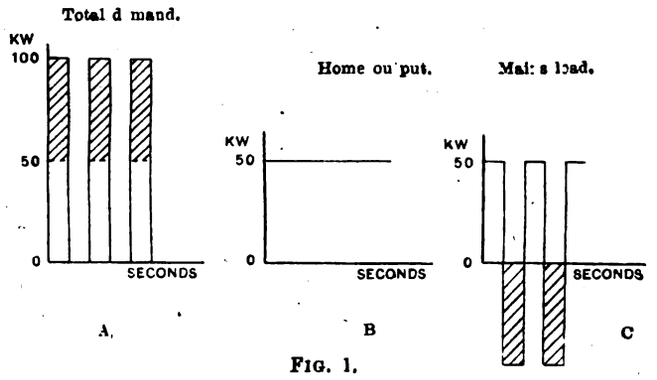

Fig. 1.

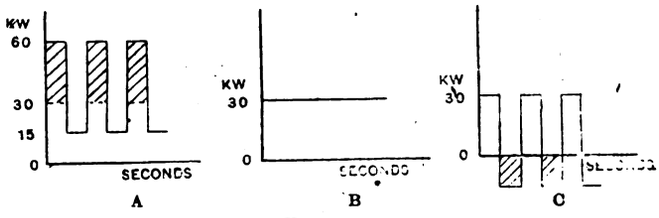

Fig. 2.

From mains, clear; to mains, shaded.

and it is important to note that the readings of a meter used under such circumstances are liable to be anything up to 100 per cent. slow, due to reverse running during low load when the load curve is very fluctuating.

On steady or reasonably steady loads the trouble does not arise, but if a rapidly fluctuating load is concerned (as in textile mills, particularly spinning mills) the private power plant runs at full output continuously; the central station supply is drawn upon during the peaks of the load curve, and more or less of this amount of energy is returned during the troughs of the load curve. As an example (from a paper in *Elektrotech. u. Maschinenbau*), the two cases represented by figs. 1 and 2 may be considered. The left-hand diagram in each case represents the total demand to be supplied. In fig. 1A it amounts to 100 KW. for 1 second and zero for 1 second; if the output of the private generator be constant at 50 KW., the demand on the mains during one-half of the load cycle is replaced during the next half, so that the net meter reading is zero, and the works owner gets the benefit of peak load assistance for nothing. In fig. 2 the load varies periodically between 60 and 15 KW., and the private output is 30 KW. (constant), so that in this case the replacement is less than the withdrawal (see fig. 2C), but the meter still has a large negative error. The conditions in the two cases and the total deficiency in meter reading per hour of working under these load curves, are summarised in the following table:—

	Case (1).		Case (2).	
	Peak.	Trough.	Peak.	Trough.
Total load, KW.	100	0	60	15
Home generated, KW. ...	50	50	30	30
Taken from mains, KW....	50	—	30	—
Supplied to mains, KW....	—	50	—	15
Deficiency in meter record, units per hour... ...	25		7½	
Meter error, per cent. ...	100		50	

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In general, if K_1 = power taken from the mains during the peak load; K_2 = power supply by private plant; and K_3 = minimum power demanded during the trough of the load curve; the meter record is actually—

$$w = K_1 . t_1 - (K_2 - K_3) . t_2$$

where t_1, t_2 = durations of peak and trough periods respectively. Hence, the percentage meter error is—

$$p = (1 - w/K_1 t_1) \times 100 \text{ per cent.}$$

One way of obviating error due to reversal in the above manner is to provide the meter with some form of locking gear which prevents the armature making more than one backward revolution, but even so it is possible to lose a great deal of revenue in the course of a year where the load fluctuates so rapidly, and one revolution of the meter disk corresponds to so much energy, that one revolution or less represents the energy drawn from the mains during one peak period, and returned more or less completely during the succeeding trough period. The best method of overcoming the difficulty is to provide such fly-wheel inertia in the plant to be driven that the peak demand from the mains is reduced, and the private generating equipment is kept busy on the load itself or in bringing the fly-wheels up to speed. The circuit conditions are equalised without troublesome equalising currents flowing.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

"Mazda" Shade for Subdued Lighting.

The more stringent regulations lately enforced by the authorities as to the lessening of outward illumination from shops, offices and private residences have made it necessary for every individual lamp to be shaded. A neat and effective screen of attractive appearance is being issued by the BRITISH THOMSON-HOUSTON CO., LTD., Mazda House, 77, Upper Thames Street, E.C., and any number in reason will be supplied to business firms, contractors, and retailers upon request. The shade is posted flat, and is made up of stout dark-coloured card, with stencil cut-out lettering backed by orange-tinted paper. The shade can be placed over any electric lamp without removing the latter, and if an ordinary fancy glass shade is used the "Mazda" shade will go over it. To place the screen in position, the two wings are locked together around the holder, this movement causing the shade itself to assume a curved form, thus shutting off the direct light rays from about one-third of the circumference of the lamp.

Timber-Piling Machine.

A portable electric machine for piling timber, patented by Mr. H. C. Hilke, is being made by the SEATTLE MACHINE WORKS, U.S.A. It consists of a lattice steel tower from 24 to 40 feet high, over which runs a continuous chain elevator, lifting planks on one side, carrying them over the top, and lowering them on the other side, where they are taken off at any desired height by the men building the pile. The chain is reversible, and the machine can equally well be used to unpile timber. It is stated that by use of this machine timber can be quickly piled at the lowest possible cost.

SUBSTITUTES FOR OIL IN HIGH-PRESSURE SWITCHGEAR.

THOUGH the risk of oil switch explosions may be practically eliminated by proper design and construction, the use of inflammable liquid to quench a high-temperature flame can hardly be regarded as an ideal practice. There is a possibility also of fires which originate elsewhere than in the switch cases themselves being fed from oil in the latter. Provided nothing were sacrificed in electrical efficiency and safety, there would be a distinct field for a non-inflammable substitute for oil in high-pressure switch practice and about seven years ago E. Peyrusson (Paris) took out patents protecting the use of carbon tetrachloride in this connection. Nothing appears to have been done, however, till Voigt and Haeffner experimented with the use of that material in 1911, in ignorance it is said of Peyrusson's patent. The German experiments were revived in the summer of 1914, and conducted with special vigour after the outbreak of war, when there was a great scarcity of oil. The position is said to have been reversed a little later when oil became again available, and the raw materials for carbon tetrachloride, and the glycerine to protect it from evaporation, became scarce. Whatever the precise bearing of the matter on the question of Germany's supplies of material, the following notes from test data recently published in the *E.T.Z.* have an interest of their own.

Carbon-tetrachloride (CCl_4) or "benzinoform" is a colourless liquid of sp. gr. 1·6, which boils at 76¾° C. and freezes at − 26·7° C. It evaporates as freely as benzine when exposed to the atmosphere, but it is incombustible and does not conduct electricity. The high sp. gr. of benzinoform (about 80 per cent. greater than that of switch oil) increases the difficulty of handling filled containers and necessitates heavier design of the latter. A more serious disadvantage is the great volatility of the tetrachloride. The level of liquid in an ordinary enclosed switchbox, filled with this material, falls 1 mm. per day by evaporation, and even after packing the joints as thoroughly as possible, the loss amounts to 0·5 mm. daily fall in level. Consideration of possible pressure rises inside the casing precludes sealing the case hermetically, and also renders a liquid seal inadequate. The use of a float is of little assistance, for though the exposed surface of the liquid is reduced, there is capillary creeping in the clearance between float and container. Peyrusson's patent suggested the use of a layer of glycerine or glycerine and water to prevent evaporation; this is satisfactory in its primary function, but if the switch-box be lowered for inspection of the switch, the latter becomes covered with a film of glycerine, which soon forms verdigris. Other troubles introduced by the use of glycerine are mentioned below.

Copper is practically unaffected by benzinoform at atmospheric temperature, but after prolonged immersion in the liquid warmed to 45° C., the metal is deeply corroded and covered by a greasy white layer. Aluminium, silver, and lead are less attacked, and tin is particularly immune, so that tinning gives satisfactory protection against chemical attack by CCl_4 except as regards hinges and contact surfaces, which cannot be permanently protected by a surface coating. Rubber, vulcanite, pertinax and micanite cannot be used in CCl_4 but fibre and mica are unaffected, and litharge cement, though blackened on the surface, does not lose its strength.

In respect of dielectric strength, the behaviour of benzinoform depends on whether the stress is momentary or sustained. The following data show the breakdown distance between pointed electrodes:—(A) For oil; (B) for CCl_4 and momentary stress, lasting 2 secs. or so; (C) for CCl_4 stressed for 20 minutes without breakdown:—

Test pressure between points.	Distance between points (mm.). (A) Oil.	(B) CCl_4 momentary.	(C) CCl_4 sustained.
10 KV.	6	—	9·5
30 ,,	12	—	20
50 ,,	20	—	33
60 ,,	26	12·5	42·5
80 ,,	41	36	66
100 ,,	62·5	59	—

The tests from which these data were obtained were made with CCl_4 which had already been used for short-circuit tests; though turned brown by this treatment the liquid had still good enough insulating properties to make it suitable for use in high-pressure switchgear. A switch designed on the basis of the figures in col. (C) above would obviously be able to withstand high surge pressures without breakdown. Probably the marked difference between the sustained and momentary dielectric strength of CCl_4 is due to the liquid being set into brisk motion by electrification; the movement is much more pronounced than in oil.

During the past 18 months various tests have been carried out on switches filled with CCl_4 and operated under various conditions of load and pressure. Limitations attached to the use of the "new" insulating material were soon discovered. Benzinoform evaporates so rapidly that the presence of a small leak in the container is not betrayed by visible staining or oozing, yet the loss of liquid may be so serious, that flash-over occurs through the reduced head of dielectric to the conducting "earthed" layer of glycerine, which alone affords effective protection against surface evaporation. It is not permissible to draw the switch out through the glycerine for routine inspection purposes, because the film of glycerine thus collected forms verdigris on the copper, and a conducting covering on the insulators; leakage across the latter then causes quantities of CCl_4 vapour to be driven off. Benzinoform does not possess the lubricating value of oil, hence it may be necessary to employ more powerful operating springs and solenoids, and presumably wear will occur more rapidly than in standard switchgear. The lack of lubrication is particularly undesirable when the switch has to break a short circuit, and should act as quickly and freely as possible.

The best form of switch for use with CCl_4 is the closed pattern in which the leading-in insulators are taken through the bottom of the switch, and the moving part passing through the glycerine layer is limited to a round rod. Accessibility for easy inspection must be sacrificed.

A mixture of 25 per cent. benzinoform, with 75 per cent. ordinary switch oil (by volume) loses only 5 per cent. in weight during 3 hours' heating to 100° C., and is thus much less volatile than pure CCl_4. The mixture is not incombustible, but is much less inflammable than oil. The small evaporation loss at 100° C. is evidence of the intimacy of the mixture, for the boiling point of pure CCl_4 is 76·5° C. The fact that the incombustible CCl_4 would distill off first in case of a switch fire might prove a point of practical importance, but the ultimate fire risk is obviously only reduced and not entirely eliminated. It is suggested by Vogelsang that some of the "incombustible" switch oils placed on the market have been simply mixtures of oil and benzinoform; as such they are not truly incombustible, but the characteristics of benzinoform afford good grounds for hoping that chemistry may yet evolve incombustible liquid dielectrics of high insulating value.

Though they may form the basis of more fruitful research, the data and information given above afford no ground for prophesying or recommending the use of benzinoform alone, or even in admixture, as a substitute for oil in switchgear. That its possibilities have been investigated at such length, at such a time, is probably another indication of Germany's difficulties and exigencies. Whatever future developments may be—and this field of research is certainly worth exploring—benzinoform as a substitute for switch oil may fairly be classed with iron and zinc as a substitute for copper conductors and with linoleum as a substitute for leather soles!

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INSULATING OILS FOR TRANSFORMERS.*

Early in 1913 the Research Committee of the Institution of Electrical Engineers appointed a sub-committee to consider the properties of and methods of testing switch and transformer oils. Letters were sent to a number of manufacturers and users of oils, and to Universities, and the replies received were reviewed in an interim report by Mr. W. Pollard Digby in January, 1915. The Sub-Committee has considered the suggestions received with regard to the proposed tests, which in the first place are being limited to transformer oils. A brief account of the tests, most of which have been in practical use for some time, is given below. The points that now require investigation are:—

1. How far are the results consistent when made by different observers on the same sample of oil?

2. Could the results of the tests be relied upon to indicate with certainty the behaviour of the oil under practical working conditions?

The Institution has received a grant from the Advisory Council for Industrial Research for this work, and the Sub-Committee proposes therefore to put the experiments in hand at once, especially in view of the delays caused by the war.

The Sub-Committee expresses its indebtedness to Mr. Pollard Digby for the services rendered by him in examining the information received and drafting the first report, and to the small committee consisting of Messrs. A. R. Everest, A. C. Michie, and T. O. Thomsen who prepared the draft of the tests.

In order to judge the suitability of an oil for use as a cooling insulating medium, it is necessary to know its characteristics in the following respects:—Tendency to sludge; loss by evaporation; flash point; viscosity at different temperatures; chemical reactions; density and coefficient of expansion; cold test (solidification); moisture absorption; dielectric strength; specific resistance; thermal transference; and specific heat.

Sludging.—The object of this test is to obtain an idea of the tendency of the different oils to form solid deposits when they are subjected to the action of heat and air. This action is considerably influenced by the presence of certain metals. The method recommended is a modification of that used by Dr. Michie. The oil contained in a flask is subjected to the action of heat and oxygen for a given time, a piece of the metal in question of given surface area being present in the oil during the test. It would be of interest to obtain comparative figures for copper, iron, lead, tin, zinc, and aluminium, and, in view of the importance of copper in electrical work, data should also be obtained for tinned copper, silver-plated copper, and copper covered by insulating material such as cotton.

Besides the formation of solid deposits in the oils after these have been subjected to the conditions of the test, note should be made of any corrosive effects on the metals, the formation of water and acids, and the extent to which the oils have darkened in colour.

Loss by Evaporation.—Two different methods of carrying out this test are described. A definite volume of oil is heated in a beaker at 100 deg. C. for 8 hours. In one method the body of the beaker is immersed in the heating bath, its open mouth being exposed to the air of the laboratory but shielded from draughts. In the second method the beaker is carried in a revolving tray in a hot-air oven. The result is expressed in terms of loss of volume and ratio of surface to volume of oil, the height of beaker wall above oil surface at the commencement of the test being stated.

"Closed" Flashpoint.—The temperature at which vapours accumulating above the oil in a closed vessel become inflammable is determined by means of either the Pensky-Martens or Gray's instrument. The oil is rapidly heated to about 25 deg. C. below its suspected flash point, the heating being continued beyond this at the rate of 2½ to 3 deg. per minute. At each additional degree of temperature the cover is opened and a flame inserted. The lowest temperature at which flash occurs is thus determined.

Viscosity.—The standard method in Great Britain for this determination is that of Redwood, which notes the time in seconds required for a definite volume of oil to run through an aperture of fixed dimensions. Measurements are made at 15.5 deg. C., 50 deg. C., and 80 deg. C.

Chemical Reactions.—The oil is tested for acidity and alkalinity. An iodine test is also recommended, as it is believed that this test gives a good general indication of the tendency to sludge.

Density and Coefficient of Expansion.—The density is determined at the three temperatures 15.5 deg. C., 50 deg. C., and 80 deg. C., by means of specific gravity bottles or pyknometers, preferably of the Sprengel tube type. From these data the coefficient of expansion is obtained.

Cold Test.—This test determines the temperature at which the oil commences to congeal. A knowledge of this characteristic is of importance in connection with oil switches used in exposed situations and cold climates.

Moisture Absorption.—This test is made to determine the tendency of an oil to absorb moisture from the atmosphere, and is made by taking dielectric (breakdown) tests upon the originally dry oil after successive intervals of exposure.

Dielectric Strength and Specific Resistance.—These are familiar laboratory tests.

Thermal Transference.—A certain amount of information is available regarding the relative cooling effects in a transformer with oils of different viscosities, but it is felt that more exact information would be of value, and a method of investigation recommended by the National Physical Laboratory is described in detail.

Specific Heat.—The method of performing this test is left to the judgment of individual experimenters. Data should be obtained at 15.5 deg. C., 50 deg. C., and 80 deg. C. Reference is given to published data upon this subject. It is suggested that specific heat tests at 15.5 deg. C. might with advantage be made upon the oils both in their original condition and after drying, but for the test at higher temperatures dried oil should be employed.

Detailed methods of investigation for each characteristic recommended are given in the *Journal*.

* Abstracted from the *Journal* of the Institution of Electrical Engineers for April 1st, 1916.

AN ELECTROLYTIC OXYGEN AND HYDROGEN INSTALLATION.

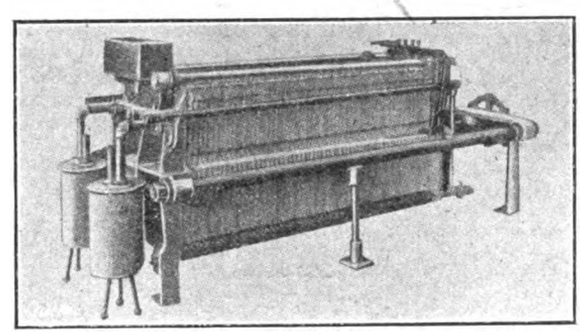
A new electrolytic oxygen and hydrogen plant recently put into operation at the works of the Fore River Shipbuilding Corporation, Quincy, Mass., is run entirely automatically, requiring the attention of only one man to a shift, the plant being run continuously by three men in three eight-hour shifts.

The plant consists of a crude-oil engine, belt-connected to a 45-kw. d.c. generator, and one of the National Ox-Hydric Co.'s electrolysers, as shown in the accompanying illustration, guaranteed to produce 3,500 cubic feet of oxygen per 24 hours and twice that amount of hydrogen.

The oxygen and hydrogen, after being produced from the electrolyser, pass into steel gasholders of 2,000 cu. ft. capacity each. From there they pass through a suction line into suitable compressors, which boost the pressure in the pipe lines between the gasholders and point of consumption to the amount required at the blowpipes. Between compressors and blowpipes or operating stations, are suitable concussion tanks to take the pulsation of the compressors off the pipe lines.

The plant is also equipped with high-pressure compressors, for the purpose of compressing oxygen and hydrogen into cylinders where it is not advantageous to run pipe lines, such as on board ships and other extreme points of the company's shipbuilding yards.

The National electrolyser is of the improved "filter-press" type. It consists mainly of a number of decomposition cham-



Filter-Press Electrolyser.

bers connected in series. These chambers are formed by clamping together a series of cast-iron electrodes, so recessed and grooved that each plate forms, with its neighbour, a chamber which holds the electrolyte, and in which the generation of the gases takes place.

The electrodes are carefully insulated one from the other by means of patented rubber-bound asbestos diaphragms. The electrodes and diaphragms are arranged alternately, and are supported by the insulated frame of the filter press. The required number of electrodes and diaphragms with the corresponding end plates are then pressed tightly together by means of a heavy screw standard, thus making the whole equipment form a hermetically sealed tank of the filter-press type, the diaphragms serving both as an insulation and gasket, and forming the sides of the cells, preventing any mixture of the two gases generated. The fact that the electrodes are thus separated by the diaphragms causes one side of the plate to act as the anode of the chamber and the other side as the cathode of the adjacent chamber.

The electrodes are composed of a special alloy, and are heavily coated with nickel, which makes them neutral to oxygen and alkali, and prevents the formation of deposits or the oxidisation of the electrodes themselves.

The number of chambers required is, of course, dependent upon the production of gases required, as well as the voltage of the electric current. The electrolysers of the National Ox-

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Hydric Co. are designed for any standard D.C. circuit, or, with the use of a motor-generator set, for any of the standard A.C. circuits, thus doing away with the inefficient low voltage and high amperage necessary with the individual-cell type of installation. Furthermore, these electrolysers occupy about one-fifth the floor space required by the individual cell type.

By the design of electrode the anode and cathode are brought close together, so as to reduce to a minimum the electric resistance, while, at the same time, the hydrogen gas is effectually kept separate from the oxygen gas without preventing the proper passage of the electrolytic solution between the anode and the cathode.

The electrodes themselves are made with corrugated surfaces, increasing the active electrode surface and forming a large number of very small vertical channels through which the gases rise freely to the upper part of the plates. At the top of each electrode and hermetically sealed together are substantial chambers in which the gases are separated from the electrolyte. From these chambers the gases pass off in a dry state into ducts extending through each plate, these ducts forming continuous conduits, owing to the manner in which the plates are assembled. The gases pass through these conduits into their respective receivers or storage tanks. One of the main features of the design is the way in which the conduits are kept free from electrolyte; this is accomplished by a device which is cast integral with each plate, thereby eliminating any possibility of a short circuit even should the conduits become filled with the solution.

The electrolyte is a 21 per cent. solution of pure caustic potash in distilled water. After the electrolysers are once filled with this solution, distilled water is added from time to time to take the place of the water decomposed; the potash lasts many months. The distilled water is fed to the electrolyser by an automatic device which maintains a constant level of the electrolyte throughout the machine.

Under normal load conditions, the voltage required per cell is two volts or less. Therefore, to operate on a 110-volt circuit an electrolyser containing 55 cells is necessary; and on the same basis, 110 cells are necessary for a 220-volt circuit.

Assuming continuous operation and normal load conditions, the electrolysers yield 4 cu. ft. of oxygen and 8 cu. ft. of hydrogen at atmospheric pressure per KW.-hr. of energy consumed when the plant is operated at a temperature of 68 deg. F.

The gases produced are very pure, the oxygen being of 99.5 per cent. purity. The electrolyser will stand an overload of 50 per cent. without any ill effects. This feature of being able to overload the plant and generate a proportionately greater amount of gas is of great advantage.

The water of which the electrolyte is formed has to be distilled in large commercial plants, but in the smaller individual plants the purchase of distilled water in quantities sufficient to operate the plant is advocated.

The electrodes are said to be practically indestructible. The asbestos diaphragms are very durable, and, being neutral to the elements with which they come in contact, have a life fully equal to that of the electrodes. All other parts of the equipment are practically not subject to any wear and tear.—*Metallurgical and Chemical Engineering.*

DIESEL ENGINE USERS' ASSOCIATION.

At the April meeting of the Association, the accident to an air compressor attached to a Diesel engine at the Smithfield Markets was further discussed. Mr. W. Fennell suggested that it might be advantageous to fit some suitable form of coil instead of the usual purge pot.

Mr. R. Lyle referred to an accident of a similar nature which had occurred on an air compressor attached to a 300-B.H.P. Diesel engine at the works of the Hoffmann Manufacturing Co., Ltd., in 1913. On that occasion, fortunately, no personal injuries resulted from the accident. The engine had been at work continuously for 24 hours before the accident occurred, whereas, in the Smithfield case, the accident occurred on starting the engine. It was found that the H.P. suction and delivery valves of the compressor were somewhat worn and fouled with carbon deposit. An exhaustive inquiry was held, but no very definite conclusion was arrived at. It was suggested that the bursting of the purge pot was caused either by the high pressure getting back from the blast vessel or being built up, or by high pressure due to the combustion or explosion of oil vapour. Mr. Lyle did not think that the first theory was tenable, as the calculated bursting pressure of the purge pot was over 2,000 lb. per sq. in., and the pressure in the blast vessel did not exceed 850 lb. at the time of the accident; the necessary pressure could not be built up, as a test by the makers, which consisted in blanking-off the delivery pipe and running the compressor up to full speed, proved that the relief valves dealt efficiently with the air. He considered that the trouble was undoubtedly caused by explosion, brought about by high terminal pressure and temperature in the intermediate-pressure cylinder, which might have been caused by the H.P. valves sticking up, as was suggested in the case of the Smithfield accident. There was, however, another probable cause of the accident which his experience suggested. He had been able to satisfy himself that one cause of a rise in temperature in the I.P. purge pot was from a choking of the I.P. cooling coil, due to a carbon deposit taking place at the sharp gun-metal bend which coupled the I.P. delivery pipe to the cylinder. This might lead to the generation of an ignition pressure and temperature at this particular spot, and this pressure *would not be recorded by a gauge on the* I.P. *purge pot*. The precautionary measures taken as a result of the accident were as follows: A check valve was fitted on the H.P. delivery pipe as close as possible to the air compressor casing; pressure gauges were fitted to the I.P. and L.P. stages, so as to give timely warning when the valves needed attention; instructions were given for the valves to be cleaned at more frequent intervals, and it was recommended that this should be done every six weeks, but the experience gained by a study of the gauge pressures would be the best guide; the valves also should be renewed before any play or rounded seatings became accentuated.

Referring to Mr. P. H. Smith's recommendations in connection with the Smithfield accident, Mr. Lyle stated that his experience led him to suggest that the provision of anti-vibrators in connection with the gauges was better than throttle valves, as being more reliable in damping the oscillations and in providing freedom from choking. He considered that large relief valves provided no proper safeguard against explosions, though he quite agreed that valve wings choked the area. He thought that a non-return valve should certainly be fitted between the H.P. delivery and the blast bottle. With regard to Mr. P. H. Smith's statement that the L.P. purge pot was always the hotter when the machine was in good order, Mr. Lyle contended that this would depend on the type of the compressor, and that when fitted with the L.P. condenser type of cooler the reverse would be the case.

Mr. P. H. Smith desired to make a correction in connection with the remark in recommendation (6) in his report by adding the words, "this remark applies only to compressors in which cooling coils are used, and not multitubular coolers."

The next meeting of the Association will be held on Wednesday, May 10th.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

"Glow Lamps."

In the recent new wiring regulations of the Institution of Electrical Engineers, the Institution Committee adopts the term "glow lamps" to refer to incandescent electric lamps.

It is of interest to note that this term does not appear to be used at present by any of the electric lamp manufacturers in their lists as a descriptive term for the electric incandescent lamp. Examination of over 100 lamp catalogues issued by electric lamp manufacturers for a long period only traces the use of the expression "glow lamps" in one of them.

A. B. C.

Electricity in War Areas.

It is with great pleasure that one receives out here regularly a copy of the Electrical Review, kindly sent by the editors and publishers, which enables one to keep in touch with what is happening in electrical spheres at home and abroad.

It may be of some interest to your readers to hear that electricity is playing an important part on this front; one finds where power is available from company mains that full advantage is taken of it in every possible way, and it is truly painful to see the thousands of pounds' worth of up-to-date electrical plant, *i.e.*, large capacity sub-stations, transmission lines, transformers, &c., lying about in the "unhealthy area," rendered useless either by shell fire or exposure to the bad weather one has had to contend with in recent weeks.

One wonders if the orders after the war for reconstruction, new installations, &c., will be placed at home, as undoubtedly a huge volume of business is bound to be obtained out here.

One interesting application of electricity is, perhaps, worth mentioning. A certain mobile workshop near the line was equipped with a dynamo coupled to an internal-combustion set, but it was discovered that an old flour mill, dating back from 1787, possessed an overshot wheel, driven from a small stream near by, and shafting (incidentally, the drive was bevel wheel and pinion with wooden renewable teeth). This has now been utilised as prime mover, a countershaft obtained from a "shelled" thrashing machine fitted up, and the dynamo is now driven by water-power, an improvised transmission line being run to the workshop supplying power and lighting, and, consequently, saving valuable liquid fuel.

Previously, in another part of the front, the same dynamo was taken off its engine bed and coupled to a 3-phase motor that happened to have lost its owner, and connected to com-

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pany mains, the insulators of the transmission lines in this case being the tops of champagne bottles, filled with plaster of Paris.

One wonders what will be the next vicissitude the dynamo will pass through.

A.M.I.Mech.E., A.M.I.E.E.

B.E.F., France.

The Resistance of a Cubic Frame of Wire.

The solution of this question has provoked considerable discussion, and Dr. Fleming has given the general form of solution for such mesh questions, involving a set of simultaneous equations, and their solution by determinants. This is, doubtless, the correct general method, but a good many engineers have little familiarity with determinants, and it may be worth while to show a very simple way of treating the particular case.

Fig. 1 shows the cube framework in perspective, with the 12 wires numbered. Fig. 2 shows these wires developed by following the three paths from one angle of the cube to that opposite. It is at once obvious that these paths form two terminal sections each of three wires in parallel, and a central section of six wires in parallel. The resistance of the three

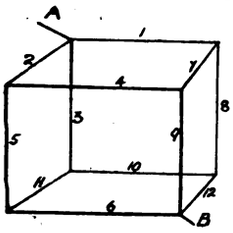

Fig. 1.

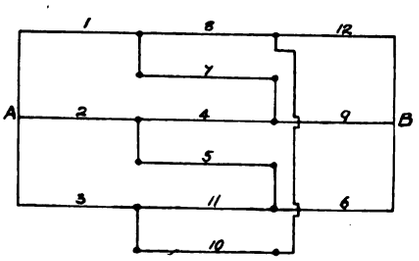

Fig. 2.

sections in series is, therefore, $1/3 + 1/6 + 1/3 = 5/6$ of the resistance of one wire, assumed all equal as in the question. The vertical connections represent the junctions of the wires at the angles of the cube, and are of zero resistance. The method seems to be applicable to any mesh arrangement, but it may obviously involve complex arithmetic where the mesh sides are of different resistances and otherwise complicated.

Henry M. Sayers.

London, S.W., *April 16th*, 1916.

WAR ITEMS.

Exemption Applications.—At the Lambeth Tribunal an application for exemption was made by an electrician employed by the South Metropolitan Electric Supply Company, Ltd. As an outside worker it was a moot point as to whether he was in the revised list of reserved occupations. His grounds for exemption were that he was in a "reserved occupation, and that he was employed on public utility service." The case was adjourned for the appearance of the applicant's departmental manager, who later informed the tribunal that the man was exempt. He had that morning had a letter from the Minister of Munitions declaring that the men previously exempt as far as public electric lighting companies were concerned, were still exempt. The Mayor said they would adjourn the matter for inquiry. These exempt men ought to have badges and certificates, and the tribunal should not be burdened with their appeals.

At Stratford-on-Avon, on April 12th, the manager of the electricity works claimed exemption for Mr. H. L. Smith, electrician, on the ground that it was expedient in the national interest that he should remain in his present occupation of installation work. Two months were allowed to find a substitute.

In applying at the Sunderland Tribunal for the exemption of a journeyman electrician, a firm of electrical engineers said they considered him indispensable to the town because of his expert knowledge of X-ray and other surgical apparatus, and because he was often engaged in repair work at the Royal Infirmary and other hospitals in the district. There was no one else in the firm who could do such skilled work. Conditional exemption was granted.

At Richmond-on-Thames, on April 15th, the Richmond Electric Supply Co., Ltd., applied for exemption for an assistant in the showroom, it being claimed that the occupation was a reserved one. The tribunal decided otherwise, and refused the appeal.

At the Durham County Appeal Tribunal, last week, application was made by the Imperial Tramways Co., Ltd., for the exemption, on the ground of indispensability, of two fitters employed at Stockton-on-Tees. Both were single, and had been granted temporary exemptions. It was stated that the men were essential for the proper working of the company's system, which was the means of transit of munition workers. It was absolutely essential that the cars should be kept in perfect order. At the beginning of the war, the company had 16 fitters, and this number had been reduced to eight. It was stated further that a representative of the Ministry of Munitions had recently visited the works, and had had to admit that in his search there for men who could be spared, he had drawn blank. The elder man applied for was granted exemption until August, when, it was pointed out, it would be open to the firm to make a further application. The appeal in regard to the younger man failed.

Before the East Kent Appeal Court, on April 14th, Mr. Joseph Iggulden, electrical engineer, of Folkestone, appealed against refusal of exemption by the local tribunal. The Court decided that the latter body should grant three months' exemption.

Dartford Light Railway Co. have applied for exemption for 12 motor men, a driver, repairer and fitter, a driver and mechanic, a car and overhead equipment repairer, a driver and traffic inspector, and a brake fitter and overhaul repairer. All the rest of the employés are over military age. Conditional exemption was given to each, with a time limit of six months to those not married.

At Lewes, the Electric Supply Co. applied for absolute exemption for an engine fitter and cable jointer, and the request was complied with. Conditional exemption was also allowed the company's clerk.

The Surrey Appeal Court has refused an appeal for exemption made by Mr. E. B. Slaughter, electrical engineer, of Haslemere.

At Rugby, Mr. Hosking, assistant works manager to the British Thomson-Houston Co., Ltd., appealed for exemption for six engineers, two of whom completed their college course on March 31st, and the other four would do so on July 31st. The military recommended no exemption for two from a college in Scotland, who had finished their theoretical training, and exemption until July 31st to the four from English colleges, to enable them to complete their course of studies. Mr. Hosking said they were not pupils, but testers, who wished to come to Rugby to do practical work, and to be trained as electrical engineers. Before the war they had 94 testers, they had lost 55, and at present had 42 English testers and 12 of other nationalities. In testing it was absolutely impossible to dilute with female labour. The military recommendation was agreed to, and Mr. Hosking said he should appeal.

At Malmesbury, Mr. B. de Bertodano applied for temporary exemption for Richard Bishop, who runs an electric plant serving Cowbridge House. Exemption until July 15th was granted.

At Basingstoke, exemption was sought for an electrical wireman, engaged in the electrical installation at Park Preweth Asylum by Messrs. Hill, Upton & Co. The firm's manager said that their work was under the direction of the War Office, as the new asylum might be used as a military hospital. Exemption was allowed until May 15th for applicant to have his certificate as a voluntary munitions worker renewed.

At Bacup, last week, the secretary and manager of the Corporation electricity department appealed for the exemption of a fitter's labourer. It was submitted that this was a certified occupation, that there was pressing work in hand in connection with the sub-station for special purposes, and that it would take considerable time to train another man. The military representative said there was nothing in the lists or instructions which entitled the appeal to succeed. The appeal was disallowed.

The Austrian Electrical Industry in War Time.—A communication on this subject was recently published in the "E.T.Z." from E. Honigmann, of Vienna, who, after giving a survey of the situation from the time of the outbreak of the war, states that the electrical industry quickly recovered in the early months from the inevitable reactions which occurred at the beginning of the war, and accommodated itself to the new state of affairs. By way of illustration of this fact, it is mentioned that the companies which are liable to make a public return of their accounts, although not able to distribute such good dividends as in normal times, were yet able to divide acceptable profits for 1914 despite the large provision made for reserve funds and the exercise of great prudence in the preparation of the balance sheets. It is probable that the results for 1915 will show an improvement, as the turnover of those firms who produce articles for army requirements experienced a considerable increase, whilst at the same time yielding better results owing to the cessation of the keen competition which formerly took place. Other factors in the situation are that the old stocks, including those which had been partly or entirely written off long ago, were disposed of at good prices, that manufacturing has been simplified, that the production of munitions which caused many difficulties at first became profitable with the growing experience of the workmen and the increase in the output, and that a large portion of the working expenses declined.

The electricity works within whose scope of supply are situated works which are engaged on army contracts, also earned a larger income, not only on account of an expansion in the demand on the part of old customers, but also because of the addition of many new connections, as numerous owners of private installations preferred to obtain a supply from central stations, owing to the dearness, or difficulty of procuring, coal or liquid fuel for their own individual plant. Thus, for instance, the company owning the

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great station at Rossitz was compelled to install a large new generating set in order to meet the greater demand for energy. After the re-conquest of the Galician oil yielding region provisionally occupied by the Russians the difficulties experienced by the owners of oil-engined installations were probably overcome, but the price of crude oil is still so high that it is more profitable to have a connection with a generating station. As to the question of a scarcity of raw materials, the author remarks that the Austrians helped themselves in the same way as the Germans by the adoption of substitutes, as, for instance, iron and zinc for conductors, paper insulation, &c.

It is submitted that an expressed dearth of raw materials has probably not yet been perceived. Nevertheless it is contended that precautions should now be taken, so that on the conclusion of peace the replacement of exhausted stocks should not be left to the action of individuals, as this would lead to the forcing up of prices by speculators and the causing of immeasurable damage to the industry. The work of acquiring raw materials should be carried out according to a scheme of centralisation under Government control, under which the materials would be grouped together.

American Engineers and Preparedness.—At a special meeting in New York on March 20th, attended by 3,000 engineers, the following resolutions were adopted:—

"The engineers assembled in public meeting on March 20th, 1916, under the auspices of the Engineers' Committee on Military Lectures, believe that it is unworthy a great nation like the United States, and that it is dangerous to the peace, safety and liberty of its people, to remain in our present position of inadequate military, naval and industrial preparedness.

"We believe that between pacifism and militarism there is a just, safe and proper ground, greatly in advance of our present position—a ground which involves large additions to both the navy and army, a large increase in our schools for training officers and a co-operation and mobilisation of the physical and industrial resources of the nation.

"We believe that this nation should never make war except to enforce peace; that when strongly supported by armed resources its influence in maintaining its own liberties and rights, and the liberties and rights of the weak and oppressed throughout the Americas, will be greatly strengthened.

"We believe that Congress should give due weight to the opinion of experts and should then appropriate sufficient money to put the nation in a position of defence against attack on either the Atlantic or the Pacific Coast.

"We demand that our representatives in Congress act in accordance with this expression."

Many prominent electrical engineers were among those subscribing to the resolutions.—"Electrical Review and Western Electrician."

Made in Holland.—The "Auckland Weekly News" refers to complaints that are being made by New Zealand importing firms that although direct trade with German factories is blocked by present conditions, a large amount of business that will ultimately accrue to the benefit of the German firms, is still being done in New Zealand, especially in electrical requisites. One dealer attributes the cause of the trouble to the fact that a large number of Anglo-German businesses, with works in England, are in the hands of supervisors, but their goods are going out to New Zealand in competition with the manufactures of Britain and her Allies and of neutral countries. He asks: "Why should enemy enterprises be allowed, under this thin disguise, to keep open the market in the Dominion, so that purely German business may step in at the close of the war and reap the benefit of this warming pan system, as if their trade had never suffered interruption?" The "News" later refers to the question of electric lamp manufacturing thus:—"As a striking illustration of the flimsy pretexts on which enemy trade is permitted, the trader produced a certificate covering a small consignment of a particular kind of electric lamp, manufactured in Holland. He had received a circular advertising the line and had sent a small order to see what he might discover. Sure enough, with the goods came a certificate from the British pro-Consul in Rotterdam to the effect that the Dutch company had satisfied him that the goods had not been manufactured in enemy territory, and that they 'did not contain materials or labour of enemy origin to a value exceeding 17 per cent.' So that, it was pointed out, £17 out of £100 of the value of the goods in Holland admittedly went to assist the enemy. The lamps in question, it is stated, are being sold in New Zealand by thousands."

Trade After the War.—Mr. Asquith was recently asked in the Commons whether any, and if so what, steps were being taken by the Government to formulate a trade policy after the war. In reply, according to the "Times," he said that a committee of the Cabinet was appointed some time ago to deal generally with all questions of reconstruction—including those relating to commercial and industrial policy—which were likely to arise at the close of the war. The detailed investigation of particular aspects of the problem would be carried on by sub-committees, as to the most important of which the Cabinet were in communication with the Dominions.

Dilution of Labour.—In reply to a Member of the House of Commons who asked the Minister of Munitions to what extent his demand for 80,000 skilled and 200,000 unskilled workers had been met, Dr. Addison said that the effect given to the policy of dilution, that was, the performance by women or unskilled men of work hitherto performed by skilled men, had enabled the demands for skilled men to be largely met. The demands for skilled men which could not be filled by the employment of women or unskilled men had been partly satisfied by the transfer of war munition volunteers from private work, the release of skilled men from the Colours, the introduction of labour from the Dominions, and from certain foreign countries, and by training semi-skilled persons or persons skilled in trades similar to those in which vacancies existed. There was still, however, a large demand for skilled men. This was especially important in shipyards, and the demand could only be met by the further progress of the methods referred to, and particularly by further dilution. The demand for unskilled workers had been largely reduced, mainly by the introduction of women.—"Morning Post."

Post Office Tube.—According to the "Daily Telegraph," the suggestion has been made by Colonel Norton-Griffiths that the work of the Post Office Tube Railway should be suspended so as to release the large number of men employed for pioneer battalions and other Royal Engineer units, where they are urgently wanted. Though the Postmaster-General stated that it would not be expedient to suspend such work, he was considering, in conjunction with the Ministry of Munitions, whether it would not be advisable to divert some of the men now employed on the tunnel.

Exports to China.—The "London Gazette" for April 18th and 21st contains further lists of firms and persons in China and Siam to whom exports may be consigned.

LEGAL.

Electric Battery Contract.

An action by Pritchett & Gold & Electrical Power Storage Co., Ltd., manufacturers of electrical batteries, against Hamble, River, Lake and Co., Ltd., Hamble, Hampshire, was heard by Mr. Justice Sargant, in the Chancery Division, on April 17th.

Mrs. Hilda Beatrice Currie, of Upham House, Aldbourne, Wiltshire, was originally a defendant to the action, but, as counsel explained, she interpleaded, and an order was made whereby she paid into Court £255 odd, and withdrew from the action, her costs having to be provided for by the Judge. The action now came on between the plaintiff company and the defendant company.

Mr. Grant, K.C., who appeared for the plaintiffs with Mr. Merlin, said the claim was for payment of the price of a contract for the supply and erection of an electrical installation at Mrs. Currie's premises. The main contract was between her and the defendant company. The plaintiffs were sub-contractors to the defendant contractors. The contract was dated February 14th, 1914, and was for a general electrical installation for the purpose of lighting, pumping water in case of fire, and telephonic communication within the house, garage and engine room at Upham. The price for the whole of the work was £1,363. Defendants wanted to sub-contract for the battery—a 66-cell one—and the plaintiffs were to supply it and put it into working order, and start it off for £286. Plaintiffs delivered the material in a large number of cases ready for erection, but before the erection the defendant company went bankrupt. They, however, took the materials supplied by the plaintiffs, and did the erection, and now they said that the property in the goods passed to them when the plaintiffs delivered the materials, notwithstanding that the contract was not completed. They declined to pay the contract price, and said the plaintiffs would have to take whatever dividend the company could pay. Plaintiffs, on the other hand, said they had a contract for the supply of the materials for the battery, and they were to put it up and start it off, and until that contract was completed on the premises, no property passed in any portion of the goods. Counsel argued that this was one contract, not for the sale of goods at all, but for materials to be supplied and work to be done in the erection of the battery, coupled with the superintendence of the first charge.

His Lordship: You say it was a contract for the supply of a battery in working order?

Mr. Grant: That is so.

Mr. Romer, K.C., who appeared with Mr. H. E. Wright for the defendants, said the plaintiffs made default to erect the battery, and the defendants did it.

The hearing was continued on April 18th.

Mr. Romer, K.C., who appeared with Mr. H. G. Wright for the defendants, argued that the plaintiffs had tendered for a battery, and had not incurred the responsibility of erecting it. This was not a case analogous to that of a man contracting to build a motor car on a buyer's premises; it was a contract to supply the component parts of a battery, and the moment the articles were delivered the property passed from the plaintiffs to the defendants.

Mr. Grant, K.C., said in reply that there was no completed contract until the battery was erected.

His Lordship, giving judgment, said the real question was

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when did the property in the goods pass. If the property in the materials for the battery passed to the defendants, as was alleged, at or about the time of the delivery of the materials, free on rail for the railway destination, then of course the plaintiff company were only entitled to prove in the liquidation for the amount due to them. If, on the other hand, the property in the materials did not pass, then the plaintiffs were entitled to the materials, and under the arrangement made by the order of the Master, to have paid out to them the sum paid into Court by Mrs. Currie. In his judgment all the difference was made by the special terms of the actual contract between the parties which seemed to him, on their true interpretation, to amount to a contract for the sale and purchase of a battery as one complete and entire whole *in situ* and in working order with its first charge included. The legal consequences were that the property still remained in their original owners, the plaintiff company, and they were entitled to have paid out to them the sum paid into Court and to have the costs of the action against the defendant company.

A stay was granted with a view to an appeal.

CEDES ELECTRIC TRACTION, LTD

UPON the petition of the Tudor Accumulators, Ltd., Mr. Justice Neville, on April 18th, made an order for the compulsory winding up of this company. The matter had been standing over for some time, and counsel for the respondent company said he could now no longer resist the order.

THE KINGSTOWN ELECTRIC LIGHTING SCHEME.

THE Irish Court of Appeal delivered a considered judgment in the appeal by the Dublin Southern District Electric Supply Co., Ltd., from the decision of Mr. Justice Barton in the matter of the arbitration between the company and the Kingstown Urban District Council, refusing an application made by the company for an order directing the Taxing-Master to tax the costs of the company as against the Council, in the proceedings in connection with the scheme for the electric lighting of Kingstown, on the scale provided by the Acts for the taxation of Parliamentary costs, or, in the alternative, that the costs should be taxed as Chancery costs on the higher scale as between solicitor and client, or for such order as the Court might think reasonable. Their Lordships had previously dismissed the appeal.

The LORD CHANCELLOR now pointed out that, in making his award, the arbitrator, Mr. S. L. Brown, K.C., did not use the word "expenses," or refer to expenses by name. On looking at the schedule to ascertain what it was that was made a rule of Court, no submission in the ordinary sense could be found. The Arbitration Act of 1889 did not apply to Ireland, and if the matter had been amply dealt with by statutory provision, it did not apply to that country. They were confined to the provisions of the Common Law Procedure Act and the older statute of William III, dealing with arbitration. It did not appear that the immense difficulty raised by that simple consideration was brought before Mr. Justice Barton, and the trouble that he (the Lord Chancellor) found, was that the company, of necessity, having obtained the order which made the presumed submission a rule of Court, could not themselves argue or suggest that the proceedings were now irregular. Nor could the other side do it, because they were content to have the order made, so far as the award generally was concerned, which, he believed, had been obeyed. The award was afterwards confirmed. It was a very serious question whether, in view of what appeared to be a defect on the face of the proceedings, they should base their decision on that state of affairs. The whole point turned on whether there was any award on the word "expenses" in Sec. 28; this conclusion was that if that section was to apply, as he was willing to consider it, it covered something to be paid by one party to the other and was really only costs; that it included costs, and that where it was a larger thing than costs, and where the expression was interchangeable with costs, the arbitrator had jurisdiction to make the order which he did, giving costs simpliciter. It was impossible not to see that a grave and serious question arose as to whether the whole proceedings in the case were not outside jurisdiction. He thought, however, on the whole, as he found an order purporting to be regular, which might be within jurisdiction if there was a real submission, he might safely declare his opinion that Mr. Justice Barton's view was correct.

Lord Justice Molony and Lord Justice Ronan concurred.

The LORD CHANCELLOR said Parliamentary costs would be, of course, indemnifying costs, his view being that the decision of the Court of Appeal in England in Peterson's case was conclusive on the subject. He also pointed out, with regard to the extension of the Arbitration Act to Ireland, that three lines would have cured what was a very manifest error.

MR. T. M. HEALY, K.C., M.P. (for the company) said it might interest the Court to know that when a clause was being drafted the Board of Trade ruled it out.

In reply to Mr. Clancy, K.C., M.P. (for the Council), the LORD CHANCELLOR said the ruling was that the appeal was dismissed, with costs.

S. T. BALDRY *v.* SUN ELECTRICAL CO., LTD.

JUDGE PARRY, at the Lambeth County Court, on 20th inst., gave judgment in the application for compensation made by Samuel Theodore Baldry, aged 14 years, who, through his father, Joseph William Baldry, engineer, of 65, Kirkwood Road, Peckham, brought an action under the Workmen's Compensation Act against the lad's employers, the Sun Electrical Co., Ltd., of 118-120, Charing Cross Road, W. The facts were reported in our issue of April 7th, page 391. A piece of metal thrown by another boy caught the applicant in the right eye, the sight of which he lost. His HONOUR, in giving a considered judgment, said a suggestion was made that the boys were larking, but their evidence convinced him that this was not so. They were taking an intelligent interest in their surroundings, and seeking information from each other, as human children of their age would do, and, according to modern educationalists, should be encouraged to do so. He had no doubt that this was an accident arising out of, and in course of, the applicant's employment, and made an award in his favour of half wages of 9s. 10d. a week since the date of the accident, with costs.

MORGAN JAMES *v.* BEDWELLTY DISTRICT COUNCIL.

MR. JUSTICE ASTBURY, in the Chancery Division, last week, gave judgment in the action of Morgan James, flannel manufacturer, Maesycymmer, against the Bedwellty District Council. The matter is reported in the *South Wales Echo*, which says that plaintiff sought damages for the pollution of the river Rhymney with sewage, which, it was alleged, clogged plaintiff's turbine to such an extent, that it would not work, and, as the consequence, plaintiff had to obtain electric power and light for his factory and house from the South Wales Electric Supply Co. at considerable expense. Defendants denied liability, and pleaded that the machinery could not work owing to its neglect and defective erection.

His LORDSHIP said there was only one fact not disputed, and that was that the Council poured their undiluted sewage into the river. Not unnaturally, perhaps, defendants sought to throw the blame on the other District Councils, particularly the Council of Gelligaer. On the evidence, he thought there were three contributory causes to the loss of the power of the turbine. The first was that the plaintiff neglected to replace worn blocks; the second was that the vanes of the turbine were choked with solid sewage matter mixed with coal dust, and the third was that, owing to the presence of sewage, the screens to the turbine became unusable. The parties, and especially the defendants, had spared no expense in presenting the case. Balancing the evidence as best he could, and notwithstanding the expert views which were very positively given by the defendants' witnesses, he had come to the conclusion that solid sewage did find its way from defendants' pipes to plaintiff's factory, and that even if plaintiff had kept his turbine in proper repair, it could not have given satisfactory power. He awarded plaintiff damages for £150 and costs, and refused a stay of execution, remarking that he thought the Council had indulged themselves very freely in incurring expenses for expert evidence.

MUNITIONS CASES.

BEFORE the Oldham Munitions Tribunal two Belgians applied for leaving certificates to enable them to leave the service of an electrical manufacturing firm. They complained that they felt ill and said they desired to go to London for a rest and to undergo medical treatment. A doctor's certificate was produced showing that both men needed a rest. It now transpired that one of the men did not want to go to London, but wished to take up textile employment at Bradford, having been offered a wage of £4 per week. Spinning, according to the doctor, would suit him better than shell-work, which was too heavy for him. The men said they received 28s. and 32s. per week respectively, with 3s. war bonus in each case, but according to the statement of a representative of the firm their average earnings were 47s. per week and 37s. 8d. per week respectively. The applications were refused.

At a General Munitions Tribunal at Oldham, an electrical firm complained that the Gordon Spinning Co., of Hollinwood, had engaged a junior clerk from their office without consent or leaving certificate. Mr. Marland, of the electrical firm, described the youth's work and strongly complained about outside firms taking their clerks after they had trained them. At least a dozen boys from their place had been taken into cotton mills during the last few weeks. Mr. A. J. Ashton, K.C. (President), said they did not intend to allow textile companies to go on taking these boys as they had been doing. They were going to protect the munitions establishments as much as they could. There would be a fine of £2 in this case, but it must be clearly understood that if offenders came again, either in Oldham or in other towns, they would take a severe view of the matter. Mr. Pickford, manager of the Gordon Co., said he was sorry if he had acted wrongly, but he had done it in ignorance. The President said he was prepared to accept that statement. If he had thought the act had been committed other than in ignorance he would have imposed a fine of £10 or £15.

Trade with Australia.—H.M. Trade Commissioner for Australia (Mr. G. T. Milne) is about to visit those trade and industrial centres in the provinces which have been decided upon as most advantageous to visit in view of the applications that have been received from firms in or near those centres, and from Chambers of Commerce. The itinerary of H.M. Trade Commissioner's tour includes Bristol, Newport (Mon.), Cardiff, Birmingham, Wolverhampton, Walsall, Coventry, Leicester, Nottingham, Derby, Stoke-on-Trent, Dublin, Liverpool, Manchester, Sheffield, Huddersfield, Bradford, Leeds, Newcastle, Edinburgh, Dundee Dunfermline and Glasgow in the order named.

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BUSINESS NOTES.

Greece.—The French Consul-General at Athens gives the following particulars regarding the commercial situation in Greece as far as concerns imports. Price, owing to the competition of German and Austro-Hungarian products, is an essential factor, and should be fixed at the lowest level practicable, and should embrace freight, insurance and packing. Among wares which French exporters might offer with a good chance of sales are lighting apparatus, chemical products, machinery, dynamos, steam-engines, &c. The Greek merchant only rarely opens direct negotiations with oversea producers, and foreign exporters have more often to treat with commission agents whose standing in consequence becomes of first importance. To obtain all needful details regarding such firms' credit and reputation, French exporters have only to apply by letter to the French Chamber of Commerce at Athens-Piræus, or, in Paris, to the Office National du Commerce Extérieur (which bodies would, doubtless, extend their services to British exporters, in special cases). Additionally, the French Consul also advises a more extensive employment of travellers, if only to counterbalance the local activities of the numberless German travellers in Greece. Particular attention must likewise be given to the drafting of the terms of the agreements come to. The bills of lading drawn in duplicate and sent by two different routes, should be as much as possible made out in a way to lessen the risks of the misappropriation of this deed and the diversion of the goods to improper third parties. Packing should be light, but strong. Settlement is made through a bank, which hands the documents to the purchaser against payment forthwith or against an accepted bill. The French exporter is dissuaded from drawing directly on the purchaser. Credit varies from two to three and from six to 12 months, and as the renewal of bills is common throughout the Levant, exporters would commit a great error in showing themselves too strict on this head. In Greece commercial causes come before the civil courts; suits are decided by a Commission of Customs officials, which is attached to the Ministry of Finance, against whose decisions there is no appeal. The French Consul advises the making out and forwarding of invoices in the fullest detail, with gross and net weights of each article; to pack goods in solid cases, banded if possible; to insure against theft and other risks, and to indicate on the invoice the name of the representative in Greece of their insurance company to whom the goods-receiver should prefer his claim for damage or loss. It is to be observed that all commercial travellers are subject to special regulations, prescribed by Article 6 of the Commercial Code arranged between Germany and Greece, whereby among other things, they must be furnished with a letter of recommendation subscribed by a competent authority in their own country; samples which they bear are allowed duty free only on condition that they are re-exported unmutilated within from six to 12 months, and subject to fulfilling certain Customs formalities. Commercial travellers are likewise exempt from the patent tax, if Greek commercial travellers are granted a like exemption. The office of the French Chamber of Commerce in Greece is available for use by French commercial travellers for the reception of their correspondence, and, on occasion, for the exhibitions of samples.—*La Revue Electrique.*

The Board of Trade C.I.B.—At a recent meeting of the Advisory Committee of the Board of Trade Commercial Intelligence Branch, it was reported that the number of written and personal inquiries received, exclusive of the foreign samples section, during 1915 was 50,400, as compared with 40,600 in 1914, and that in view of the success which had attended the British Industries Fair, the Board of Trade had decided to hold a similar Fair next year, to be opened on February 1st.—*Daily Telegraph.*

Aircraft Constructors.—The *Times* records the formation of the Society of British Aircraft Constructors, Ltd., to encourage, promote, and protect British aircraft industry. Among the firms who have signified their intention to join are:—Austin Motor Co. (1914), Ltd., Wm. Beardmore & Co., Ltd., Boulton and Paul, Ltd., Brush Electrical Engineering Co., Ltd., Mann, Egerton and Co., Ltd., Handley & Page, Ltd., Phœnix Dynamo Manufacturing Co., Ltd., Robey & Co., Ltd., Ruston, Proctor & Co., Ltd., Vickers, Ltd., and G. & J. Weir, Ltd.

Liquidations.—Ilkeston Motor and Electrical Engineering Co., Ltd.—Creditors must send particulars of debts, &c., to the liquidator, Mr. A. Boaler, King Street, Nottingham, by May 16th.

Teleradio Electric Co., Ltd.—A meeting is to be held on May 22nd, at Balfour House, E.C., to hear an account of the winding up from the liquidator, Mr. E. H. R. Trenow.

Ardwick Electric Regulator Co., Ltd.—This company is winding up voluntarily with Mr. J. W. Shepherd, 78, King Street, Manchester, as liquidator. A meeting of creditors is called for May 5th.

British Accumulator Co., Ltd.—Meeting of creditors, May 4th, at Tanfield Buildings, Bradford.

Trade Announcements.—In order to expedite delivery of telegrams to the Edison & Swan United Electric Light Co., Ltd., Ponder's End, Middlesex, customers are asked to address all telegrams: "Ediswan, Enfield," when communicating with the Ediswan Works.

The new works of Messrs. Austin Walters & Son are at Gaythorn Electric Works, Manchester. Their old address was inadvertently given in our paragraph of last week. The word *stores* in the last line but one of that paragraph, of course, should have read *stores*.

The Greenly Advertising Service have issued a folder entitled "Preparedness," briefly explaining the service which they are prepared to render. Copies will be sent to manufacturers and merchants on receipts of an inquiry to 37 and 38, Strand, W.C.

The General Insulate Co., 1008-20, Atlantic Avenue, Brooklyn, N.Y., makers of "Insulate" and "Hi-Heet" moulding compound, are extending their works so as to more than double their present capacity.

Book Notices.—*The Relation of Imports to Exports.* By J. Taylor Peddie. Second Edition. London: Longmans, Green & Co. 5s. net.—The author describes this book as a study of the basis of a new National and Imperial Policy. A series of essays, in which a number of leading authorities are quoted at length, has been written to induce the public to see that all questions relating to the welfare of the State should be judged from the national point of view, and not from the standpoint of political party or individual interest. In the introductory notes the author holds that the destiny of nations is now guided by the efficiency of their systems of national economics. He takes credit that another volume of his was "largely instrumental in bringing about the formation of a strong Industrial Research Committee, under the auspices of the Government," which has placed £30,000 at its disposal. We are inclined to think that some others also believe that they were "largely instrumental" in that connection. In the preface to the second edition, he asserts that a great many of the legislative measures approved of in recent years would have taken on a much different character if they had been based on a clearly defined national policy, and this volume is submitted with a view to making a beginning in this direction. The essays in which he unfolds the national policy are "The Relation of Imports to Exports; Foreign Exchange (the Bill of Exchange)"; "National Economics or Empiricism?" Part of the last of these, as he says, was read after luncheon to the Institute of Industry in January last. The four immediate objects which he considers the public should aim at establishing before the war concludes, or shortly thereafter, are Nos. 1, 2, 3 and 6, which were published in the Electrical Review for January 21st, page 66—a Ministry of Industry, better representation in Parliament of national industry, finance, science and commerce, the establishment of industrial banks, and the standardisation of our educational system.

"Scientific Papers of the Bureau of Standards": No. 260, Centre of Gravity and Effective Wave Length of Transmission of Pyrometer Colour Screens, and the Extrapolation of the High Temperature Scale; No. 261, Studies of Instruments for Measuring Radiant Energy in Absolute Value: an Absolute Thermopile; No. 264, Photometry of the Gas-filled Lamp; No. 265, Life Testing of Incandescent Lamps at the Bureau of Standards; No. 269, Effect of Imperfect Dielectrics in the Field of a Radio-Telegraphic Antenna. "Technological Papers of the Bureau of Standards": No. 62, Modern Practice in the Construction and Maintenance of Rail Joints and Bonds in Electric Railways; No. 63, Leakage of Currents from Electric Railways; No. 68, Standardisation of Automobile Tire Fabric Testing.

"Circular of the Bureau of Standards": No. 14, Analysed Irons and Steel Methods of Analysis; No. 17, Magnetic Testing.

"*Journal* of the Röntgen Society." No. 47. Vol. XII. April, 1916. London: Percy Lund, Humphries & Co., Ltd. Price 4s. net.

Bankruptcy Proceedings.—A. F. Hawdon, electrical engineer, Gosforth.—Application for discharge is to be heard at Newcastle-on-Tyne, on May 11th.

J. Swainson, electrical contractor, Chorlton-cum-Hardy and Manchester.—Trustee (Mr. A. Yearsley) released March 24th.

Catalogue.—British Thomson-Houston Co., Ltd., Rugby.—List No. 4,501 C, giving an illustrated description of, and price and dimensional information respecting, lightning arresters for C.C. circuits.

LIGHTING AND POWER NOTES.

Argentina.—A preliminary meeting of shareholders of the newly constituted co-operative association for the supply of electric light and energy in Mar del Plata has been held. The installation is expected to be working by next summer season. It is proposed to charge 40 cents per unit during the summer and 25 cents during the winter months.

After careful consideration of the request of the Compania Alemana Transatlantica de Electricidad for permission to supply electric current by means of aerial wires in certain of the less densely-populated districts of the Federal Capital, the request has been granted, similar permission, however, being accorded to all other electrical companies operating in the city.

Australia.—The *Commonwealth Engineer* recently summarised the position of the controversy regarding the departure from standard frequency and voltage in the case of the West Australian Government's power plant at Perth. The Federal Council of the Electrical Association of Australia has endeavoured to induce the W.A. Premier to conform to the existing standards, pointing out the disadvantages which will arise from the Perth

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area having to be specially provided for, in view of the 40-cycle A.C. supply and 250-volt consumers' pressure which is being adopted, but has apparently been unsuccessful. It may be added that 50 cycles has been generally adopted for A.C. work on large Australian supply undertakings, while the voltage adopted for Perth consumers, 250 volts, adds to existing divergencies as follows:—Adelaide 200, Brisbane 220, Melbourne 200 and 230, and Sydney 240 volts.

Aylesbury.—Loan Application.—The U.D.C. has applied to the L.G.B. for sanction to a loan of £550 for battery extensions at the electricity works. The Council has agreed that notice be given to the occupier of the Bull's Head Hotel to discontinue receiving current from the Aylesbury Electric Theatre, Ltd., or any company or person other than the Council.

Burton-on-Trent.—The T.C. has decided to carry on the cable extensions to cost about £600, including the provision of transformers and motors, and to meet the cost out of revenue. The extensions are needed for additional power customers.

Cardiff. — Restricted Lighting. — The electrical engineer reported to the Tramways and E.L. Committee that the new lighting restrictions order, which came into force on the 14th inst., would mean a loss of £20,000 to the department. There have been no restrictions in lighting up to now.

Grimsby.—The Electric Lighting Committee has decided not to accept any new consumers of current for lighting purposes, the plant being already overloaded. The engineer, in his report, recommends that a scheme of extensions be prepared, so that orders can be placed immediately on the close of the war. The report was adopted. The Committee agreed, in the event of the war being over by next winter, to continue the existing restrictions as to private and public lighting.

Heywood.—Although the actual figures showing the result of the working of the electricity department during the past year have not yet been made public, the Electricity and Tramways Committee has decided to ask for a sum equal to the production of a 4d. rate for the reduction of the adverse balance; last year a 5d. rate was granted.

India.—Electric Power Schemes.—In view of the growing demand for electric power in Mysore, Mr. S. G. Forbes, chief electrical engineer, has formulated two projects to supplement the present works at the Cauvery Falls. They are known as the Shimsha and the Kededatu schemes, estimated to cost 67 lakhs and 30 lakhs respectively. Power from these would be fed into the existing transmission cables. Increased production up to 40,000 H.P. is provided for, with a further possible increase up to 50,000. In discussing a paper on the subject before the Mysore Engineers' Conference, Mr. Forbes, besides forecasting a possible supply of 3,000 to 4,000 H.P. for Madras City, points out that the railway from Bangalore to Mysore can be electrified. He thinks the schedule of trains over this 87 miles' section could be so arranged that power consumption would be fairly uniform throughout the day at an average of 1,000 H.P.—*Indian Engineering.*

Itchen.—Prov. Order.—The B. of T. has informed the U.D.C. that it has no power to grant an extension of the E.L. order for three years after the war as requested by the Council, but under the existing circumstances it will defer the question of revoking the order for a year.

London.—St. Pancras.—The Ministry of Munitions has agreed to the request of the B.C. that the contracts in connection with the King's Road station extension may be declared war contracts, so far as the two new boilers and the building portion of the work are concerned. The Ministry suggests, however, that the installation of the coal storage bunkers and coal and ash-handling plant should be left over, if possible, in order to economise in the use of steel. The Electricity Committee thinks it important that the whole of the portion of the station extension scheme now arranged for should be allowed to proceed without modification, and it has accordingly appointed a deputation to wait upon the Ministry to explain the urgent needs of the case.

Woolwich.—A supply of current is to be given to a large firm engaged on Government work, necessitating the purchase of apparatus, and at a total cost of £140. Having regard to the fact that the amount of coal to be handled at the Globe Lane Station has nearly quadrupled, and there is every possibility that it will further increase, the Electricity Committee's original proposal to purchase a grab to be fitted to the existing telpher is quite insufficient to meet present needs, and it is reported that other arrangements have been made in connection with the existing extensions now being completed. The B.C. has received sanction to the borrowing of £3,290 for mains, transformers and hire rentals.

Luton.—New Plant.—The electrical engineer reports that two new boilers, an economiser and steel piping, and ash and soot-handling plant, will be required for next winter's load.

Lymington.—Price Increase.—The Electricity Co. has informed the T.C. that as from March its charges for current will be further increased by 5 per cent.

Manchester.—Rate Aid.—At the meeting of the Electricity Committee to consider the estimates, it was stated that in order to provide the £30,000 for rate aid for the previous year £1,825 had to be taken from the reserve fund, the surplus available being £28,175, as against £34,426 the previous year. The number of units sold for the year ended March 31st, 1916, was 141½ millions, as against 127¾ millions for 1915, and the income had risen from £530,740 to £605,652. For the current year the Committee estimates that the sales will increase by about 42 million units. Owing to the high price of fuel and other costs the estimated surplus on the year's working is £9,000. To provide the £30,000 for rate aid it will be necessary to withdraw the balance in the reserve fund and carry forward as a debit against the year 1917-18, £10,943.

Mexborough. — Proposed Loan.—The U.D.C. has decided to apply to the L.G.B. for sanction to borrow £700 for the purchase of a new boiler, &c.

Rathkeale (Co. Limerick).—Workhouse Lighting.—The average cost of gas lighting for the workhouse for the six years 1909-14 was £100 per annum, while the electric light bill for the year ended in March, 1916, showed a cost of only £65.

Rochdale.—Year's Working.—The working of the electricity department during the past year shows a profit of £2,537, compared with £1,522 in the previous year, and a loss two years ago of £330. The income amounted to £51,307, compared with £33,553, an increase of £17,754. Working expenses amounted to £30,379, compared with £18,379, an increase of £12,100. The gross profit was £20,928, or £5,655 more than in the previous year. Interest and sinking fund charges, and allowances to employés on active service, amounted to £18,390, compared with £13,751 in the previous year. The depreciation fund amounts to £10,286, the sinking fund to about £35,000, and there is £4,857 in the reserve fund. The capital value of the undertaking is given as £227,673. Last year £1,500 was contributed to rate relief, but this year it is recommended that the profit of £2,537 shall be placed to reserve.

It is proposed to apply for L.G.B. sanction to the borrowing of about £60,000 for extensions to the electricity works building and plant, in accordance with recommendations in the report of Mr. S. L. Pearce, Manchester city electrical engineer, who has recently been called in to prepare an expert report.

Southampton.—In the course of a report upon the condition of the machinery and mains, the electrical engineer reminds his Committee that last year English agents found it difficult, and finally impossible, to obtain brushes from Germany for the Willans turbo-generator. For some months this machine was run as little as possible, in order to eke out the stock, there being no English makers of these brushes. Sample brushes obtained from a French firm have now proved fairly satisfactory.

Stratford-on-Avon.—Price Increase.—The T.C. has consented to the Electricity Co. increasing the charge for energy for lighting from 5d. to 6d. per unit for the year or for the duration of the war.

Tasmania.—Owing to delay in the delivery of material, the Government's Great Lake hydro-electric scheme is not likely to be ready to supply light and power before May. The turbines at the power station were given a trial run recently, when the machinery ran smoothly, and everything was in good order. All that remains to be done before power is available at Hobart is to carry the transmission line across the Derwent at Bridgewater.

Tynemouth.—Year's Working.—The report of Mr. Turnbull, the borough electrical engineer, on the working of the electricity department for the year ended March 31st last, shows that the total units sold amounted to 4,809,841, as against 4,296,305 in 1914-15; of these, 2,844,860 were three-phase units supplied to large consumers not over the Council's mains, while of the balance 1,833,893 units were purchased in bulk, and only 291,653 units were generated by the Council's plant. The total revenue for the year was £23,030, and the net surplus, after meeting all expenses, £738, as compared with £1,787 in the previous year.

Watford.—Loan Sanction.—The U.D.C. has received sanction to the borrowing of £1,625 for electricity purposes.

West Ham.—The electrical engineer reports having obtained quotations for further automatic protective devices to be used in connection with the three main generators, and that he proposes to put these on order immediately. When installed, these devices, the engineer submits, will bring the principal generators into line with the most modern practice in regard to automatic protection.

Weymouth.—Price Increase.—The T.C. has decided, in view of the loss of £1,500 on last year's working, that the charges for electricity be increased as from April 1st as follows:—15 per cent. on lighting and fixed price lighting, 20 per cent. on heating, cooking, power and contract supplies, and that the meter charges be reduced from 2s. 6d. to 1s. per quarter.

Wolverhampton.—Price Increase.—The T.C. has decided to advance the price of electricity by 10 per cent.

Application is being made to the L.G.B. for sanction to borrow £17,100 for the extension of the Corporation's electricity plant.

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TRAMWAY and RAILWAY NOTES.

Australia.—The Minister of Victorian Railways (Mr. H. McKenzie), states that satisfactory progress has been made towards the inauguration of the surburban electrification scheme. Contingent upon the arrival of sufficient apparatus from the contractors, Messrs. Siemens Bros. Dynamo Works, Ltd., it would be practicable to commence the running of electric trains on the line between Essendon and Sandringhan about the end of the year. The Agent-General and the consulting engineer, Mr. Merz, had waited on the Minister for Munitions to obtain his consent to the contractors proceeding with their work, but they were unable to obtain any definite promise. The Commissioners are in communication with Mr. Merz who has requested the contractors to submit any proposal they can make for the early completion of the contracts. The Minister stated that the present indications are that the determining factor in the matter will be the supply of switchgear.—*Melbourne Age.*

Birmingham.—Trailer Cars, &c.—The Tramways Committee reports that no definite decision has been arrived at with reference to the running of trailer cars. A car was being prepared, and would be placed on the Handsworth route as an experiment; if successful, the question of introducing such cars upon the tramway routes of the city would be considered.

The scheme for constructing a branch tramway off the Erdington route, to open up communication with Tyburn, had been postponed until after the war; meanwhile motor-'buses, of which several of the 12 ordered had been delivered, would be used to convey employés to the works in that district.—*Birmingham Daily Post.*

Blackburn.—Year's Working.—The annual report of the Corporation tramway department for the year ended March 31st last, shows that the total revenue was £68,410; the working expenditure amounted to £46,964, and after meeting financial charges the net balance was £1,757 as against £1,572 in 1914-15. The figures mentioned scarcely vary from those of the previous year. An increase of about £1,200 in war grants has been met by savings in other directions. Less miles have been worked and more passengers carried, the totals for the year being 1,091,050 car miles and 12,246,151 passengers. The receipts per c.m. reached 14·17d.

Blackpool.—Year's Working.—The gross profit on the Corporation tramways for the last 12 months was £35,036, the total income being £80,070. After allowing for interest, sinking fund repayments, &c., there was £16,275 available for the relief of the rates, reserve funds, &c. The year was financially the third best in the history of the tramway undertaking, there being a disposable balance of £24,552 in 1913-14, and of £17,664 in 1912-13.

Bradford.—Railless Goods Traffic.—Owing to the shortage of team labour and cartage facilities the question of utilising the tramway system for the conveyance of goods has been considered by Mr. C. J. Spencer, the tramways manager, with the result that a vehicle has been built by the tramway department as an experiment to run on the railless trolley principle, fitted with accumulators which will take in a supply of current from the overhead wires. It is considered that such a vehicle might be loaded with merchandise at a railway goods depôt and follow the tramway system to almost any part of the city. It is calculated that one of these vehicles would do the work of 10 men and 10 horses and carts, and at considerably less cost. The matter has been placed before the B. of T. by Sir Wm. Priestley, M.P., and Ald. James Hill, M.P., and the authorities in London have granted every possible facility. It is proposed to erect a number of vehicles of the type in question, and the experiment at Bradford will, it is understood, be watched by the B. of T., with a view to its development in other centres.—*Leeds Mercury.*

The general manager (Mr. C. J. Spencer) presented a report to the Tramways Committee regarding the issue of free tramway tickets during the year ended March 31st last. During the 12 months 442,230 free tickets were issued to soldiers, Belgians, and visitors attached to the Lord Mayor's Relief Fund, the aggregate value of these being £2,770. The proportions were: 333 400 to soldiers (£2,084), 97,180 to Belgians (£607), and 12,650 to Lord Mayor's Relief Fund visitors (£79).

Bury.—Year's Working.—The profit on the Bury sections of the Corporation tramways during the past year was £7,314, and it was decided to recommend that this should be apportioned as follows: insurance fund account, £1,000; reserve and depreciation fund, £1,314; and borough rates, £5,000. On the Radcliffe section a profit of £769 was made under the first agreement, and a loss of £368 under the second agreement; this is borne partly by Bury and partly by Radcliffe.

Croydon.—Strike.—At a meeting, on Tuesday, the employés of the South Metropolitan Tramway Co. decided to return to work at once, subject to certain guarantees; the Corporation employés, who also took a vote on the position, decided to remain out until the T.C. agrees to arbitrate or to have a meeting of both sides, with an independent chairman.

Darlington.—The Electricity and Light Railways Committee's report of the tramway revenue last year showed an increase of nearly £1,000. An increased demand for electricity was reported, by about 40 per cent. as compared with the previous year.

Female Tramway Drivers.—The Tramway and Vehicle Workers' Association has made representations to the B. of T. and the Ministry of Munitions against the suggested employment of women as tramway drivers, and the secretary of the Union, Ald. Jackson, of Salford, stated last week that requests had been made that the departments named should receive deputations on the subject. The Union contends that no case has been made out for the employment of women as car drivers, or for the assumption that men over military age cannot be obtained for the work.

Hyde.—Female Labour.—At the local Trades Council on the 18th inst. a protest was made against the proposed introduction of women as tramway drivers in the district. It was stated that the local Joint Tramways Board had invited applications from males or females who wished to learn driving.

Heywood.—Year's Working.—During the past year the loss on the tramway undertaking amounted to £518, compared with a loss in the preceding year of £1,042. The gross income amounted to £11,985, an increase of £358, and the gross expenditure to £12,503, a decrease of £165. It has been decided to ask the Corporation for a sum equal to the production of a penny rate for the reduction of the adverse balance.

Kingsbury.—The District Council is giving support to the application of the M.E.T. Co. for permission to use trailer cars.

Leeds.—Year's Working.—The returns of the Tramway Department for the year ending March 31st 1916, show that the income was £475,505 (traffic receipts £467,197; haulage of minerals £2,620; and rents £5,054) representing an increase of £40,994 as compared with a year ago. The working expenses were £230,715, as against £228,134 in the previous year, which left a gross profit of £239 278 as compared with the previous year's £206,376. To this is added £10,302 in respect of bank interest and dividends, and redemption fund investments bring the net revenue to £249,589, £35,375 in advance of the previous year. From this has to be deducted interest on capital £49,474; income-tax £15,319; rent of lines £3,072; allowances to dependents of employés serving with the Colours £13,271; redemption fund contribution £64.789; permanent-way renewals and exhausted loan on power plant sold during the year £11,550; reserve fund for third party risks £2,044, leaving a net surplus of £86,822, representing an increase of £5,256 as compared with the figure for a year ago. Of this surplus £15,000 is placed to the reserve fund, and £71,822 is to be devoted to the relief of the rates.

L. & Y. Electrification.—A tabular statement which has been prepared in connection with the electric train service between Manchester and Bury (which was inaugurated last week) shows that the electric system cuts down the time of the journey substantially. By steam train the journey from Manchester to Bury, with stops, is shown as taking 32 minutes, as compared with 24 minutes on the electric service. From Bury to Manchester the time by steam train is 29 minutes, and 22 minutes by electric train.

Manchester.—Estimates for 1916-17.—The Tramways Committee, after considering the annual estimates of receipts and expenditure for the year 1916-17, has agreed to contribute £100,000 to the relief of rates as it has done on two previous occasions, but to do this it is probable £10,865 will have to be taken from the reserve and renewals fund. This rate contribution was fixed by the City Council three years ago, and it is considered that it will have to be revised before the end of the year. For war service allowances the department paid £31,764 for the year ended March, 1915, last year the amount was £92,881, and for the current year it is estimated that £94,000 will be necessary, making a total in three years of £218,645. Last year's revenue was £939,416, an increase of £27,540 over the previous year and £14,106 higher than 1914 which was a record year; the car miles run were 18,486 440, and the passengers carried, 209,853,344, an increase of 7,084 924 over 1915. The revenue per car mile was 12·196d. as against 11·3d. in 1915. The estimated expenditure for 1916-17 is £950,365 based on an estimated car mileage of 18,500,000. After providing for the payment of £100,000 to the city fund and meeting the extraordinary expenditure arising out of the war, viz., war services allowances, £94,000 and £40,000 income-tax, the department will not only be unable to make any provision for renewals, but it is estimated that there will be a deficiency of £10,865.

Northampton.—Precautions which have been taken in case of Zeppelin raids, almost led to a strike of the Corporation tramway employés last week-end. The tramcars ceased to run a fortnight ago at 8 p.m. and this led to a reduction of the working hours and a consequent loss of wages to the drivers and conductors of the cars of from 7s. to 8s. per week. An offer by the Tramway Committee to pay half rates for the lost time was declined. After further consideration the Committee agreed to the demands.

Portrush and Giant's Causeway.—County Court Judge Orr, sitting at Ballymoney, Co. Antrim, decided that the Portrush and Giant's Causeway Electric Tramway was to be assessed as a tramway, not as a railway, and that the Portrush Urban Council was therefore entitled to recover £8 in its action against the tramway company for moieties of poor-rate and consolidated town rate.

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Rochdale.—YEAR'S WORKING.—The net profit of the Corporation tramways for the year just ended amounts to £3,608, a decrease of £676 by comparison with that of the previous year, and it has been decided to ask the Council to approve the placing of the whole of the profit to the renewals fund, which will then stand at £22,149. The gross takings to March 31st last amounted to £87,908, an increase of £4,733. Working expenses amounted to £48,124, an increase of £1,283. Interest on loans, income-tax, sinking fund, rent of leased lines, and receipts due to Heywood, accounted for £34,780, as against £32,652 in the previous year; half wages to men on active service, and war bonus to employés remaining with the department, amounted to £3 262, as against £1.208 a year ago. The sinking fund has been increased from £108,033 a year ago to £120,868 at present.

Southampton.—ELECTRIC VEHICLE.—The Tramways Committee has decided to purchase an Edison battery automatic tip-wagon at a cost of £950, and to pay for the same out of the depreciation and renewals fund.

Southend-on-Sea.—According to a financial statement prepared by the borough accountant, the total loss incurred on the motor-'bus undertaking, subject to loss on realisation of the assets still in hand, amounts approximately to £1,179. Edison Accumulators, Ltd., has offered to supply additional 'bus chassis at the price tendered in April, 1915—viz., £890 each—and also to replace the existing motor-'bus chassis with a new model, less a sum in respect of depreciation. The Committee has adjourned consideration of the matter until after the war. The Committee has resolved to try, as a tentative measure, the services of suitable women and girls with a view to utilising them as temporary drivers.

Stalybridge.—In connection with the protest of the Trades Council against the contemplated employment of women as tramcar drivers, it was reported at a meeting of the Council last week that the commercial manager of the Joint Tramways Board had written stating that women drivers would only be put on in the last resort, and then only after thorough training and on level routes. No driver was allowed on hilly routes until after two years' service. It was decided to leave the matter where it was for the present.

West Ham.—The B. of T. has given its consent to the Corporation's proposal to substitute a double line of tramway track for the existing interlacing lines in Woodgrange Road. The Tramways Department proposes to purchase a second-hand motor-lorry for cartage purposes.

York.—FEMALE LABOUR.—The Tramways Committee proposes to instruct women as drivers of the Corporation cars, and the tramway manager has asked the drivers and conductors if they would be willing to work with women drivers, and would be prepared to stand by the Corporation in the event of disturbance with other employés. The matter has been referred by the men to the Tramways Trade Union, which has requested the Committee to receive a deputation before taking any action in the matter.

It was proposed at a meeting of the Tramways Committee that four women should forthwith be instructed as drivers; an amendment that no action should be taken until the Committee had received the deputation from the Union was carried on the casting vote of the chairman.—*Manchester Guardian.*

TELEGRAPH and TELEPHONE NOTES.

Constantinople.—A letter addressed to a German newspaper in March contains a reference to the situation of the telephone service in the Turkish capital. A few days previously the Turks celebrated the anniversary of the taking-over by the Government of the undertaking of the English Telephone Co. According to the well-known newspaper the *Tanin*, the requestration of the undertaking was due, apart from the state of war with Great Britain, "to the defective fulfilment of the obligations and the conditions of the concession assumed by the English company." On the occasion of the celebration the present general manager of the telephone system sought to prove that the Turkish administration had turned out far superior to the former English management, and that the statement of the retiring Englishmen, who predicted that the telephone service would be suspended within two months, had come to nought. It was mentioned in this connection that, notwithstanding the scarcity of materials, the number of exchanges had increased during the year, simultaneously with a reduction in the number of telephone girls from 120 (!) to 94, some of whom are young Turkish girls. At the same time the daily conversations had risen from an average of 8,600 to 23,000. These figures were also quoted by the Turkish newspaper in question, which added that no single employé was now in the service who was not an Ottoman subject.

Glasgow.—The opposition of a number of subscribers to the increase in telephone rates for unlimited service has resulted in the formation in Glasgow of a Telephone Subscribers' Defence Association.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—May 24th. N.S.W. Government Railways and Tramways. 16 600-volt D.C. motors for tramway stores, Randwick.*

MELBOURNE.—May 1st. City Council. Meters and maximum-demand indicators. See "Official Notices" April 7th.

May 31st. Victorian Government Railways. Transformers for five years. First order, 220 transformers in six months.*

Birkenhead.—May 2nd. Electricity Department. Twelve months' supply rough slack, small coal and coke breeze. Electrical Engineer, Craven Street.

Glasgow.—May 4th. Electricity Department. Twelve months' supply of cables and meters. See "Official Notices" to-day.

New Zealand.—June 23rd. Oamaru Borough Council. Overhead mains and street-lighting equipment (Contract No. 2); power-station equipment (Pelton wheels, alternators, &c.) (Contract No. 3); service meters (Contract No. 4); line transformers and accessories (Contract No. 5).*

Salford.—May 8th. Electricity Department. High-pressure steel steam pipes and separator, also cast-iron pipes and valves. See "Official Notices" April 21st.

West Hartlepool.—April 28th. Electricity Department. Two water-tube boilers with superheaters and mechanical stokers. See "Official Notices" April 14th.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Bray.—U.D.C. One year's supply of electricity meters: Electrical Apparatus Co., Ltd.

Burton-on-Trent.—T.C. Coal (4,000 tons) for the electricity works: Messrs. Jonathan Longbottom & Sons.

East Ham.—Accepted tenders for coal for the Electricity Department for 12 months:—

E. & A. Shadrack.—1,000 tons Nailstone best hand-picked hards, £1 4s. per ton; 2,000 tons Nailstone best 1½-in. nutty slack, £1 1s. 10d.; 1,000 tons Swadlincote 1½-in. nutty slack, £1 2s. 11d.; 2,000 tons Cadley Hill 1½-in. best nut y slack, £1 2s. 6d.

E. Foster & Co.—1 500 tons Bestwood washed peas, £1 1s. 8d. per ton; 1,000 tons Craigola Welsh large steam, £1 8s. 11d.; 1,500 tons Pooley ¾-in. slack, 19s. 5d.; 1,000 tons Ibstock slack, 16s. 6d.

Government Contracts.—List of new contracts for March, 1916:—

WAR OFFICE.

Secondary batteries.—Premier Accumulator Co., Ltd.; Pritchett & Gold and Electrical Power Storage Co.

Electric cable and wire.—B.I. & Helsby Cables, Ltd.; Callender's Cable and Construction Co., Ltd.; Connolly Bros., Ltd.; Hooper's Telegraph and India-rubber Works, Ltd.; Johnson & Phillips, Ltd.; Liverpool Electric Cable Co., Ltd.; St. Helens Cable & Rubber Co., Ltd.; Saxonia Electrical Wire Co., Ltd.; Siemens Bros. & Co., Ltd.; Yorkshire Cable Co., Ltd.

Electric cells.—J. C. Fuller & Son, Ltd.; Siemens Bros. & Co., Ltd.

Electric lighting sets.—Day Motor Co., Ltd.

Generating sets.—Aster Engineering Co.; Austin Motor Co.; W. H. Dorman & Co.; Electric and Ordnance Accessories Co.; Fyfe, Wilson and Co.; Keighley Gas & Oil Engine Co.; Arthur Lyon & Wrench, Ltd.; New Pelephone Engine Co., Ltd.; Norris, Henty & Gardners, Ltd.; Parsons Motor Co., Ltd.

Electric lamps.—Brimsdown Lamp Works, Ltd.; Bulpitt & Sons, Ltd.; Dick, Kerr & Co., Ltd.; Edison & Swan U.E.L. Co., Ltd.; E. Griffiths and Sons; Lyon & Wrench, Ltd.; Siemens Bros. Dynamo Works, Ltd.

Switchboards.—Park Royal Engineering Co.; Siemens Bros. & Co., Ltd.

Transformers.—British Electric Transformer Co., Ltd.

Works services.—Electric light, &c., Crayford: Pinching & Walton. Electric light at Clipstone Camp, Mansfield: V. G. Middleton. Electric light at Park Hall, Oswestry: V. G. Middleton. Power house and equipment at Wigton: Girdleston & Co.

INDIA OFFICE STORE DEPARTMENT.

Generator sets.—Lancashire Dynamo & Motor Co.; Dorman, Long & Co.

H.M. OFFICE OF WORKS.

Engineering works.—Electric passenger lift, Edinburgh Inland Revenue Office: Aldous & Campbell, Ltd. Westminster Government Offices, Southern Buildings Extension: Electric paper and coal lifts, Medways Safety Lift Co.; electric passenger lifts, Waygood-Otis, Ltd.

POST OFFICE.

Telegraph apparatus.—Creed, Bille & Co., Ltd.

Telephone apparatus.—B.I. & Helsby Cables, Ltd.; Siemens Bros. & Co., Ltd.

Testing apparatus.—General Electric Co., Ltd.

Tubular iron telegraph arms.—Bullers, Ltd.

Telephone cable.—Telegraph Construction & Maintenance Co., Ltd.

Bronze wire.—T. Bolton & Sons, Ltd.; Shropshire Iron Co., Ltd.; F. Smith and Co., Ltd. (incorporated in the London Electric Wire Co. and Smiths, Ltd.).

Copper wire.—T. Bolton & Sons, Ltd.; B.I. & Helsby Cables, Ltd.; Elliott's Metal Co., Ltd.; Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. & Smiths, Ltd.); Wilkes, Son & Mapplebeck, Ltd.

COMMISSIONERS OF PUBLIC WORKS, IRELAND.

New Public Offices, Dublin, South Block: electric wiring, bells, switchboard, &c.—V. G. Middleton.

High Wycombe.—T.C. Refuse destructor: Messrs. Goodrich & Hamlyn, £1,435.

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Llandaff and Dinas Powis.—Rural District Council. One year's supply of A.C. meters: Electrical Apparatus Co., Ltd.

Leyton.—The quotation of Messrs. Edgar Allen & Co. has been accepted, at £480, for a new lay-out.

Mexborough.—U.D.C. Water-tube boiler, £615: Messrs. Babcock & Wilcox, Ltd.

Southampton.—The Electricity Committee, having received tenders for British-made meters, has decided to divide the contract between Messrs. Chamberlain & Hookham and Messrs. Ferranti, Ltd., and has authorised the engineer to obtain any additional meters from the British Thomson-Houston Co. at prices not exceeding those quoted by the other firms named.

The Tramways Committee proposes to accept the tender of Mr. G. P. Wilson for brake blocks and castings, at £5 12s. 6d. per ton, an increase of 8s. per ton compared with last year.

Southend-on-Sea.—Owing to the increase in the price of materials, the E.L. Committee has agreed to pay the contractors for the supply of joint-boxes an extra sum of 2½d. per box in respect of 250 boxes recently ordered by the electrical engineer. The Town Clerk reports that subsequent to the decision of the Council in January last, to pay £168 to Messrs. Callender's Cable and Construction Co., Ltd., for cable ordered in December, 1914, in connection with the proposed supply of current in the Leigh area (the payment for which had been delayed in consequence of the withholding by the L.G.B. of the sanction to the raising of the necessary money for the purchase thereof, and for the construction of the Leigh sub-station) a portion of the cable had been supplied to the Government, and that Messrs. Callender's had offered either to replace such cable now, undertake to replace it at the termination of the war at the original contract price, or credit the Corporation with the value (£480), plus £210, being the increased value of the copper at the existing market price, thus reducing the amount payable to the firm to £991. The Committee has decided to accept the last-named offer.

Corporation. B.I. & Helsby Cables, Ltd.: Six miles of overhead trolley cable, at 1s. 4¾d. per lb.

West Ham.—The Council's contract with the Fuller Electrical and Manufacturing Co., Ltd., for the supply of motors for the Sales Department terminated at the end of March last. The engineer invited nine leading firms to send in quotations, but only four replied. Out of these that of the Fuller Co. was the only complete one; their prices, although much higher than last year, were slightly lower than those of any of the other three on most of the items, and slightly higher on two or three other items. The firm intimated, however, that they would not enter into a contract and reserved the right to increase prices at a month's notice. Under the circumstances the engineer proposes to continue to buy from the company until such time as it seems desirable to make another contract.

FORTHCOMING EVENTS.

Society of Engineers.—Monday, May 1st. At 5 p.m. At Caxton Hall, S.W. Conference on "Engineering and Scientific Research," to be opened by Dr. J. A. Fleming, M.A., F.R.S.

Institution of Electrical Engineers (Birmingham Local Section).—Wednesday, May 3rd. At 7 p.m. At the University, Edmund Street. Annual meeting.

Chemical Society.—Thursday, May 4th. At 8.30 p.m. At Burlington House, W. Ordinary scientific meeting.

Iron and Steel Institute.—Thursday, May 4th, at 10.30 a.m., and Friday, May 5th, at 10 a.m. At the Institution of Civil Engineers, Great George Street, S.W. Annual general meeting.

Royal Institution of Great Britain.—Friday, May 5th. At 5.30 p.m. At Albemarle Street, W. Lecture on "Electrical Methods in Surgical Advance," by Sir J. M. Davidson.

Saturday, May 6th. At 3 p.m. At Albemarle Street, W. Tyndall Lecture on "X-rays and Crystals: New Methods of Research," by Prof. W. H. Bragg, F.R.S.

NOTES.

Electric Light Switching Examinations.—The results of Messrs. Lundberg's recent examination are given elsewhere in this issue. The continued popularity of these competitions indicates that interest in them is sustained, and we have no doubt that really useful results accrue both to the competitors, who are thus induced to sharpen their wits and study the possibilities of the subject, and to the electrical trade, which will benefit by the increased knowledge thus acquired. A noticeable feature of the list of names is that we find there wiremen, students, Associate Members of the I.E.E., contractors, graduates, and apprentices, showing the width of the field from which the competitors are drawn.

Inquiry.—Makers of small steatite parts are asked for.

The Metric System.—In the paper on "Electric Power in Slate Quarries," of which an abstract appears elsewhere in this issue, there were included drawings which happened to be figured partly in inches as well as millimetres, and these afford interesting examples of the draughtsman's failure to appreciate the meaning of "significant figures." For instance, the original dimension being 310 mm., he gives the English equivalent as 12·2049 in. The latter is an absurdity, for the dimension relates to the frame of a motor, on which an accuracy of one part in 100,000 as here given would be ridiculous. Even to figure to mils is superfluous; the proper equivalent here is 12·2 in. Other instances occurring on the same drawings are the following:—Distance between centres of holes, 440 mm., 17·323 in. (17·32 would suffice); 330 mm., 12·9924 in. (12,99 would suffice). Of course, there should be no occasion for conversion—all the dimensions should be in the same notation, and that metric; but when and whilst conversion is necessary, it ought to be done with the aid of common sense. The dimensions of a bed-plate or motor frame are not gauged to the $\frac{1}{1000}$th of an inch in commercial workshop practice. In most cases $\frac{1}{100}$th in. and $\frac{1}{10}$th mm. are ample limits.

We welcome the decision of the Electric Vehicle Committee, reported on p. 485, to give the metric equivalents of all their standard dimensions (and trust that the error illustrated above will not be allowed to occur).

A report on the use of the metric system in export trade has been prepared by Director S. W. Stratton, of the United States Bureau of Standards. This report was considered so complete and of such a useful character that it has been issued as a Senate document, in the form of a booklet consisting of 80 pages. It will be found interesting by all manufacturers, especially those who are cultivating an export trade.

Institution and Lecture Notes.—Tramways and Light Railways Association.—At the annual Congress of this Association, which will take place on Friday, June 30th, there will be the annual general meeting at Westminster Palace Hotel, at 2.30 p.m., followed by a paper by Mr. W. Tuke Robson, general manager of the Southampton Corporation Tramways, and a discussion thereon. There will be a motor-'bus visit to the L.G.O. Training School, at Milman Street, Chelsea, and after the exhibition of kinema films showing London traffic scenes, with special reference to Rules of the Road for tramcars, 'buses, and other traffic, methods of training, &c., tea will be served during which Mr. Blain will give a short address on "The Safety Movement." The members' dinner will be held in the evening at the Trocadero Restaurant.

Royal Institution.—The lecture arrangements for the coming months include the following:—

Friday, May 5th, at 5.30. Sir J. Mackenzie Davidson, on "Electrical Methods in Surgical Advance."

Friday, May 19th, at 5.30. Col. E. H. Hills, F.R.S., on "The Movements of the Earth's Pole."

Friday, May 26th, at 5.30. Prof. C. A. Barkla, F.R.S., on "X-rays."

Tuesday, May 30th, and June 6th, at 3 o'clock. Dr. T. Martin Lowry, F.R.S., on "Optical Research and Chemical Progress."

Saturdays, May 6th and 13th, at 3 o'clock. (Tyndall Lectures.) Prof. W. H. Bragg, F.R.S., on "X-rays and Crystals." (1) New Methods of Research. (2) First Results and their Applications.

Saturdays, May 20th and 27th, at 3 o'clock. Prof. H. S. Foxwell, on "The Finance of the Great War—New Problems and New Solutions; How we Stand To-day and What Lies Ahead."

The Committee on Neglect of Science.—A meeting will be held at the invitation of this Committee, of which Sir Ray Lankester, K.C.B., F.R.S., is chairman, on Wednesday, May 3rd, in the rooms of the Linnean Society, Burlington House, Piccadilly, London. Lord Rayleigh, O.M., Past President of the Royal Society and Chancellor of the University of Cambridge, will take the chair at 3 p.m.

Resolutions will be submitted stating:—

That it is a matter of urgency, in order to promote national efficiency in the near future, that the natural sciences should be made an integral part of the educational course in all the great schools of this country, and should form part of the entrance examination of the Universities of Oxford and Cambridge, as well as of the newer universities.

That it is in the highest degree desirable that the Government should encourage the study of the natural sciences, and thereby increase the efficiency of our public servants, by assigning capital importance to the natural sciences in the competitive examinations for the Home and Indian Civil Service, and by requiring some knowledge of the natural sciences from all candidates for admission to Sandhurst; and

That the method indicated is the only one by which it is practicable to bring about the desired change in the attitude of the schools and colleges throughout the country towards the natural sciences and to make some knowledge and understanding of those sciences general. As the results of such changes will only develop in the course of years, it is urgent that the matter should be at once taken in hand by His Majesty's Government.

Many well-known public men have expressed their sympathy with the objects of the meeting, and several of them are expected to take part in the proceedings.

Those desiring admission to the meeting should apply to the Hon. Secretary of the Committee on the Neglect of Science, 38, Victoria Street, Westminster, S.W.

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Industrial Fatigue.—In our leading article to-day we draw attention to a memorandum issued by the Ministry of Munitions on the subject of "Industrial Fatigue and its Causes" (Memo. No. 7, Cd. 8,213; Wyman & Sons, Ltd. Price 1½d.). The keynote of the report is the necessity for due alternation of work and rest if the maximum efficiency, in the most general sense, is to be attained, the respective durations of these periods depending upon the nature of the occupation. By way of illustration the case is quoted of two officers at the Front, who recently, for a friendly wager, competed in making equal lengths of a certain trench, each with an equal squad of men. One let his men work as they pleased, but as hard as possible. The other divided his men into three sets, to work in rotation, each set digging their hardest for five minutes and then resting for ten, till their spell of labour came again. The latter team won easily. In another instance, a group of five male voluntary Sunday workers in a certain munitions factory were able in eight hours (including one hour for meals), to exceed the average day's output of eight week-day men, who worked 14 hours (including 1½ hours for meals). Whilst the squad probably could not have kept up the pace daily, there could be little doubt that they could repeat their 8 hours' effort on, say, four days a week, and the startling result follows that in those four days they could do more than the whole week's work of an equal set of men working for the longer hours; yet they would have more time for recreation and sleep and three whole holidays in the week. The work was of a uniform "repetitive" kind, involving moderate physical exertion. The experienced manager of a large shell factory employing 1,200 men and 1,500 women states that the system of three 8-hour shifts gives better output and maintains better health than that of two 12-hour shifts, and that there is a period of slacking, *often quite unconscious*, during a 12-hour shift which is detrimental to output.

On the question of Sunday work by exhausted men, a foreman said that he did not believe in "a holiday on double pay." Another foreman said that Sunday work gave "six days' output for seven days' work on eight days' pay." At a large shell-making factory the men during the early months of war worked seven 12-hour day and seven 12-hour night shifts in the week. Recently Sunday work has been stopped, and the men work from 6 a.m. to 7.30 p.m., with 1½ hours for meals, tea being also brought to the men while the machinery is running. The factory now produces an increased number of shells with half the number of workers, and the manager attaches the greatest importance to the week-end rests. At another large munitions factory men engaged in the heavy work of moulding are required by the management to rest 15 minutes in every hour of work, the manager being satisfied that this arrangement was good for the men and for the output. The men objected because they were on piece-work, and they thought the production would be lessened, but the output per hour was found to be actually increased.

References are given in the Memorandum to a report by Prof. Stanley Kent to the Home Office on industrial fatigue (Cd. 8,056, price 4½d.); "Fatigue and Efficiency," by J. Goldmark, New York, 1913; and the Interim Report to the British Association (Manchester, 1915) by the Committee on the Question of Fatigue from the Economic Standpoint. The following works also bear upon the subject: "Motion Study," by Frank B. Gilbreth; London, Constable & Co., Ltd. Price 4s. 6d. net. "Psychology and Industrial Efficiency," by Hugo Münsterberg; London, Constable and Co., Ltd. Price 6s. net.

Electrical Trade in Argentina.—Statistics which are based upon a census are generally of a belated character, and those which were published a few months ago by the Argentine General Administration of Trade and Industry, in regard to an industrial census which was undertaken in Buenos Aires for the year 1913, form no exception. The principle of the census was founded on the Trading-tax Register, and the firms concerned were requested to supply the desired information. It is considered possible that many of the figures returned may have been less than those which were actually the case, on account of the apprehension that the statistics might be utilised for the purposes of taxation. With this reservation a report recently issued shows that there were 45 electricity works in Buenos Aires in 1913, with a share capital of £7,900,000, which disposed of electrical energy for the sum of £2,050,000. The value of the native raw materials consumed by these works was £4,300, whilst that of the imported raw materials amounted to £498,000. The staff employed numbered 735 and the workmen 2,991, the salaries and wages averaging £193 5s. and £135 10s. per annum respectively. The works are for the greater part distributing stations of the German Transmarine Electricity Co., whose former monopolistic position is now threatened by the Italian-financed undertaking of the Cia. Italo-Argentine de Electricidad. It is mentioned that this company has already assured itself of contracts for the supply of energy for the harbour and the Palermo part of the city. Previous to the advent of this rival the price charged for lighting purposes was 5·17d. per KW.-hour, and that for power was 3·06d., but the competition has caused the prices to be reduced. The boilers which supply steam to the turbines in the generating stations are now fired with Mexican oil, and the Transmarine Co. is said to be financially interested in one of the oil-producing companies.

The report, proceeding to discuss the manufacturing side of the question, states that 121 firms produced electrotechnical goods in 1913, the combined capital being £218,000 and the value of the turnover £352,900. In manufacturing these products, inland raw materials of the value of £27,250 were used, whilst the imported materials totalled £68,300. The staff numbered 197 and the workmen 1,168, and the wages averaged £125 and £81 10s. per annum in the two cases respectively. Apart from these undertakings carbon brushes were produced by firms having a capital of £17,500, whose turnover, however, was comparatively insignificant. It is concluded from the figures that electrical work in Buenos Aires is very largely dependent upon other countries, especially as the imports of electrical machinery and plant in 1913 were of the approximate value of £2,000,000.

Appointments Vacant.—Engineer and manager (£400), for the Mexborough and Swinton Tramways Co. See advertisement pages to-day.

Electric Steel.—A South Australian company has in hand a project to establish in each of the capitals of the Commonwealth an electric steel furnace for making cast steel out of scrap iron. The furnace is a Swedish patent, and an English expert will superintend the works.—*Times*.

For Sale.—Greenock Corporation electricity department has for disposal one 500-B H.P. Belliss & Morcom triple-expansion engine, coupled to a 6-pole Silvertown dynamo, with spare armature. See advertisement pages to-day.

Volunteer Notes.—ENGINEERING INSTITUTIONS' V.E.C.—Orders for week commencing May 1st, 1916.—By Lieut.-Col. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, May 1st.—Sections 1 and 2, Technical; Sections 3 and 4, Squad and Platoon, Signalling Class.

Tuesday, May 2nd.—6 to 7 p.m. School of Arms; 7.15 to 8.15 p.m., Recruit Drill.

Thursday, May 4th.—Shooting for Sections 1 and 2, and Signalling Class; Recruits, 5.45 to 7.45 p.m.

Friday, May 5th.—Sections 3 and 4, Technical; 1 and 2, Squad and Platoon.

E. G. FLEMING,
Company Commander and Acting Adjutant.

3RD BATT. (OLD BOYS) CENTRAL LONDON VOLUNTEER REGIMENT.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, April 27th, 1916:—

Week-End Parades.—Saturday.—The Battalion will Parade as strong as possible outside Baker Street Station, and proceed by train to Wembley Park for Ceremonial Drill, under the Commandant.

Sunday.—The Battalion will Parade as strong as possible at Liverpool Street Station (low level entrance, G.E.R.), at 9.30 a.m., and proceed by train for Entrenching duties. The Battalion will return to town about 6 p.m. This being the last day on these particular trenches, a large muster is required in order to finish them and leave them in a fit condition to hand over.

Fatigue Party.—A volunteer Fatigue Party is required on Monday, May 1st, at Wembley Park. Members volunteering for this duty should report themselves to the Camp Quartermaster at Wembley Park, at 11 a.m. and 2.30 p.m.

Musketry.—There will be shooting at Bisley on Saturday next, the 29th inst. Names must be sent in to the Musketry Staff, not later than Friday midday. Members proceeding to Bisley must report themselves, in Uniform, to Sergeant Cotter, at 12.45 p.m. No. 6 Platform, Waterloo Station.

A. G. JOINER, *Major and Adjutant*, O.B.C.

Electric Vehicle Committee.—A meeting of the Committee was held in London on April 14th, 1916, Mr. R. A. Chattock presiding. It was announced that all the Associations, with the exception of the Tramways and Light Railways Association, whose reply had not been received, had re-nominated their representatives on the Committee. The Committee re-elected the representatives of the provincial electricity supply companies, makers of electric vehicles, Edison Accumulators, Ltd., and Chelsea Electricity Supply Co., Ltd. It was decided to invite the Motor Manufacturers and Traders' Society to nominate a representative to sit upon the Committee. The present officers of the Committee were re-elected for the present year, except in the case of Mr. A. H. Seabrook, who, by reason of the work he is engaged upon in connection with munitions supply in London, is unable to devote any time to the work connected with the honorary editorship of the *Journal*. This work the hon. secretary (Mr. F. Ayton) is undertaking *pro tem.* until someone can be found who will accept the position. It was decided that, in future, dimensions for standards will be given in both metric and British measures, and that, in regard to the British measures, exact dimensions will be quoted in mils, while ordinary dimensions will be quoted in fractions. The secretary was instructed to bring this rule to bear in quoting dimensions of standards in the annual report of the Committee. Mr. E. W. Curtis, of the General Vehicle Co., was nominated as the Committee's representative upon the Tire and Road Wear Research Committee of the Society of Motor Manufacturers and Traders. The next meeting of the Committee was fixed for Friday, June 16th, at 2.45 p.m.

Fatalities.—At the resumed inquest held at Failsworth last week respecting the death of Ernest Capewell, who had been employed as a labourer at the works of Messrs. Ferranti, Ltd., and who had a mishap whilst lifting a carboy of nitric acid, the jury returned a verdict of "Death from misadventure."

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Electrolytic Hypochlorite for Hospital Ships.—A report to the Medical Research Committee on the use of sodium hypochlorite prepared by the electrolysis of sea-water, for disinfecting and antiseptic purposes on shipboard, especially in hospital ships, has been made by Drs. H. D. Dakin and H. G. Carlisle, and was abstracted in the *British Medical Journal* of March 25th.

The report contains a description of apparatus installed on H.M.H.S. *Aquitania*, and is illustrated by scale drawings which would make it possible for any combination of doctor and engineer to introduce the method into any ship in which its use seems advisable. The electrolyser consists of a rectangular box of teak or cedar bolted together, and divided into 20 or 25 cells by means of carbon plates placed parallel to one another. Great care must be taken in the selection of the carbon plates, and a particular kind of graphite is recommended. Two wires leading the ship's current (100 to 110 volts direct current) are suitably connected through a switch with the electrolyser, which, to ensure even distribution of current, is provided with a copper plate attached to four binding screws at each end. If the voltage be 200 to 220, two electrolysers can be placed in series. Thanks are expressed to Dr. Edward Hopkinson, of Messrs. Mather & Platt, Manchester, for his assistance in constructing a practical and efficient apparatus, and apparently that firm is prepared to provide electrolysers.

When using ordinary sea-water, it is inadvisable to continue electrolysis for more than 10 minutes. In that time, with a current of 60 to 75 amperes at 110 volts, a solution will be obtained containing usually a little less than four parts per 1,000 of sodium hypochlorite or available chlorine. For most purposes it is advantageous to limit the electrolysis to five minutes, and at the end of that time the solution will contain from 2 to 2·7 parts per 1,000 of sodium hypochlorite or available chlorine. For swabbing floors, walls, latrines, &c., this may be diluted with an equal amount of water.

The results of the free use of hypochlorite in the wards were most gratifying. The general opinion, after the experience of two voyages to the Mediterranean, was strongly in favour of the hypochlorite as contrasted with phenolic disinfectants. In the typhoid and dysentery wards the results were particularly striking, and the absence of odour most marked. The most important effect, however, had been the large reduction in secondary infection occurring among the ship's staff.

The hypochlorite had also been used for the purification of the ship's drinking water. About 1 part in 1,000,000 was sufficient for all ordinary purposes, and the instability of electrolytic hypochlorite was so great that after three or four hours all traces of chlorine disappeared.

Electrolytic hypochlorite for surgical use should not be kept for more than 24 to 48 hours, but it can be so readily and cheaply prepared that this is not a matter of consequence.

The solution was also useful in the laundries and in the swimming bath on the *Aquitania*. No significant damage to ship structures was observed after two months' use.

The *Aquitania*, accommodating more than the seven largest London hospitals, gave Lieut.-Col. R. H. Fuhr full opportunity for forming a considered opinion, particularly as large numbers of dysentery and paratyphoid cases had been carried. The confinement of approximately 4,000 patients in a limited space rendered essential most stringent sanitary precautions, and Col. Fuhr states that he has satisfied himself that for efficiency, economy, and utility, electrolytic hypochlorite is very essential for hospital ships.

Engineering Equipment Required for Peking Government University.—With reference to the desire of the Chancellor of the Chinese Government University at Peking to obtain samples and models of engineering products of United Kingdom manufacture, it is notified that a well-known London firm of consulting engineers has been appointed to the office of honorary consulting engineers to the University, with a view to co-ordinating the equipment of the engineering school. The firm referred to (which holds a similar appointment with the Hong Kong University) has been instructed to prepare plans of the school of engineering, the equipment of which is to be proceeded with; a list of the apparatus required is being prepared, and the firm desires to get into communication with United Kingdom manufacturers who would be willing to present the necessary apparatus either free of charge or on specially favourable terms. The advantages which may be gained to British trade through Chinese students learning from samples and models of British make are obvious.

United Kingdom manufacturers who are prepared to assist in the manner indicated may obtain the name and address of the honorary consulting engineers on application to the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.—*Board of Trade Journal.*

Engineering and Scientific Research.—At the meeting of the Society of Engineers (Inc.), on Monday next, a conference on the above-named subject will take place. It will be opened by Dr. J. A. Fleming, who has played a prominent and effective part during the war in directing attention to the nation's neglect of science, and to the handicap thereby imposed, not only upon our industries, but also upon our military efficiency. A large number of leading engineers and industrial authorities are expected to take part in the discussion.

In his paper, Dr. Fleming reviews the whole field indicated by the title, and indicates the nature of the reforms that are required in order to remedy the errors of the past.

The Board of Education has allocated £40,000 for scientific and industrial research, as compared with £25,000 last year.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Mr. Ewart Bignell, who was installation superintendent at Sutton (Surrey), with the South Metropolitan Tramways Co., has resumed his duties after being invalided from the Army.

Worksop U.D.C. has appointed Mr. J. Fletcher, station superintendent, to take charge of the electricity works during the absence, on active service, of the electrical engineer, Mr. Crowther. His salary is to be increased by £25 a year.

The Southampton Electricity Committee proposes to advance the salary of the assistant mains engineer, Mr. F. G. Gilbert.

The Oldham Tramways Committee has recommended the appointment of Mr. P. Priestley, general manager of the Mexborough and Swinton Tramways Co., as manager of the Oldham Corporation Tramways. There were 47 applications.

The West Ham Corporation has been recommended to grant some small increases in the salaries of certain employés in the electricity department. In the case of the assistant engineers-in-charge it is proposed to raise the maximum salary payable to £2 10s., and in the case of the junior engineers-in-charge to £1 15s.

Mr. J. F. Cameron, manager of the Northampton Tramways, while attending to repair work at the generating station last week-end, stepped in the darkness into a 6-ft. inspection pit. Mr. J. Cottier, who went to Mr. Cameron's assistance, fell into the pit on the top of the manager. He escaped with slight injuries, but Mr. Cameron had two ribs broken.

Having regard to the extra duties imposed upon the tramways manager consequent upon the Leyton District Council's resolution not to insure against third party risks, it is proposed to increase his salary from £400 to £425 per annum, rising by annual increments of £25 to a maximum of £500.

The Luton Town Council has been recommended to increase the salary of the assistant electrical engineer, Mr. H. A. Kell, from £200 to £215 per annum, and that of the chief technical assistant, Mr. A. H. Gates, from £182 to £200 per annum.

General.—The Executive Committee of the City and Guilds of London Institute have appointed Prof. Gilbert T. Morgan, D.Sc., F.R.S., of the Royal College of Science, Dublin, to the Chair of Chemistry at the Institute's technical college, Finsbury, rendered vacant by the death of Prof. Meldola.

A correspondent says that Mr. Walter Pilling, who has been a member of the Rochdale T.C. since 1903, and is an Alderman, has sent in his resignation. It is understood that his action is due to his dissatisfaction with the methods of the Electricity Department in connection with the supply of electricity to certain mills in which he is largely interested.

An agreement has been concluded with Mr. Clifford C. Paterson, M.I.E.E., A.M.I.C.E., principal assistant in charge of electro-technical and photometric buildings at the National Physical Laboratory, to join the Osram-Robertson Lamp Works, Ltd., as director of laboratories for research and technical manufacturing purposes. The arrangement will commence at the conclusion of the war, or before that date if possible.

Mr. H. P. Gibbs, consulting electrical engineer to the Mysore Government, and general manager of the Tata hydro-electric scheme in Bombay, is shortly returning to the United States on long leave, *viâ* Australia and Vancouver.—*Indian Engineering.*

The *Commonwealth Engineer* states that in consequence of a protest by the Professional Officers' Association of the Commonwealth Postmaster-General's Department against the appointment of imported officers over the heads of Australians, a competitive examination was recently held for the position of electrical engineer for the telephone branch at Adelaide. The salary is £528 per year. Mr. R. Lawson, formerly assistant engineer on the staff of the chief electrical engineer, and who was one of the imported officers, was selected. Mr. P. Kennedy, of Western Australia, gained second honours.

Mr. Ernest Hardman was married at Blackpool, on April 19th, to Miss Ethel A. Service. An aneroid barometer was presented by the staff and employés of the Yorkshire Electric Power Co. Mr. Hardman is a charge engineer at the Barnsley power house of the Yorkshire Co. The barometer was presented on behalf of the entire staff by Mr. H. F. G. Woods, resident engineer. Mr. Geo. Sheppard, who acted as best man, is a colleague of Mr. Hardman's.

Roll of Honour.—At a meeting of the Salford Tramways Committee on April 18th, Ald. Worsley (Deputy-Mayor) presented to Sergeant W. R. Smethurst, of the Royal Sussex Regiment, the D.C.M., which has been awarded to him for conspicuous gallantry in the field. Smethurst was for several years employed as a motor-man in the Salford tramways

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department. He was also handed an illuminated copy of a resolution of congratulation on his distinction, which was *passed* by the Tramways Committee.

Lance-Corporal HERBERT HARVEY, of the Royal Fusiliers, formerly engaged at the West Ham electricity works, who *has been* missing in Flanders since October, 1914, is now *officially reported* killed in action.

Lieutenant H. A. CLIFTON, of the East Lancashire Regi*ment*, who has fallen in action whilst serving with the Kut relieving force *in* Mesopotamia, was, before the war, engaged as an electrical engineer at Woolwich, with Messrs. Siemens *Bros.*

The *Times* records that Second-Lieutenant JAMES CLEMENT SMITH, Royal Fusiliers, an electrical engineer, was killed at *the Front* on March 27th. He joined the Public Schools Battalion of the Middlesex Regiment shortly after war broke out.

Second-Lieutenant T. O. H. BATES, A.M.I.E.E., of the 89th Punjabis, late chief electrical engineer to the Tata Steel & Iron Co., Bombay, died on April 12th of wounds received in action. Prior to his appointment in India, he held the position of engineer-in-charge at the Morley Corporation electricity works, and also that of electrical engineer at the Rotherham Main Collieries.

Lance-Corporal R. DAVID, formerly an assistant at the Bristol depôt of the Edison & Swan Co., Ltd., has received a letter from the Divisional Officer on active service referring to his distinguished conduct in the field on March 19th and 20th, 1916.

Obituary.—MR. J. STOTT.—We regret to record the death of Mr. Jones Stott, for 12 years manager of the Heywood Corporation electricity works. He was 42 years of age, and three years ago resigned his appointment on account of failing health. Death was due to heart failure.

NEW COMPANIES REGISTERED.

N. E. C. T. A., Ltd. (143,669).—This company was registered on April 19th as a company limited by guarantee, but having a share capital of £4,000 in £1 shares (2,000 6 per cent. cumulative preferred). Each member undertakes to contribute not more than £1 in the event of winding-up. To enter into contracts (a) to obtain special trade discounts on the purchases or dealings of members or others, and (b) to indemnify clients of members or others against the supply of faulty workmanship or materials; to carry on, as principals or agents, the business of manufacturers, repairers, commission agents, contractors or dealers in electrical machinery, instruments, appliances, wires, cables, accessories, and apparatus, electricians, electrical, gas, mechanical, or general engineers, &c. The subscribers (with one pref. share each) are: W. Cross, 7 & 9, Ridley Place, Newcastle, electrical engineer; P. Collinson, 3 & 5, Millergate, Bradford, electrical engineer; H. Marryat, 28, Hatton Garden, E.C., electrical engineer; J. Orringe, 24, Belvoir Street, Leicester, electrical engineer; W. R. Rawlings, 82, Gloucester Road, S.W., electrical engineer; W. A. Shaw, 107, Princes Street, Stockport, electrical engineer; S. H. Webb, 15, Cank Street, Leicester, electrical engineer. Minimum cash subscription, seven shares. The management is vested in a council, which shall consist of such persons who are existing members of the Central Board of the Electrical Contractors' Association (Incorporated) as shall consent to be members of the company, and act thereon. The first are W. Cross, P. Collinson, H. Marryat, J. Orringe, W. R. Rawlings, W. A. Shaw and S. H. Webb. Secretary: L. G. Tate. Registered office: 20, Bucklersbury, E.C.

Mitcham Rubber Co., Ltd. (143,592).—Registered April 13th, by Lumley & Lumley, 15, Old Jewry Chambers, E.C. Capital, £50,000 in £1 shares. Objects: To carry on the business of india-rubber, asbestos, gutta-percha, flax hose, flax and cotton belting, lawn tennis, and ship and engineers' stores, manufacturers and dealers, electricians, telegraph and electrical engineers and contractors, submarine and other cable and telegraph instrument manufacturers, wire drawers, wire rope makers, manufacturers of and dealers in pneumatic and other tires, and wheels of cycles, carriages, and vehicles of all kinds, &c. The subscribers (with one share each) are: R. M. Albery, Coombe Hill Road, East Grinstead, Sussex, gentleman; E. W. Hopton, Furzedown, 74, Crowborough Road, Tooting Common, cashier; H. C. Bouttell, 3, Ermine Road, Lewisham, S.E., clerk; F. Hopkins, 12, Holmewood Road, South Norwood, Surrey, secretary; E. H. Taperell, 20, Chester Road, West Green, N., clerk; J. E. Anstey, 31, Barcombe Avenue, Streatham Hill, S.W., clerk; F. G. Mathews, 116, Pendle Road, Streatham, S.W., clerk. Minimum cash subscription, 7 shares. The first directors (to number not less than three or more than seven) are to be appointed by the subscribers. The directors shall have the right to appoint "departmental directors." Qualification, 250 shares. Remuneration (except departmental directors), £100 each per annum, and 10 per cent. of the net profits, divisible (maximum additional remuneration, £5,000). Solicitors: Lumley & Lumley, 15, Old Jewry Chambers, E.C.

Troughton & Simms, Ltd. (143,586).—This company was registered on April 12th, with a capital of £21,200 in £1 shares, to take over the business of mathematical instrument makers carried on by W. Simms and J. Simms, at 138, Fleet Street, E.C., and 340, Woolwich Road, Charlton, as Troughton & Simms, and to carry on the same and the business of astronomical instrument makers, manufacturers of instruments connected with land survey, electrical, and other scientific apparatus, &c. The subscribers (with one share each) are: W. Simms, 132, Shooters Hill Road, Blackheath, mathematical instrument maker; J. Simms, Craighead, Abbey Wood, Kent, mathematical instrument maker. Private company. The number of directors is not to be less than two or more than five; the first are W. Simms, J. Simms, and A. D. Simms. The first two named are permanent joint managing directors, subject to holding £5,000 shares each, with £1,200 per annum respectively. Qualification of A. D. Simms, 500 shares. Registered office: 340, Woolwich Road, Charlton.

Precision Screw Co., Ltd. (143,612).—This company was registered on April 14th, with a capital of £3,000 in £1 shares (2,000 pref.), to carry on in the United Kingdom or elsewhere the business of manufacturers of screws, particularly screws and parts for electrical and scientific instruments and small engineering and scientific apparatus, &c., and to adopt an agreement between E. Homberger and F. E. Collinson. The subscribers (with one share each) are: F. E. Collinson, 7, Hempstead Road, Walthamstow, N.E., instrument manufacturer; E. Homberger, 9, Hempstead Road, Walthamstow, N.E., engineer. Private company. The number of directors is not to be less than two or more than five; the first are E. Homberger and F. E. Collinson (both permanent, subject to holding £500 shares). Registered office: Provost Works, Macdonald Road, Walthamstow.

Anchor Electric Co., Ltd. (143,676).—This company was registered on April 20th, with a capital of £4,100 in £1 shares (1,700 10 per cent. cum. pref.), to take over the business of electrical engineers, manufacturers of electrical apparatus, fittings, and batteries, being a portion of the business carried on by A. Richmond and T. T. Rankin, C.E., B.Sc., M.I.M.M., M.I.M.E., at 81, Cannon Street, E.C., together with the benefit of the experiments made and secret processes used by the proprietors. The subscribers (with one preferred share each) are: A. Richmond, 81, Cannon Street, E.C., electrical engineer; T. T. Rankin, 81, Cannon Street, E.C., electrical engineer. Private company. The number of directors is not to be less than two or more than seven; the first are A. Richmond and T. T. Rankin (both permanent). Qualification (except first directors) £100 shares. Remuneration, £50 each per annum. Registered office: 81, Cannon Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Derby Lamp Works, Ltd.—Second mortgage debenture dated March 30th, 1916, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled and unpaid capital. Holder: W. L. T. Arkwright, Caxton House, Westminster.

Charing Cross, West End & City Electricity Supply Co., Ltd. (29,122).—Capital, £2,100,000 in 130,000 pref., 130,000 ord., 80,000 City Undertaking pref., and 80,000 City Undertaking ord. shares, all of £5 each. Return dated March 23rd, 1916. 80,000 pref., 80,000 ord., 80,000 City Undertaking pref. and 70,000 City Undertaking ord. shares taken up. £1,200,000 paid on the pref., ord., and City Undertaking pref.; £350,000 considered as paid on the City Undertaking ord. Mortgages and charges: £1,087,178.

Clarke, Chapman & Co., Ltd. (39,045).—Capital, £250,000 in 18,000 ord. and 7,000 pref. shares of £10 each. Return dated March 7th, 1916. 15,281 ord. and 6,985 pref. shares taken up; £10 per share called up on 3,536 ord., £2 10s. on 200 ord., and £10 on 4,435 pref.; £80,210 paid; £152,450 considered as paid, being £10 per share on 11,545 ord., £7 10s. on 200 ord., and £10 on 2,550 pref. Mortgages and charges: £100,000.

Crossley Bros., Ltd. (51,970).—Return dated March 9th, 1916. Capital at date of return, £973,700 in 40,339 pref. and 57,031 ord. shares of £10 each. All shares taken up; £278,200 paid on 27,820 pref.; £695,000 considered as paid on 12,519 pref. and 57,031 ord. Mortgages and charges: Nil. On March 14th, a resolution was confirmed sub-dividing each £10 share into ten £1 shares.

Asbestos and General Paint Co., Ltd. (formerly Asbestos Fireproof Paint Co., Ltd.).—A notice of the appointment of H. E. Moore, of 41, Bedford Row, W.C., as receiver and manager by Order of Court dated April 12th, 1916, filed pursuant to Section 94 of the Companies (Consolidation) Act, 1908.

Newton & Wright, Ltd.—Land Registry Charge on certain land in Islington, dated March 27th, 1916, to secure all moneys due or to become due from company to Union of London & Smiths Bank, Ltd., 455, Oxford Street, W.

G. H. Turner & Co., Ltd.—A memorandum of satisfaction in full on April 14th, 1916, of second debs., dated April 21st and July 12th, 1915, securing £100, has been filed.

CITY NOTES.

Brush Electrical Engineering Co., Ltd.

MR. E. GARCKE presided at the annual meeting on April 18th. He said that, despite the many difficulties of the past year, they had maintained the improvement of recent years. In fact, the gross profits were a little larger, being £61,800, as against £60,800 in 1914, but general charges had been £1,200 higher, and £1,200 more had been spent on maintenance and plant and buildings; so that the net distributable profits for 1915, after paying debenture interest, were £17,300, compared with £19,100 in 1914. Out of this they proposed to write off for depreciation £8,000, to put £5,000 to reserve, to pay an extra 4 per cent. on the second prior lien loan debenture stock, which would require £2,000, and would make a return of 10 per cent. for the year on this stock, and then to increase the carry forward by £2,200, which would then stand at £9,321, equal to about 9 per cent. of the share capital. During the year they had spent £31,962 on capital account in connection with Government contracts on which they were engaged. This expenditure was anticipated and referred to last year, and it was then stated that they would have to issue the balance of the second prior lien debenture stock in order to provide the necessary funds. They had obtained the consent of the Treasury to make the issue. In view, however, of the fact that they were paying 10 per cent. per annum on this stock, and that the present was not a good time to make issues of capital on the most favourable terms, they were postponing this issue as long as possible. Meanwhile, they were utilising their profits and temporary loans to provide the cash for capital expenditure. That was obviously better finance than to raise capital at a high cost in order to pay dividends, and the directors were glad that the shareholders at the last meeting approved the course recommended not to commence the payment of dividends on share capital during the war. They might, however, have to issue some more debenture stock, although they would postpone doing so as long as possible. In addition to other things, they had turned out a large quantity of transport material as well as turbo-generators, motors, and transformers. Although the net profits had not been quite up to those of the previous year, due to the fact that they had to some extent had to bear the brunt of higher wages and a largely enhanced cost of materials, it was satisfactory to feel that their work had

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been of national importance. With regard to the Ljungstrom turbine, the performance of this machine continued to be highly satisfactory. Naturally, some of the directions in which they looked for orders for this class of plant were closed for the time being, and development had to some extent been retarded, but during the year they had provided Ljungstrom sets to the Government and munition works, as well as to electricity supply stations and industrial undertakings, and in every case with gratifying results. Ljungstrom sets of larger size were now in course of installation. Orders were in course of execution for Japan and New Zealand. Whilst, as he had already said, the home market was at present necessarily restricted, the Swedish Ljungstrom Co. had made phenomenal progress, and found itself for the time being unable to cope with the demand which had arisen for turbines of this design. The figures representing the output of turbines by the parent company, as well as the Brush Co., were really very remarkable. It now amounted to 132,000 KW., thus showing that the Ljungstrom turbine had passed completely out of the experimental stage. Their own arrangements for the manufacture of this turbine, with its auxiliaries, on a more extended scale, were well forward, and would have been complete in normal circumstances long before this, but owing to the abnormal conditions prevailing, the delivery of some of the new machine tools on order had been unavoidably delayed. However, they were already reaping some of the benefit they hoped ultimately to enjoy by the installation of this new tool equipment, and he hoped that before long tools for the whole sequence of their manufacturing operations would be available.

Mr. B. S. Broadhurst (managing director) seconded the motion, and the report was adopted without discussion.

South Metropolitan Electric Light and Power Co., Ltd.

At a meeting of debenture stockholders held on April 19th, Mr. H. R. Beeton presiding, a resolution was passed making certain modifications in the provisions of the trust deeds in order to more clearly define the obligations of the company thereunder with regard to setting aside sums to depreciation, &c., and, according to the *Financial Times*, to put an end to questions which have arisen. Mr. Beeton said that his co-trustee and himself believed that the resolution would enhance the credit of the company and contribute to the prosperity which, he felt sure, they all agreed was now fully assured. The chairman of the company seconded the resolution.

Cuba Submarine Telegraph Co., Ltd.

The total receipts for 1915 were £45,312, and the expenses were £29,121, leaving £16,190, plus £7,891 brought forward. Several of the cables were seriously affected by earthquakes, cyclones, and other causes during the year, necessitating heavy expenditure both of cable and for steamer hire in repairing same, amounting to £13,655, which has been charged against revenue. £2,500 has been placed to pension fund, and after paying 10 per cent. on the preference shares, less income-tax, and 5 per cent. on the ordinary shares, free of income-tax, £7,581 is to be carried forward. Annual meeting: May 3rd.

Johnson and Phillips, Ltd.

The profit for 1915 on trading accounts, &c., after making provision for bad and doubtful debts, and after charging to revenue upwards of £9,000 for maintenance of buildings, plant, &c., was £69,084, plus £24,296 brought forward, less the dividend paid in April, 1915, £8,750. Remuneration of directors, &c., absorbs £1,958; debenture interest £5,727; debenture sinking reserve fund £7,182; second debenture interest £2,500; depreciation on machinery and plant, &c., £12,149; interest on loan £1,063; reserve account £20,000, to meet contingencies in connection with the war; leaving available £34,050. After paying 5 per cent. dividend on the ordinary shares, £8,750, £25,300 is to be carried forward. The business has been a "controlled establishment" since August last. Annual meeting: Yesterday.

Oriental Telephone and Electric Co., Ltd.

The gross earnings for the year 1915, including dividends and interest from subsidiary companies, amounted to £90,631, plus £15,481 for payments made under the deed of compromise dated June 9th, 1915, and the balance brought forward £56,136, making £162,248. Working expenses, maintenance, &c., absorbed £38,655, depreciation of securities £5,500, interim dividends, debenture interest, and redemption charges £18,368, leaving £99,726. After paying the final dividends of 3 per cent. on the preference and 6 per cent. (making 10 per cent.) on the ordinary shares, £70,000 is transferred to reserve account, £2,000 to staff pension fund, and £15,467 is to be carried forward. The exchanges worked by the company continue to expand and show improved revenues. Underground cabling extensions are in progress at Singapore and Madras, from the operation of which additional revenue will accrue to the company. The Indian local companies show considerably increased revenues for the past year. The Bengal Telephone Co., Ltd., has paid the same dividend as for 1914, viz., 7 per cent. In order to provide permanent quarters for increasing business, the directors of that company have decided to purchase a central site in Calcutta, and intend to erect a suitable building thereon, in which will be installed a new switchboard equipment. Additional share capital will be issued to meet the necessary expenditure, and this company will take its proportion of the issue. The Bombay Co. has paid a dividend of 20 per cent., as against 16 per cent. for 1914. The amount of the dividend in both instances has been included in the accompanying revenue account. Both the Telephone Co. of Egypt, Ltd., and the China and Japan Telephone & Electric Co., Ltd., have had a satisfactory year: the former continues to pay the previous rate of dividend of 8 per cent., and the latter 10 per cent., as against 5 per cent. for 1914, which have also been brought into the revenue account. The annual meeting was held on Wednesday.

Potteries Electric Traction Co., Ltd.

The capital expended during 1915 was £532. The revenue was £136,167, the traffic receipts at £119,872 showing an advance of £4,789. After deducting expenses, including £11,269 for debenture and other interest, the balance is £40,872, as against £35,825 for 1914. There is to be placed to reserve £8,035, as to renewals £10,000; preference dividend 5 per cent., requires £12,250; 3 per cent. dividend on the ordinary shares amounts to £7,350, and £4,935 is to be carried forward. The reserve now stands at £36,824, and the renewals account at £35,7[illegible]. The tramway and omnibus receipts for the second half of the year showed satisfactory increases. Owing to labour shortage through the war, working conditions were exceedingly difficult. The negotiations with the Stoke-on-Trent Corporation for the postponement by the Corporation for a definite period of their rights to purchase certain portions of the company's undertaking, have not so far resulted in agreement. Annual meeting: May 1st.

Willans and Robinson, Ltd.

For the year 1915 there was a net profit of £16,726, after payment of debenture interest, provision for depreciation of plant and machinery and revaluation of stocks, allowances to employés on active service, as well as special provision on account of outlays and commitments arising from war conditions. The company was among the first to become a "controlled establishment" under the Munitions of War Act, 1915, *i.e.*, from July 12th last. During the year the Queen's Ferry works were disposed of. In 191[illegible] the majority of the ordinary shares were acquired on terms by interests whom Mr. H. Barber represented. An opportunity has arisen by transfer of the greater part of such interests of introducing additional parties. The directors consider this will be advantageous to the company's interests, and a resolution confirming the conditional release of Mr. Barber from his covenant not to transfer the shares will be submitted to the shareholders for approval at the meeting today. Warrants will be issued covering the dividends on "A" and "B" preference stocks, and interest on the funding certificates. A dividend for the year of 10 per cent. on the ordinary shares is recommended, leaving a balance of £8,776. Of this it is proposed to carry £7,099 to the reserve fund, and to distribute £1,677 among the holders of "B" stock and ordinary shares in manner provided by the Articles.

Urban Electric Supply Co., Ltd.

Mr. P. D. Tuckett, presiding at the annual meeting on April 12th, referred to the effect of the drastic lighting restrictions and of consumers' economy on the lighting revenue, also to the heavy increase in cost of materials, especially coal, which was up by £8,868, or about 30 per cent., while the quantity was often inferior to that of similar class coal prior to the war. They had been deprived of the services of many of their most experienced and highly-trained men at a time when they could least afford to lose them. Over 150 men had enlisted, and allowances had been made. Considering all these adverse circumstances, it was fortunate that they had so little less profit than a year ago. Both the profits earned at the various works and the net profit balance were less than £5[illegible] below the 1914 figures. They had placed £9,389 to reserve for depreciation, as against £10,904 in 1914. The item investments now stood at £178,531, as a large part of their advance to the Cornwall Co. had been converted into shares of that company. They had connected the equivalent of an additional 83,986 lamps, a 10 per cent. increase, of which 83 per cent. represented power, a much larger proportion than in previous years. These additional connections had entailed a capital expenditure of £31,846, which was largely met from the proceeds of the Cornwall Co.'s debenture issue made last May. This year new connections and capital expenditure would be materially reduced, as they were not in a position to finance any large developments in these difficult times. In regard to their different undertakings, Hawick and Grantham had largely saved the situation, the former owing to the activity of its mills, and the latter owing to its military camp. Glossop and Twickenham showed useful increases of £700 and £5[illegible]. He very much hoped that Twickenham, with its largely increased power load, to provide for which the greater part of last year's capital expenditure was incurred, would show a further large increase of profit during the year, for he feared that it might be the only undertaking from which they would receive any considerable increase, most of the others being likely to be increasingly affected by the adverse conditions already mentioned, and particularly by the increase in the price of coal, which was now substantially higher than last year's figure; indeed, the difficulty had been to get coal at all. The whole situation was a most anxious one for all large coal-users, and he doubted whether there was much prospect

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of any material relief whilst the war lasted. They had been reluctantly compelled in a good many instances to make some increase in their rates of charge, but how far it would compensate them it was impossible to forecast, for it was one of the peculiar characteristics of the business that, owing to the altogether disproportionate ratio which capital and standing charges bore to running costs, a rising or falling revenue was not accompanied by a corresponding increase or decrease in the costs of production. In other words, loss of revenue largely represented loss of profit, just as an expanding revenue largely represented increased profit. It was a most satisfactory feature in normal times, and a correspondingly unsatisfactory one in abnormal times. It had been a great disappointment that the Cornwall Co.'s extremely gratifying progress should have been interrupted so unfortunately, but it was directly attributable to the war conditions, and particularly to the fact that half the active mining population had gone to the Front, where their expert knowledge was no doubt of the utmost value in trench warfare. The increased demand for power, which the various war activities had brought about, and which had been a marked feature of the year, had materially contributed to prevent the results shown by several of the towns being worse than they were, whilst Stamford and Twickenham's improved results were almost entirely due to increased power load. Amongst the many uses to which the supply of power was being directly put for the purposes of the war were the manufacture of shells, grenades, fuses, stretchers, motors, motor cycles, motor lorries, and propellers, whilst wolfram from the mines supplied by this company in Cornwall constituted a most important element in the manufacture of high-class steel. With their street and shop lighting practically gone for the time being, and with lighting consumers generally economising, the lighting revenue, in spite of additional connections, was in many cases substantially reduced; and when they combined with this an abnormal war expenditure of some £11,000 or £12,000 it was not at all surprising that some of the towns showed worse results than for the previous year. Speaking broadly, the towns which had suffered most had been those which were most largely dependent on a lighting load, such as Weybridge, whilst the towns which had benefited most were those with an industrial population and a power load like Hawick. Glossop's improved profit was almost entirely due to the improved earnings of its tramway, which had greatly benefited by the prosperity of the industrial population it served.

River Plate Electricity Co., Ltd. The report for 1915 states that the net revenue, after providing for administration expenses, bad debts, and all necessary depreciations, amounts to £38,713, plus £20,513 brought forward, making £59,226. The board proposes a dividend of 7 per cent. for the year on the ordinary stock, to set aside as special provision for bad debts £5,000, income-tax £5,000, and to carry forward £18,387. The persistence of unfavourable trading conditions in the Argentine, aggravated by the prolongation of the European war and the great rise in freights and cost of materials, has, as in the previous year, adversely affected the net results. The continuance of hostilities has also prevented the payment of interest upon the 5 per cent. obligations of the German Trans-Oceanic Electric Co., of Berlin. It has likewise prevented the eighth annual payment of £2,300 due upon April 1st, 1916, on account of the amortisation of the 5 per cent. obligations being made. No dividend is included in the year's receipts upon the 21,000 £1 shares of the Argentine Electricity Co., received in connection with the sale of Tucuman, but upon the issue of that company's report, due shortly, it is expected that a small dividend will be declared. The important capital improvements and extensions at Ensenada and La Plata in progress during the last two or three years are now satisfactorily completed. No further capital expenditure of any moment is in contemplation. The further 25,000 £1 preference shares and 25,000 £1 ordinary shares issued in 1914 are now fully paid and have been converted into preference stock and ordinary stock.—*Financial Times.*

Calcutta Tramways Co., Ltd.—The revenue, including interest on investments and deposits, less interest on loans, and the balance brought forward of £7,566, amounts to £116,736. A final dividend of 6s. 6d. per share is proposed, making 9¼ per cent. for the year, transferring to reserve for depreciation, &c., £15,000, contribution to staff provident fund £1,309, leaving to be carried forward £6,812.

Colombo Electric Tramways and Lighting Co., Ltd.—The directors announce a dividend of 10 per cent., free of tax, for 1915; £15,000 is put to general reserve and renewal fund, which has been dealt with by writing off £3,000 from the special renewal fund, and £8,165 is carried forward.

Bath Electric Tramways, Ltd.—The accounts for 1915, after providing for the preference dividend and sinking fund instalment, show an available balance of £8,486, which the directors recommend (says the *Financial Times*) should be carried forward to augment the reserves available for the purposes of depreciation and renewals.

Rees Roturbo Manufacturing Co., Ltd.—The available profit for 1915 is £30,419, of which £8,000 is put to depreciation and £12,000 to reserve, £10,419 being carried forward.

An Austrian Cable Works.—The Felten & Guilleaume A.G., of Vienna, reports gross profits of £145,000 for 1915, as contrasted with £106,000 in the preceding year. After defraying general expenses and making provision for depreciation, the accounts show net profits of £105,000, as against £57,000, and a dividend is proposed at the rate of 12 per cent., as compared with 10 per cent. in 1914. The prospects for the current year are declared to be favourable, as work is on hand for a long time forward, both in the electrical works at Vienna and the iron and steel works in Styria.

Capital Reduction.—*British Uralite Co.* (1908), *Ltd.*—A petition for confirming the reduction of capital from £142,500 to £91,875 is to be heard on May 9th.

Montreal Light, Heat and Power Co.—A dividend of 2½ per cent. is announced for the quarter ended April 30th.

Kaministiquia Power Co.—A dividend of 1½ per cent. has been declared for the quarter ended April 30th.

STOCKS AND SHARES.

TUESDAY EVENING.

The Stock Exchange has scarcely got back into its full swing of business, and the influence of the Easter holidays remains apparent in most of the markets. The political crisis of last week had no effect upon quotations, and the only effect which such matters are having upon the world of finance is to be seen in New York, where prices came down sharply upon the innocent statements as to another last Note to Germany. In the electrical sections, the principal feature is the further progress of telegraph stocks and shares. It is extremely difficult to get the offer of any reasonable amount, and other groups outside the Eastern have begun to share in the strength initiated by the dividends recently declared by the latter.

The good prices reached by the Underground Electric stocks have barely been maintained, though the market in them as a whole is not a bad one. There is considerable curiosity felt as to the reason for the still-unexplained rise in Metropolitan Consolidated stock, which gained another point just before the holidays. Districts keep steady, but Underground Electric income bonds eased off a trifle.

Many people are asking whether they are entitled to claim income-tax in respect of the Electric Underground income coupons, seeing that these are paid free of tax, which is deducted by the company before it distributes the dividend. Those people, however, who are entitled to relief should apply to the bank for an income-tax certificate when they are presenting their coupons for payment; and the bank will hand them a certificate somewhat similar to that which is given in cases where dividends are paid less tax, this certificate being accepted as a voucher by the Inland Revenue authorities, as entitling the holder of it to claim what may be due to him.

We believe that some little question arose between the bankers, the Underground Electric Railways Co., and the Inland Revenue authorities as to the proper procedure to be employed in this case; but the points of difference have now been adjusted satisfactorily, and, as we have already said, bondholders who are entitled to return of tax should ask for a voucher at the time they present their coupons.

Eastern ordinary has followed up its 9 points rise of last week with a further advance of 2½, and the improvements in "China" and Western Telegraph shares have been carried further. Indo-Europeans are good at 52, on the declaration of the usual dividend of £2 12s. 6d. per share, making 65s. for the year, the announcement being couched in an unusual way. Instead of this dividend being declared as the final for the year, the company calls it an interim dividend, which naturally gave rise to some hope that there might be a little extra to come when the year's accounts could be made up and properly adjusted. Apparently, the company has not yet received its final accounts for the year from the various outlying parts of the world which it serves; and it may be, of course, that the present interim dividend may also prove to be the final in respect of 1915.

Electricity supply shares are distinctly better, there being rises in nearly half-a-score of the leading issues. It would appear as though this department, the Cinderella of the industrial market, were at last to receive a little attention from investors, and that the attractions held out by good yields were not to be entirely overlooked, after all. For improvement to come in the shares of illumination companies just when the days are growing long is a novelty. We have mentioned from time to time recently that shrewd people have been trying to get the offer of shares, but without meeting any noticeable success; evidently some of the inquiries have crystallised into transactions, for the supply of stock now on offer in the market is more than usually limited. At the same time, it has to be borne in mind that the market is at all times a narrow one, and that it takes comparatively little either of demand or supply to cause prices to move.

Some of the manufacturing shares are better, too. Edison and Swan (£3 paid) have risen a florin. Electric Constructions are 6d. up, and General Electrics gained ½. India-Rubber shares, still called "Silvers" in the Stock Exchange,

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are 10s. better at their par value of £10. Cable manufacturing shares, as a whole, have followed the lead set by the cable market; and Henleys at 14½ are ex the dividend of 17s. 6d., therefore showing a net gain of ¾ on the week. The only exception to the strength of this section is a fall of 1/16 in British Westinghouse preference. Most of the chemical shares are good; Castner-Kellners, for instance, at 3½ are 2s. 6d. up.

Brazil Tractions are quoted ex a dollar dividend this week, allowing for which the price is 2½ higher. The Stock Exchange calculates that the company may now be regarded as upon a 4 per cent. basis, so far as the common shares are concerned; so that at the present price the return works out to about 7¼ per cent. on the money. The Colonial and foreign shares as a whole are steady, Mexicans once more having sunk into suspended stagnation. The movements of the American troops on the frontier, and in Mexico itself, are watched with a languid interest; and President Wilson, deep in the throes of another Note to Germany, cannot be expected to find time to deal with such a trifle as Mexican settlement.

The rubber market keeps firm, and the steady outpouring of excellent Spring dividends and reports is sufficient to command the attention, interest, and money of a wide circle of speculative investors. The price of the commodity does little to help values, but nowadays this is treated with comparative indifference, seeing that were rubber to drop to half-a-crown per lb., most of the producing concerns would still make large profits. In the metal markets, copper shares are mostly strong, but there is not much doing in these; while the armament division is disposed to be a trifle heavy.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price April 25, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6⅝	—	£7 8 2
Charing Cross Ordinary	5	5	8½	—	7 18 10
do. do. do. 4½ Pref.	4½	4½	8½	—	6 18 6
Chelsea	5	4	1½	—	6 8 1
City of London	9	8	12	+ ¼	6 13 4
do. do. 6 per cent. Pref.	6	6	10½	+ ¼	5 17 1
County of London	7	7	12⅛	+ ¼	6 13 4
do. 6 per cent. Pref.	6	6	10½	+ ¼	5 17 1
Kensington Ordinary	9	7	6	— ¼	7 0 0
London Electric	4	3	1⅜	+ ⅛	7 6 4
do. do. 6 per cent. Pref.	6	6	4½	+ ⅛	7 1 2
Metropolitan	3½	3	2⅜	—	6 6 4
do. 4½ per cent. Pref.	4½	4½	3	—	7 10 0
St. James' and Pall Mall	10	8	6	+ ⅛	6 13 4
South London	5	5	2⅝	—	8 18 10
South Metropolitan Pref.	7	7	1 7/16	—	6 14 0
Westminster Ordinary	9	7	6	+ ¼	5 16 8
Telegraphs and Telephones.	Dividend, 1914.				
Anglo-Am. Tel. Pref.	6		99	+ ½	6 1 3
do. Def.	33/6		21½	+ ⅛	7 18 6
Chile Telephone	8		6⅜	—	6 5 6
Cuba Sub. Ord.	5		7⅞	—	6 9 0
Eastern Extension	7		14½	+ ¼	*5 12 4
Eastern Tel. Ord.	7		142½	+2½	*5 12 4
Globe Tel. and T. Ord.	6		11⅛	+ ⅛	*5 4 4
do. Pref.	6		10⅝	+ ⅛	5 13 5
Great Northern Tel.	22		85½	— ½	6 4 3
Indo-European	13		52	—	6 5 0
Marconi	5		2½	+ 1/16	4 9 0
New York Tel. 4½	4½		100⅞	—	4 9 4
Oriental Telephone Ord.	10		1⅝	—	6 6 8
United R. Plate Tel.	8		6	—	*6 13 4
West India and Pan.	1		1⅛	+ 1/16	9 1 10
Western Telegraph	7		14½	+ ½	*5 12 4
Home Rails.					
Central London, Ord. Assented	4		67½	—	5 8 6
Metropolitan	1½		26½	+1½	3 15 6
do. District	Nil		19¼	—	Nil
Underground Electric Ordinary	Nil		1⅜	—	Nil
do. do. "A"	Nil		6/-	—	Nil
do. do. Income	6		85⅛	— ½	*6 19 0
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6		4⅞	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½		8½	—	7 6 8
do. 2nd Pref.	5½		9⅜	—	8 3 0
do. 5 Deb.	5		78	—	6 8 2
Brazil Tractions	4		55½ xd	+2½	7 4 2
Bombay Electric Pref.	6		10½	—	5 17 3
British Columbia Elec. Rly. Pfce.	5		58	—	9 8 8
do. do. Preferred	—		37	—	Nil
do. do. Deferred	—		38	—	Nil
do. do. Deb.	4½		62 xd	—	6 17 1
Mexico Trams 5 per cent. Bonds	—		40	—	Nil
do. 6 per cent. Bonds	—		12	—	Nil
Mexican Light Common	Nil		20	—	Nil
do. Pref.	Nil		32	—	Nil
do. 1st Bonds	—		39	—	—
Manufacturing Companies.					
Babcock & Wilcox	14		23	—	5 1 8
British Aluminium Ord.	5		22/- xd	—	6 7 3
British Insulated Ord.	15		10½	—	7 2 10
British Westinghouse Pref.	7½		2 1/16	— 1/16	7 5 2
Callenders	15		11½	—	6 10 6
do. 5 Pref.	5		4½	—	5 17 8
Castner-Kellner	20		14½	+ ½	6 3 0
Edison & Swan, £8 paid	Nil		9	+2/-	Nil
do. do. fully paid	Nil		1½	—	Nil
do. do. 5 per cent. Deb.	5		57	—	8 15 8
Electric Construction	6		16/-	+6d.	7 10 0
Gen. Elec. Pref.	6		9⅜	+ ⅛	6 4 8
Henley	20		14⅜	+ ⅜	*6 19 0
do. 4½ Pref.	4½		4	—	5 12 6
India-Rubber	10		10	+ ½	*10 0 0
Telegraph Con.	20		85½	—	*6 18 4

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, April 26th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1 8	..
a Ammoniac Sal	,,	£70	..
a Ammonia, Muriate (large crystal)	per ton	£54	..
a Bisulphide of Carbon	,,	£28	..
a Borax	,,	£38	..
a Copper Sulphate	,,	£19	..
a Potash, Chlorate	per lb.	2/6	..
a ,, Perchlorate	,,	2/-	..
a Shellac	per cwt.	93/-	..
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	,,	£14	..
a ,, Lump	,,	£9	..
a Soda, Chlorate	per lb.	1/4½	..
a ,, Crystals	per ton	120/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	1/4½ to 1/4¾	¼d. inc.
c ,, Tubes (solid drawn)	,,	1/5½ to 1/5⅝	..
c ,, Wire, basis	,,	1/4¾ to 1/5	¼d. inc.
c Copper Tubes (solid drawn)	,,	1/7 to 1/7½	d. to ½d. inc.
g ,, Bars (best selected)	per ton	£154	£6 inc.
g ,, Sheet	,,	£154	£6 inc.
g ,, Rod	,,	£154	£6 inc.
d ,, (Electrolytic) Bars	,,	£141	£4 inc.
d ,, ,, Sheets	,,	£159	£6 inc.
d ,, ,, Rods	,,	£148	£4 inc.
d ,, ,, H.C. Wire	per lb.	1/5⅝	¾d. inc.
f Ebonite Rod	,,	8/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/3	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	2/11½	1½d. dec.
i Iron Pig (Cleveland warrants)	per ton	95/-	..
l ,, Wire, galv. No. 8, P.O. qual.	,,	£33	..
g Lead, English Pig	,,	£35 10	5/- inc.
g Mercury	per bot.	£16 12 6 to £16 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e ,, ,, medium	,,	8/6 to 6/-	..
e ,, ,, large	,,	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/8½	..
r Steel, Magnet, in bars	per ton	£35	..
g Tin, Block (English)	,,	£205 to £206	£1 to £2 inc.
n ,, Wire, Nos. 1 to 16	per lb.	2/11	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Canadian General Electric Co.—The accounts for 1915 show a profit of $1,219,513, and after deducting interest and $416,222 for depreciation, there remained a net profit of $764,378. Dividends of 7 per cent. have been paid on both the preference and ordinary shares, leaving a surplus of $66,356, increasing the undivided profit brought down to $1,007,119, out of which $300,000 goes to reserve, raising that fund to $3,000,000, and $707,119 remains to be carried over. —*Financial Times.*

Stock Exchange Notice.—The Committee has ordered the undermentioned to be quoted in the Official List:—

Barcelona Traction, Light & Power Co., Ltd.—London scrip, fully paid, for £436,700 7 per cent. 50-year prior lien "A" bonds.

British Coalite Co., Ltd.—A financial daily states that the sale of the company's land at Barking has now been completed, and that out of the price received the first mortgage debentures are being paid off.

American Telephone and Telegraph Co.—The net earnings for 1915 were $41,117,487, an increase of $559,510. The interest charges were $6,498,819, and dividends at the regular rate of 8 per cent. per annum, $29,100,591. Of the resulting balance there was carried to reserves $2,500,000 and to surplus $3,018,046. The indebtedness of the company was reduced during the year by $50,963,560.

Direct United States Cable Co., Ltd.—The accounts for the year ended at March, 1916, show that the reserve fund account balance is £487,705, an increase of £10,719. A fourth and final dividend of 2s. per share (less tax) is announced, making a total of 4 per cent. for the year. Annual meeting: May 2nd.

Calcutta Electric Supply Corporation, Ltd.—The directors recommend a final dividend on the ordinary shares at the rate of 11 per cent. per annum for the half-year ended December, 1915, making, with the interim dividend, 9 per cent. for the year. £52,000 is placed to the credit of the depreciation and renewals fund, and £10,000 to reserve, the same as in the previous year.

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EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING MARCH, 1916.

THE returns of electrical exports and imports for the month of March show increased values in nearly all sections of the table.

The exports reached the respectable total of £432,396, as compared with £396 493 in February; the imports were valued at £196,251, as against £182,222 in the previous month, while the re-exports, at £17,383, were also considerably in advance of the February figures. Generally speaking, all the sections of the exports, except machinery exports, were at a higher level than in the previous month, the most noteworthy figures being, however, for cable exports, which were valued at £111,031 for the month, an exceptionally high value.

Telegraphic and telephonic exports were also considerably in advance of the February figures.

Electrical machinery imports remained practically stationary and cable imports declined, while telegraphic, telephonic and glow lamp imports (from Holland) advanced considerably in value, as compared with February.

Our best customer during the month was India, followed by France, while, as usual, Australian purchases reached a considerable value.

The total value of electrical material received from the United States during the month showed an advance on the previous month.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports	Electrical goods and appliances.	Wires and cables rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	1,209	5,133	40	229	...	1,923	13,269	262	60	1,435	...	6,974	30,534
German West Africa	...	50	...	...	...	...	...	...	...	...	...	...	50
Netherlands, Java and Dutch Indies ...	162	11,773	1,231	30	181	...	3,449	159	197	8	2,673	11,622	31,485
Belgian Congo	...	60	...	...	...	...	21	...	...	...	120	...	201
France	2,423	111	708	959	121	220	6,902	10,227	127	17	10,590	8,505	40,910
Portugal	170	1,466	...	60	...	267	2,001	16	...	66	710	1,518	6,273
Spain, Canary Isles and Spanish N. Africa...	362	...	207	...	...	160	1,723	56	86	10	56	62	3,121
Switzerland, Italy and Austria-Hungary ...	1,677	123	528	...	...	685	2,604	193	...	48	60	2,651	8,569
Greece, Roumania, Turkey and Bulgaria ...	...	...	...	...	1,500	...	35	...	...	...	...	...	1,535
Channel Isles, Gibraltar, Malta and Cyprus...	90	6,900	49	56	...	...	108	...	120	...	231	499	8,053
U.S.A., Philippines and Cuba	397	...	28	100	...	...	2,256	...	...	...	...	261	3,295
Canada and Newfoundland	198	14	108	204	...	79	1,393	...	407	...	...	24,902	27,305
British West Indies and British Guiana ...	33	169	35	76	...	...	211	...	...	...	...	46	570
Mexico and Central America	...	64	8	...	...	...	22	...	...	...	11	66	171
Peru and Uruguay	43	313	...	19	...	...	381	...	151	...	63	...	970
Chile	135	80	65	71	...	117	527	1,216	163	412	50	730	3,366
Brazil	201	456	275	251	...	65	1,156	16	597	10	...	25	3,052
Argentina	1,148	8,195	286	686	...	602	5,142	378	751	86	3,611	771	21,656
Colombia, Venezuela, Ecuador and Bolivia...	...	284	...	...	...	...	140	...	...	...	90	...	514
Egypt, Tunis and Morocco	67	1,253	3	12	...	...	424	115	659	158	71	594	3,356
British West Africa	33	303	2	112	...	47	172	...	132	36	97	1,025	1,959
Rhodesia, O.R.C. and Transvaal	1,148	8,473	339	1,434	...	625	3,863	333	354	17	340	383	17,309
Cape of Good Hope	813	4,583	146	527	100	1,350	1,338	5	1,540	...	1,938	61	12,431
Natal	23	5,166	343	103	30	42	3,444	126	814	...	253	...	10,344
Zanzibar, Brit. E. Africa, Mauritius & Aden	202	321	31	353	...	32	699	16	66	...	52	93	1,865
Azores, Madeira and Portuguese Africa ...	3	60	38	150	...	...	127	...	...	...	...	55	433
French African Colonies and Madagascar...	...	...	...	...	...	...	66	...	...	...	...	...	66
Persia	...	158	116	62	...	...	606	...	...	...	175	...	1,117
China and Siam	291	952	438	426	61	1,326	1,243	...	1,455	51	434	117	6,794
Japan and Korea	403	...	...	64	95	1,358	1,830	10	441	...	...	1,798	5,999
India	4,469	16,654	2,627	3,659	108	1,388	15,195	1,493	4,029	315	3,285	1,999	55,621
Ceylon	184	24	50	180	...	123	316	...	26	...	15	...	918
Straits Settlements, Fed. Malay States and Sarawak	707	1,637	110	325	...	70	1,100	150	212	91	245	384	5,061
Hong Kong	496	22	...	...	...	863	248	251	...	33	115	64	1,792
West Australia	229	1,608	154	985	...	138	2,124	...	75	2	3,099	11	18,425
South Australia	70	...	32	30	...	11	63	...	290	...	...	52	548
Victoria	1,215	18,390	670	957	133	1,310	2,982	2,489	583	20	4	2,072	30,825
New South Wales	1,161	7,362	1,033	2,013	324	266	5,880	167	946	256	7,691	26	27,125
Queensland	326	875	...	13	...	45	1,528	28	1,888	74	3,305	...	8,082
Tasmania	...	...	76	47	21	...	90	...	...	...	...	...	234
New Zealand and Fiji Islands	1,056	8,002	546	1,194	42	879	3,372	5,452	3,312	89	5,999	519	30,462
Total, £	21,174	111,034	10,575	15,387	3,716	14,091	88,250	23,156	19,511	3,234	55,383	67,885	432,396

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	50	...	...	669	77	...	4,696	595	110	...	4,127	10,324
Germany	...	...	...	...	...	...	...	...	...	...	...	...
Holland...	...	41	126	21,648	1,795	...	100	...	333	...	197	24,242
Belgium	...	...	...	...	...	...	...	...	...	...	...	...
France	350	2,890	...	94	32	1,215	283	...	5,214	3,269	452	13,829
Switzerland	1,587	...	156	138	20	1,219	1,157	918	196	745	50	6,186
Italy	...	5,668	...	...	...	18	822	108	...	...	90	6,706
Austria-Hungary	...	...	...	...	...	...	...	...	...	...	...	...
United States	8,517	3,699	1,562	4,264	6,106	506	11,503	62,736	5,006	8,457	20,579	132,935
Total, £	10,504	12,298	1,843	26,813	8,033	2,988	18,561	64,357	10,859	12,471	25,495	194,222

Additional imports.—Spain, carbons, £943; Japan, glow lamps, £390; lamp parts, £466; Channel Islands, machinery, £15; Canada, electrical goods, £140; lamp parts, £75.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above... ...	2,341	2,104	...	2,899	...	1,034	2,666	...	32	310	5,997	17,383

TOTAL EXPORTS: £432,396 TOTAL RE-EXPORTS: £17,383 TOTAL IMPORTS: £196,251

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

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SOME LEGAL HINTS TO THOSE WHO SELL MACHINERY.

[FROM A LEGAL CONTRIBUTOR.]

Although a very considerable proportion of judicial time is occupied with the decision of cases relating to the sale and purchase of machinery, but few reports of such trials appear in the papers. They are either too technical for the average reporter to record with accuracy, or too complicated or dull for the reader of the newspaper. An action for breach of promise affords better "copy" than an action for breach of warranty on the sale of a "booster"!

In these circumstances a few hints to the vendors of machinery, derived from experience in cases which have either actually been decided or have at least got into the lawyers' hands, may be found useful to engineers.

In many of the disputes arising out of the sale of machinery which occur in practice, the first question at issue is this: What was the contract between the parties?

In his natural anxiety to secure the business, the manufacturer is sometimes careless about the guarantees to which he stands committed. On the other hand, to obtain machinery of which he is in urgent need for the fulfilment of an important order, the purchaser sometimes closes a bargain without making his requirements absolutely plain, and without securing specific guarantees that the machine in question will do what is demanded of it.

Selling a complicated piece of machinery is not like selling a top hat. In the latter case the customer comes to the premises of the vendor, pays his money, buys the goods "on the view" and takes delivery on the spot. No question of guaranty arises. The customer does not—cannot—come back in six months' time and say: "This hat will not do the work required of it," and then bring suit for damages.

Where, on the other hand, machinery is sold a number of considerations may arise. It has to correspond with a long and complicated specification. It is generally guaranteed to do certain work under certain conditions which must be precisely explained. Let there be any departure from those conditions and the machinery will not do its work. Finally, it may have to work in conjunction with machinery supplied by another manufacturer or by the purchaser himself. It is of the utmost importance that the rights and liabilities of the parties in relation to all these matters shall be borne in mind *when the contract is framed.*

It often appears to be thought unnecessary to draw up a special contract when the parties are negotiating about a mere piece of machinery. A conversation, or a ring-up on the 'phone—confirmed (or not) by a brief letter—is sometimes considered sufficient.

Again, when a dispute arises, it frequently happens that the lawyers have to determine the real contract from (*a*) the evidence given of conversations at various interviews; (*b*) telephone conversations; (*c*) telegrams; and (*d*) letters. Small wonder, if the component parts of the contract are thus disseminated, that disputes arise as to what those terms really are.

The first principle, then, is to put the contract into writing. *Vox emissa volat sed res scripta manet* is a maxim which should be written up in every office.

In cases where an arrangement is made orally, it should always be confirmed by letter, unless it is considered that to so confirm it would be regarded with suspicion by the purchaser. In that event a memorandum of the transaction should be made by the manufacturer in his own handwriting in his own diary on the same day, and when the facts are fresh in his memory. In 99 cases out of 100 he may never have to refer to the entry again; but if a dispute occurs, and he has to state his recollection of what took place at the interview, he can refresh his memory by looking up the entry.

These are more or less general observations appertaining to all contracts; but there are certain specific things to be remembered when selling machinery. Assume the agreement is to be in writing, what should that writing contain?

In the normal case there will be an inquiry from the customer for a particular machine capable of doing so much work. The manufacturer replies sending a specification in which the machine is described. He also makes a tender to supply it at a particular price. It is in the conditions annexed to the tender that he should take particular care to make plain the circumstances in which the machine which he supplies will carry out his guarantees.

The following points should be made in the general conditions to accompany a specification and tender:—

1. *Continuous Working.*—Assuming the machinery is guaranteed for a certain period, the question whether it is to work continuously should be borne in mind. A machine guaranteed for six months' working continuously might be guaranteed for 12 months if only working by day. Again, continuous working may be an essential requirement—as, for instance, in the case of a condenser for a sugar refinery—and the manufacturer must be careful not to make himself responsible for continuous working unless he knows the machine will stand it.

2. *Indirect or Consequential Damage.*—It is sometimes prudent to say in the conditions: "The manufacturer undertakes no liability for indirect or consequential damage of any nature or due to any cause." This has effect, at any rate, to compel the purchaser to reveal the purposes to which the machine is to be put. But such a disclaimer will not release the manufacturer from the consequences of a breach of warranty. For instance, if an engine be sold as being of 10 H.P., and it turns out to be only 7 H.P., with the result that the purchaser suffers damage, this clause will not relieve the manufacturer.

3. *Machinery of Other Manufacturers.*—A composite machine or piece of apparatus may include the workmanship of other manufacturers. As to this it is well to say: "Any machinery not of our own manufacture included in this tender is sold under the warranty given to us by the makers, and which we are able to enforce, but it is not guaranteed by us in any respect."

4. *Drawings.*—It should be pointed out that drawings, &c., submitted with the tender and contained in illustrated catalogues which may form the basis of the contract are approximate only, and that after acceptance of the tender accurate outline drawings will be supplied.

The foregoing are some general conditions which will be found applicable in most cases where machinery is to be supplied.

Some particular cases remain to be considered. The manufacturer is often asked to furnish something which is to be worked in conjunction with an old machine already installed on the premises of the purchaser. In that case he should be careful to limit his guarantee by saying that what he is selling will do so much "provided the efficiency of the existing plant is as stated." A case occurred a year or two ago where an atmospheric condenser was supplied with a guarantee that it would maintain a constant vacuum of 25 in. to 26 in., with the barometer at 30 in., in the vacuum pans at a sugar factory. When installed, the condenser appeared to be unable to maintain the vacuum. In the course of a long inquiry it was found that while the condenser itself was free from leaks there was immense and abnormal leakage of air into the sugar pans which was quite sufficient to explain the drop in vacuum. In supplying a condenser, therefore, the manufacturer should be careful to point out the conditions under which he guarantees that the vacuum will be maintained.

One or two other instances come into mind. Where a gas engine is supplied and is stated to be of a certain horse-power, care should be taken to specify the quality of the gas which must be used if the full power is to be attained. For example, coke-oven gas and producer gas may vary very considerably in calorific value. In such cases the specification should state that the gas to be used must be able to produce so many B.TH.U. per cb. foot.

As a last example, mention may be made of a specification for refrigerating machinery. Here again, in the nature of things, something that is essential for the proper working of the machine may have to be supplied by the purchaser himself. The writer calls to mind a case in which a carbonic anhydride refrigerating machine was guaranteed to be able to produce a certain number of tons of ice *per diem.* The specification was very complete, but it made no reference to cooling water. There was nothing to show whether that water was to be supplied from the mains, or

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whether it was to be circulated from some kind of re-cooling device. This is clearly a matter which should be provided for in the conditions attached to the tender. The purchaser should be told either that the refrigerator will require so much water from the mains (the amount depending to some extent on the season of the year) or that a re-cooling device of a certain capacity must be installed.

But a few examples have been given above to show the necessity of disclaiming responsibility for the vagaries of apparatus supplied by the purchaser. It would, doubtless, be possible to multiply instances in the case of more complicated machines.

THE USE OF CONTINUOUS CURRENT FOR TERMINAL AND TRUNK LINE ELECTRIFICATION.

On March 21st the paper on this subject by Mr. N. W. Storer, which was read before the Institution of Electrical Engineers, was discussed by the Manchester Local Section.

The Chairman (Mr. B. Welbourn) endorsed the plea which the author made for some attempt to be made, before it was too late, to secure the standardisation of voltage and collector systems in this country. It was to be hoped that in connection with railway electrification work they would not have a repetition of what had happened in the electricity supply industry.

Mr. W. A. Barnes, referring to standardisation, pointed out that direct-current traction was competing very strongly with alternating-current traction in the only advantage the latter possessed, namely, high-voltage transmission, and on this account it would not be policy at the present time to standardise 1,200 or even 2,400 volts. Another point against standardisation at the present time was that such a course would tend to stop progress. The question of the location of the third rail had been brought before a meeting of railway engineers as long ago as 1903, when it was decided that the most advantageous position for the third rail was such that the contact surface be 3 in. above the track rail, and that the horizontal distance between the centre of the track and the centre of the third rail be 3 ft. 11½ in. This was adopted for an overrunning shoe, and it was thought that 600 volts would not be exceeded for direct-current electric traction. The above recommendation had been adopted by railway companies who electrified since 1903, but during the past two years the direct-current traction motor had been greatly improved, so much so that the 1,200-volt motor was probably more reliable than the 600-volt motor of ten years ago. The 600-volt third rail was not sufficiently well protected to be used at 1,200 volts, and on the Manchester-Bury section of the L. & Y. Railway, where 1,200 volts was in operation, this had led to the adoption of the side-contact rail adequately protected along its entire length, thus departing from the earlier standard. The gear required to operate at various voltages would have to be accommodated inside the car, and together with the equipment for regenerative control and the apparatus for changing the position of the shoe would seriously limit the passenger-carrying capacity of the car, and would cost more for maintenance and running charges. It was probable that in trunk line electrification any one railway company would adhere to one system, and only inter-running trains would be affected; he suggested that such trains be ordinary stock worked by electric locomotives which would be changed at the junction of two systems, and where through coaches were involved, trailer coaches should be used in conjunction with motor coaches in the usual way. The choice of motors depended on the relative importance of efficiency of working and efficiency of service.

Mr. Ferguson considered that the first step should be to standardise line voltage. The inter-running of trains over systems employing different voltages had been shown to require a relatively large number of switches; in maintaining equipments of this kind, however, it was well to remember that so far as the main control was concerned it was only necessary to deal with a number of similar contactors or reverse-type switches, all of which were fairly well-known pieces of apparatus, hence the maintenance was only increased in proportion to the number of similar pieces. The case of auxiliaries for high voltages and various voltages was very different, necessitating, as a rule, new types of apparatus more or less exploited and undeveloped. In the case of equipments having to run at comparatively high speed on the suburban parts of a railway, say, 2 to 4 miles between stops, and also on city lines with only half-mile stops, the field control was the proper thing, but required extra switches and extra cables, involving additional capital cost and maintenance, and there were cases where it would be advisable to put the money and material into building a large motor having a non-saturated field.

Dr. Wm. Cramp said that emphasis was laid upon what were called saturated and non-saturated fields, and no indication was given as to the point at which distinction between saturated and non-saturated was drawn. A case had been made out against the rating of railway motors on the one-hour basis; it was to be hoped that the Institution of Electrical Engineers or the Engineering Standards Committee would go into this question with the object of sanctioning a more rational basis for specifications. Such a basis had already been suggested by Dr. Pohl. The second part of the paper was a most eloquent plea for standardisation, and showed into what confusion railway equipment would be thrown if some control was not quickly exercised. The adoption of the single-phase system would obviate many of the difficulties mentioned; in fact, the paper might be turned into a demand for the single-phase system, so long as there was no co-ordination between the railway companies as regarded voltage. In the single-phase system only frequency needed to be standardised, and that only within certain limits, which should not be difficult to decide upon. Series-parallel operation of transformer or motor windings would meet all other variations. It was ridiculous to construct trains on such short lengths of line as existed in this country, with so much complicated apparatus to change from one railway company's system to another. If it were necessary to have voltages varying over the range suggested by the paper, the continuous-current system should not be adopted at all. The only solution seemed to be some form of control which would prevent a company adopting a system different from that adopted by another company, without showing good cause for the difference, and the method to be adopted to secure interchangeability.

Prof. E. W. Marchant said that one of the main advantages of series-parallel control lay in the greater efficiency on starting. The maximum possible efficiency in starting with series-parallel control and two motors was 67 per cent., whereas, starting with ordinary rheostatic control, the loss was 50 per cent. Taking the ordinary limit accepted in this country of from 150 to 200 amperes from the trolley, it was clear that very high voltage would be required on the trolley wire in order to obtain the power required to drive a railway train. Regarding the question of the D.C. voltage possible on a dynamo or motor, Mr. Catterson-Smith had experimented some four or five years ago, using a motor designed to work under compressed air at 200 lb. per square inch. The armature was designed for 3,000 volts, and he succeeded in getting an output of about 3 kw. from the machine, which was 2-pole and had a commutator only 4 in. in diameter. The design of the bearings was a most difficult matter, on account of the air pressure on one side, and the mechanical difficulties involved were too serious to warrant much hope of final success.

Mr. A. P. M. Fleming expected a great deal of trouble with high voltages, particularly in view of the extremely arduous conditions under which railway services operated in regard to moisture, dust, and oil.

Mr. C. H. Wordingham most strongly deprecated the nationalisation of railways; every country which had nationalised its railways had done so to its own detriment. Once the feeling of competition was removed, bad as railways might be in certain respects at present, they could be infinitely worse if nationalised, and it might be said without doubt that a Government department was not in a good position to conduct trading operations successfully or with advantage to the public. It was essential to confine standardisation chiefly to questions of interchangeability, and not to attempt to standardise design. By adopting a rigid standardisation, mechanical or electrical, there was a grave danger of stifling progress.

Mr. J. S. Peck said that whilst it was not possible to standardise completely, as by so doing progress might be seriously hampered, if certain provisional standards were adopted—say, 600, 1,200, 1;800, and 2,400 volts—it would prevent one railway company from adopting, say, 1,200 volts and an adjacent company 1,300 volts, 1,500, or other odd voltage which seemed at the moment to possess some special advantage. Unless some effort was made to standardise very soon, there would be the same multiplicity of voltages that existed in the States, where they had 500, 600, 750, 1,200, 1,500, 2,400, 3,000, and 5,000 volts. Mr. Barnes's suggestion of using electric locomotives operating only on their own systems seemed a very important solution of the problem. If the railways were ever amalgamated, one of the first things would be to adopt a standard voltage, which would necessitate scrapping a large amount of expensive equipment. Why should not standard voltages be adopted, as would be the case if all the railways in this country were under one management? The question of the shunt motor being more sensitive to fluctuations in line voltage was explained by the self-induction of the shunt motor field, due to many turns of fine wire, being much, very much, higher than that of the series motor with a few turns of large wire. If the line voltage went off and was suddenly thrown on again, or whenever there were large fluctuations in line voltage, there was a tendency for very large rushes of current to occur. The field of the shunt motor was sluggish in building up, and the very heavy armature current distorted the field and was apt to produce flashing. The maximum current which could be collected from a trolley wire was dependent a good deal upon the type of trolley and size of wire, but 250 to 200 amperes could be collected without much difficulty, even at high speeds. An advertisement some time ago showed a double pantograph trolley which would collect 4,000 amperes at 40 m.p.h. Compressed air was a very excellent insulator, and it had been proposed in connection with transformers in order to stop static discharge. The author

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had written to Mr. Peck to say that the only difficulties they had experienced so far with the 5,000-volt control equipment were due to earths on the resistance, due to running through slush and snow; that, however, was very easily remedied.

ELECTRIC POWER IN SLATE QUARRIES.

By G. K. PATON, A.M.I.E.E.

(*Abstract of paper read before the* Liverpool Engineering Society, *April 12th*, 1916.)

It is only within the last ten years that electric power has been introduced to any extent in the slate quarries of North Wales, some of which have been in active operation for a century or more. Under the terms of the North Wales Electric Power Act of 1904, the company is authorised to supply power in bulk to power consumers with an equivalent amount for lighting purposes.

The transmission lines of the Power Co. now extend to the principal quarrying districts in an area of nearly 400 square miles, supplying slate and granite quarries, aluminium works, and also the New Carnarvon transmitting station of Marconi's Wireless Telegraph Co., Ltd.

The generating station is situated at Cwm Dyli, near Penygwryd, in the Gwynant Valley.* Water power is the prime mover at an effective head of 1,150 ft.

Four Pelton wheels, each of 1,600 B.H.P., are installed, coupled to 1,500-K.V.A. alternators with direct-coupled exciters, generating 3-phase current at 10,000 volts 50 periods when running at a speed of 500 revolutions per minute.

Power is transmitted to the various consumers by overhead transmission lines, and each consumer has one or more sub-stations, equipped with two 3-phase oil-insulated transformers, varying in size from 100 to 750 K.V.A. capacity according to requirements.

The neutral of the E.H.T. system is earthed at the power station, and it is advisable that the neutral on the L.T. side should also be earthed. The earthing system in a slate quarry is important on account of the slate debris, which gives a poor "earth"; an earth wire should be run beyond the debris to obtain satisfactory results.

In slate mines bitumen-insulated armoured cables are the most suitable for voltages up to 550 volts. The moisture underground causes rubber to perish quickly. All cables should be armoured, the armouring being used as an earth conductor.

Overhead lines have to cross innumerable rails and footpaths, and it is often necessary to guard the lines throughout their whole length; owing to the extreme weather conditions, guarding with earthed cradles is impossible.

A simple and effective design for a 1,000-volt single circuit line is given in fig. 1, which is self-explanatory. Double circuit lines with channel arms are arranged with two insulators per conductor, to one of which the line wire is bound, and to the other is attached the anchor wires. An earth bar is fixed as an additional protection to earth the live wire effectively should it fall. Both designs are based on the fact that the insulator is the weak point of a line, and should it fail the wire may fuse or break at this point. The second insulator and anchor wires then prevent the conductor from falling.

A continuous earth wire should be run throughout, and all ironwork, motor frames, switch ironwork, and the neutral point of the secondary, efficiently connected thereto.

In Blaenau Festiniog the workings are all underground, and consequently the slate blocks and most of the debris require to be hauled to the surface, electric power being used in the larger quarries. Power is required in operating inclines, slate saw sheds, air-compressors for rock drills, ventilating, and also for pumping. In the Nantlle district the quarries are of the open pit type. Hoisting in these quarries is done by aerial suspension cableways and inclined hoists.

Slate saw sheds should be erected as near as possible to the part of the quarry from which the blocks are obtained. Advantage should be taken of the electrical supply to install units of 15 to 20 B.H.P., driving 12 to 15 saw tables, instead of the older method of concentrating all the saw tables in one large shed. When conversion is made to electric drive in these large sheds it is better to sub-divide into groups of 12 to 15 tables, each group being driven by a separate motor.

A convenient arrangement, recently laid down in Penrhyn quarry, is a shed 162 ft. by 58 ft., containing 12 saw tables, each driven by a belt from a main shaft, 4 in. diameter at the centre and tapering to 3 in. at the extreme ends, driven from the centre by means of a squirrel-cage, 3-phase induction motor of 20 B.H.P., coupled to a worm gear with a speed ratio of 960-45 R.P.M., the secondary shaft being direct coupled to the main shaft. An outline of this type of motor and worm gear is given in fig. 2. The slate tables are arranged six on each side of the motor equipment.

So far, artificial lighting has not been a success in saw sheds, owing to the habit of quarrymen to work only in daylight. In winter the working hours are thus reduced to eight hours per diem, but even then there are periods when artificial lighting is necessary indoors; the cost is so little that it is surprising that more use has not been made of electric lighting in sheds—to the author's knowledge, only one quarry has installed it.

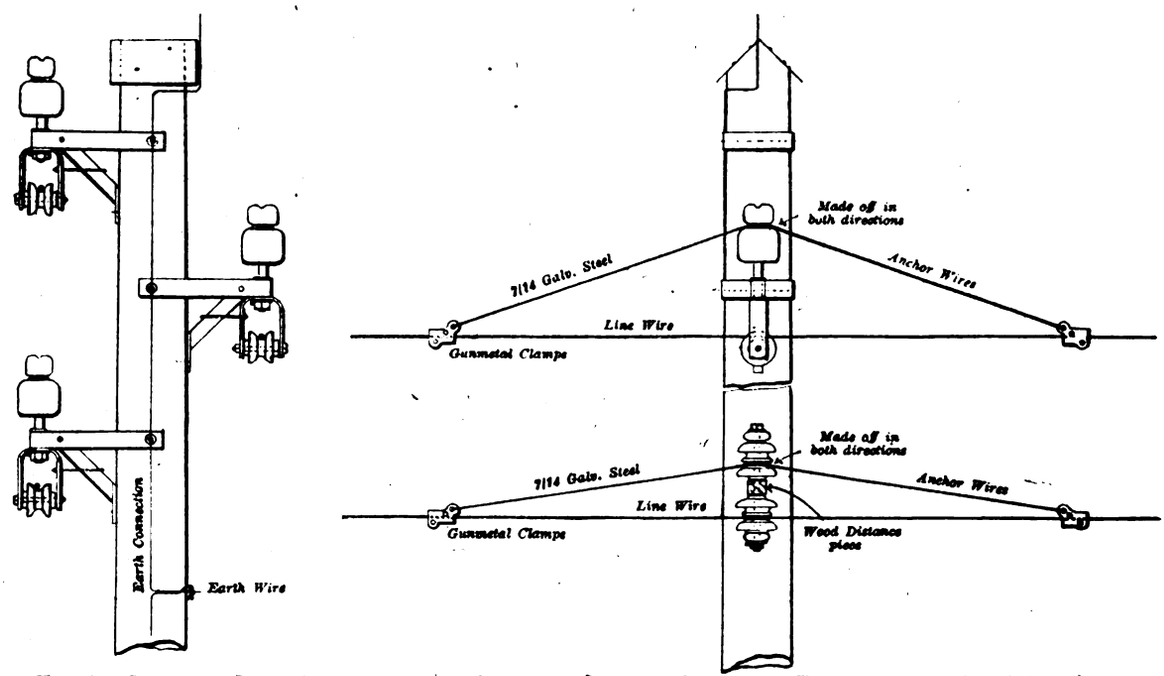

Fig. 1.—Overhead Line Construction in Quarries, Crossing Rails and Footpaths, at 500-1,000 volts.

In changing over an existing shed to electric drive, a belt drive is employed from the secondary shaft on the motor running at about 240 R.P.M., to the main shaft at 45 or 60 R.P.M. Slate dust causes considerable wear on paper or hide pinions, and it is nearly impossible to prevent dust getting about, as it is carried by the belt, even when the motor is fixed in a different compartment. A helical cut gear gives good results.

It is always preferable to use a belt drive, but when a speed reduction to 45-60 revolutions is required, this is only possible by means of a slow-speed motor. The "Cascade" motor is suitable for this purpose, a 15-B.H.P. motor running at 330 R.P.M., synchronous speed 333 R.P.M. The pulley ratio is about 7 to 1, and consequently the motor pulley is small in diameter.

From the Power Co.'s point of view, it is better to use high-speed motors, giving a higher power factor at half to three-quarter load, which is about the average over the running periods of the day.

The cost of power in slate saw sheds may be taken at 5d. to 7d. per ton of output, depending on the quality of rock, hard or soft, at one penny per unit. The running load factor varies from 45 per cent. to 55 per cent. over 9½ working hours per diem. The actual power required per table (8 ft. by 4 ft.) is on an average 1.1 KW. From tests taken, the actual cutting

* A full description of the plant has appeared in the Electrical Review.

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power per table is approximately 1 H.P., giving an overall efficiency of 68 per cent.

Where the quarries are of the open pit type, the slate blocks and debris require to be lifted out of the pit; aerial suspension cableways and inclined ropeway hoists are used for this work.

In the case of the inclined ropeway hoists, two heaving ropes are employed on one drum, one paying out as the other is pulled in, and the wagon and rope weight is balanced during most of the travel. In practice, however, it is found that the empty wagon descending is actually landed before the full wagon reaches the top of the mast at the upper landing stage. Consequently, the power required at the end of the lift is that required for the gross weight of wagon and load. The single hoist, with two main ropes, lifts a gross weight of 50 to 60 cwt., one empty wagon descending while the other load is lifted. The double hoist is arranged with four main ropes and is used to lift one or two full loads at a time, as may be required. The single hoist is driven by a 70-B.H.P. motor and the double hoist by a 150-B.H.P. motor.

The total net weight lifted with 1,135 loads during tests was 2,380 tons, and the corresponding units registered were 1,140 units, which gives per net ton lifted 0.48 unit and approximately 1 unit per journey or load.

The overall efficiency is 75 per cent. with unbalanced load, and about 85 per cent. with the wagon weight balanced, a result which may well be considered satisfactory. The time taken for each complete operation is about 1¾ minutes, so that it is not impossible to do one journey every 2½ minutes, equal to about 200 loads per day, or, approximately, 400 tons net. Under these conditions, the motor would take 200 units per diem, although actually about 100 units per diem would be a good average under normal conditions.

100 units per diem represents a load factor of 18.5 per cent. over nine working hours per diem, but taken over longer periods when other conditions, weather, &c., interfere with outdoor work, the load factor averages from 12 to 15 per cent. only. In other words, to the Power Co., a winding motor taking a maximum demand of 60 KW. intermittently, consumes in a day from 60 to 100 units, representing from 0.9 to 1.43 units per H.P. per diem, which at 1d. per unit brings in a revenue of from 5s. to 8s. 4d. per diem.

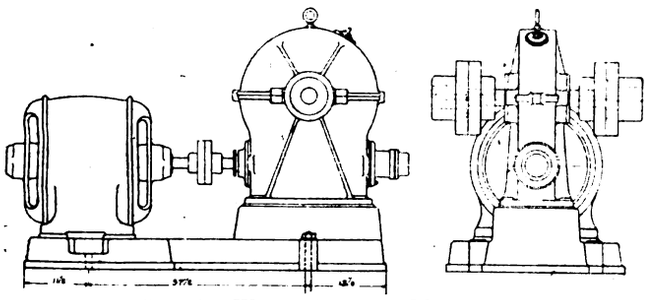

FIG. 2.—WORM GEAR AND MOTOR.

In the case of aerial suspension cableways, two winding drums, one for heaving rope, and the other for the endless travelling rope, are employed. The drums are independent of each other, and each drum has a separate band brake with foot control. The endless rope serves to hold the load carriage in position when hoisting and lowering. For travelling horizontally, the hoisting rope is drawn in and the endless rope is paid out at the same speed, the drum diameters being equal. The load may be hoisted or lowered at any point under the line of cable, and the horizontal motion may be given to the load at any height to which it may be raised. The direct lifting speed is one-third of the rope speed. Compared with the inclined hoist, which has fixed positions for picking up, it will be seen that the aerial cableway can pick up and lower at any point across the main cable.

The following particulars relate to three such cableways in operation at Penrhyn Quarry, with spans of 965, 1,010, and 1,015 ft.:—Gross load, each 60 cwt.; hoisting speed, 300 ft. per min.; travelling speed, 900 ft. per min.

Winding drums, 5 ft. diameter, giving maximum rope speed of 900 ft. per min.

Motor, 70 B.H.P. 3-phase, 50-period, 500 volts, 570 R.P.M. Slip ring, reversing, enclosed ventilated type, with extended shaft and third bearing.

Controller, Westinghouse F. 12A drum-type reversing controller, with 11 steps forward and reverse, arc shields, five-minute rated open-type, cast-grid resistance.

Switch panel, totally enclosed, oil-break automatic circuit-breaker with no-volt and overload releases, fitted with adjustable time lags.

As the driver is not in full view of the landing points in the bottom of the quarry, an electric signalling system is used, with luminous signal receiver fitted in the driver's room. The signals are given from a signal box in full view of the workings under the cableway.

The main cable suspended across a span of 1,000 ft. forms a catenary, and the power required in traversing varies according to the direction and slope of the cable.

Over a definite period 423 complete journeys were made (in and out), when the net tonnage lifted amounted to 887 tons. During this period the energy used amounted to 650 units, equal to 0.733 unit per ton, or 1.54 units per load of 42 cwt.

In another cableway the tonnage noted in 255 journeys was 574 tons, when the energy consumed amounted to 516 units, giving 0.9 unit per ton lifted, or 1.89 units per load of 42 cwt. net. These figures include journeys made with empty wagons.

The time of a complete cycle of operations is six minutes, equal to 10 journeys per hour, as a maximum. In a 10-hour working day this would give at most 100 journeys, or about 200 tons per diem, which probably has not yet been attained in ordinary working.

Taking 200 tons per diem as a maximum, the consumption of energy at an average of .8 unit per ton would be 160 units.

The average load requires a maximum power of 60 KW. or 70 B.H.P., which gives an average of 2.28 units per H.P. per diem. Over a longer period the average would amount to only about 50 units per diem, equal to only .715 unit per H.P. per diem. This is equivalent to a load factor of, say, 9 per cent. to a possible maximum of 28 per cent. over a 10-hour day, and under normal working conditions 10 to 15 per cent. would be a fair average.

The costs and tonnage handled by each type of haulage are given below:—

Type of cableway.	Cost of equipment.	Tonnage per diem. Max.	Tonnage per diem. Aver.	KW.	Units per ton.	Load factor. Max.	Load factor. Aver.	Overall efficiency.
Single incline hoist* ...	£600	400	130	200	60	0·48	35%	12-18%	76%
Aerial suspension cableway† ...	£900	200	50	100	60	·733	28%	10-15%	65 70%

* **Diagonal lift, 300 ft. Travel 400 ft.**

† **Vertical lift, 165 ft. Travel 900 ft.**

The approximate cost given in column 2 includes complete electrical equipment, ropes, masts, buildings, foundations and anchorages. The electrical equipment of the single hoist and aerial cableway is similar, with 70-B.H.P. motors and controllers.

From the figures given it will be noted that the actual tonnage handled by the inclined hoist is practically double that of the aerial suspension cableway.

Both types are used in Penrhyn Quarry, the cableways spanning the open workings, and landing the wagons on rails on which they are taken under the inclined hoist. The hoist then lifts the wagons another 300 ft. to the level of the debris tips. One hoist deals comfortably with the tonnage handled by two aerial cableways. In this way, 200 to 300 tons of debris per diem are removed from one part of the quarry workings, lifted a height of 400 to 500 ft. and a distance of over 1,500 ft., at a power cost of about 1½d. per ton.

Rock drilling in slate quarries is usually carried out by compressed air operating hammer drills; there is a big field for electric drills if they can be proved satisfactory.

A typical installation consists of an Ingersoll-Rand two-stage belt-driven compressor, driven by a 150-B.H.P. 3-phase, 50-period, 500-volt, 575-R.P.M., slip-ring, 3-bearing induction motor. Regulation of the air pressure is maintained within any desired range, usually between 80 and 100 lb., by a mechanical unloader, which operates by entirely closing the air intake, the power on the motor dropping immediately the intake pipe closes.

If a compressor is too large for its work, it is a good method to have a smaller pulley fitted to the motor and run the compressor at a reduced speed. This is done in one large quarry with good results, three different sizes of pulleys being used according to the number of drills in use.

The power consumption is dependent upon the number of drills in use, and the number of hours the plant is working. On an average, the daily load factor over a 10-hour working day is from 50 to 60 per cent., equal to 4 or 5 units per H.P. per diem.

A considerable amount of pumping is required in some quarries, and turbine pumps direct coupled to high-speed electric motors are in use. The sizes in use vary from 15 to 200 B.H.P., with a discharge up to 1,200 gallons per minute against a head up to 400 ft. The larger pumps are usually controlled from switchgear near the motor, but with smaller pumps it is possible to control them from a higher level. This is of great benefit in open quarries, as at night-time it is unnecessary for the attendant to go down to the pump, which is a more or less risky proceeding even in daytime.

It is sometimes necessary for pumping to be continued night and day, it is therefore necessary for power to be available at all times, and a bulk supply is of great benefit.

The winding or haulage load accounts for 58 per cent. of the total demand, with a poor load factor.

Air compressors and slate sawing machinery tend to balance matters with their increased load factor, but the resulting demand on the Power Co.'s system is not ideal.

The plant diversity factor equals 2. In other words, a demand of 250 KW. on the power plant will supply a quarry plant totalling 500 KW. Totalling the individual quarry H.P. connected against the actual maximum demand on the power station gives a diversity factor of about 3.

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While the present state of the slate trade may not warrant further capital expenditure, and each particular quarry must be considered by itself, the actual working costs with modern machinery are so small compared with the additional revenue from increased output and reduced working costs, that no quarry manager should be content to work under the conditions which prevailed in the past.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AUSTRALIA.—By a Proclamation, dated December 15th last, the importation or exportation is prohibited of any goods packed in a bag or sack when the combined weight exceeds 200 lb.

SWEDEN.—The exportation of antimony, unmanufactured platinum, and platinum wares other than those with precious stones or pearls inset, has been prohibited recently.

ITALY.—By a Decree dated February 17th certain Customs privileges are granted in favour of new industries. For a period of five years from March 1st exemption from Customs and Octroi duties will be granted in respect of machinery and building materials destined (1) for the establishment of factories for producing articles not already manufactured in Italy, or the products of new industrial processes; and (2) for factories existing in the Kingdom, in order to enable them to undertake industrial processes not hitherto applied, or to obtain products supplementing those already manufactured in such establishments. Regulations for the application of these privileges are to be laid down by Decree.

GUATEMALA.—A Decree, dated September 9th, 1915, provides that, as from October 1st, 1915, Guatemalan Consular Officers were to collect the undermentioned fees:—

For the legalisation of invoices, 2 per cent. of the value of the merchandise.

	American gold.
For the legalisation of ships' manifests	10 dollars.
For the "visa" of each bill of lading in quadruplicate	1 dollar.
For each additional copy	1 dollar.
For the "visa" of bills of health	2 dollars.
For the legalisation of signatures to documents to be used in the Republic	3 dollars.

RUSSIA.—Information has been received at the Board of Trade to the effect that the competent Russian authorities have decided that the differential rates of duty which are leviable on goods falling under certain sections of the Russian Customs Tariff, when imported over the Western land frontier, are not to be levied on such goods when they are imported *viâ* the Swedish-Finnish land frontier.

[NOTE.—The differential duties referred to consist of the rates for goods imported by sea, increased by 20 per cent., and are leviable under Sections 140-2, 149-61, &c., of the Russian Tariff, which has been published as a Parliamentary Return (Cd. 7,854, price 7d., ex postage). The sections in question relate, *inter alia*, to certain iron and steel manufactures, and wire and wire manufactures (including electrical cable of all kinds).]

SWEDEN.—The exportation of molybdenite has been prohibited as from March 17th, and of calcium carbide and nitrogen carbide (*calcium cyanamide*) as from April 1st.

NETHERLANDS.—The exportation of asbestos has been prohibited as from March 27th, and of zinc ore and zinc oxide as from April 1st.

SOUTHERN RHODESIA.—The following Customs decision has recently been announced:—

Washing machines driven by electrical power are dutiable under No. 193 of the Tariff at the general rate of 20 per cent. *ad val.*, the rebate allowed on goods manufactured in the United Kingdom or British Possessions (whether reciprocating or not) being 9 per cent. *ad val.*

NEW ZEALAND.—A revised decision has recently been issued by the Customs Department regarding the tariff classification of accessories for motor vehicles, cycles, and motor cycles. Certain articles, among which are included electric batteries and switchboards, will only when accompanying the motor vehicle, &c., to which they belong, be classed as parts of same. When imported separately they will be classed under appropriate tariff headings.

BRITISH SOLOMON ISLANDS.—A Proclamation has been issued under the "Solomons (Customs) Regulations, 1907," embodying new schedules of goods dutiable and free, respectively, on importation, with effect from January 19th. Among the articles exempt from duty are machinery (including electrical) and component parts thereof which the High Commissioner may from time to time specify. The schedule of goods dutiable mentions fuse, the duty on which is 10 per cent. *ad val.*, and this rate is also payable on all goods not specifically tariffed or not included in the list of exempted articles.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

5,237. "Automatically-controlled electric heater for water, &c." Sir C. S. FORBES. April 10th.
5,240. "Sparking plugs." A. E. LAMKIN. April 10th.
5,257. "Sparking plugs for internal-combustion engines." A. B. BACK. April 11th.
5,259. "Motor-driven vehicles whereof the motor may be utilised for driving the vehicle or dynamo carried thereon." J. L. GORDON. April 11th.
5,252. "Electrical alternating-current machines." J. L. BROWN. April 11th.
5,279. "Apparatus for cutting wires or cables under water." G. W. SUTTON. April 11th.
5,280. "Gas alarm and telegraph." J. M. MEADOWS. April 11th.
5,289. "Electric cable-laying machine." E. C. BLACKSTONE, E. CARTER, F. CARTER AND R. E. WATTS. April 11th.
5,293. "Dynamo-electric machines." D. SUCHOSTAWER. April 11th.
5,300. "Electric arc lamps." T. L. CARBONE. April 11th.
5,319. "Sparking plugs." V. PONS. April 11th. (France, May 14th, 1915.)
5,325. "Semi-automatic telephone exchange systems." G. DRAKIN, L. POLINKOWSKY & WESTERN ELECTRIC Co. April 11th.
5,337. "Electrical aim corrector and teacher." J. M. CHARLTON. April 12th.
5,341. "Insulators for supporting electricity conductors or appliances." J. W. ASTLEY AND BRITISH INSULATED & HELSBY CABLES, LTD. April 12th.
5,343. "Electric lampholders." A. P. RUTHERFORD. April 12th.
5,377. "Dynamo-electric machines." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.). April 12th.
5,391. "Continuous-current generators." ALLMANNA SVENSKA ELEKTRISKA AKTIEBOLAGET. April 12th. (Sweden, May 5th, 1915.)
5,398. "Insulating compositions for electrical purposes, &c." J. ANDERSEN AND E. SOBERG. April 12th.
5,422. "Portable military telephones." J. W. DUNGEY & C. B. KERSTING. April 13th.
5,442. "Electro-thermic induction furnaces." C. B. FOLEY. April 13th.
5,445. "Electrical controlling apparatus." E. C. R. MARKS (H. Goldberg). April 13th.
5,458. "Wireless telegraphy and telephony." SOC. FRANCAISE RADIO-ELECTRIQUE. April 13th. (France, December 28th, 1914.)
5,466. "Wireless telegraphy and telephony." SOC. FRANCAISE RADIO-ELECTRIQUE. April 13th. (France, March 1st, 1915.)
5,471. "Wireless telegraphy and telephony." SOC. FRANCAISE RADIO-ELECTRIQUE. April 13th. (France, March 9th, 1915.)
5,497. "Electric wire-cutting device." W. MCROSTIE, A. WILLOWS & F. WILLOWS. April 14th.
5,498. "Shunting device for windings of electro-magnets." W. A. STEVENS. April 14th.
5,501. "Field or portable telephones" H. BURGE. April 14th.
5,507. "Purifying and alloying iron." BRITISH THOMSON-HOUSTON Co (General Electric Co., U.S.A.). April 14th.
5,524. "Arc light electrode with capillary passages." PLANIAWERKE AKT. GES. FUR KOHLENFABRIKATION. April 14th. (Germany, September 13th, 1915.)
5,526. "Dynamo-electric machines." A. H. NEULAND. April 14th.
5,559. "Machines for laying cables and wires underground." W. E. MARTIN. April 15th
5,567. "Means for concentrating or intensifying light of electric filament lamps." A. G. FRANCE. April 15th.
5,568. "Reflectors." A. G. FRANCE. April 15th.
5,569. "Electric incandescent lamps." A. G. FRANCE. April 15th.
5,570. "Storage batteries." W. A. CROWDUS. April 15th. (U.S.A., April 22nd, 1915.)
5,573. "Reflectors and shades of electric lamps, gas lights, &c." A. G. FRANCE. April 15th.
5,577. "Electric switch." G. MARKT. April 15th.
5,579. "Special service system for machine telephone switching exchanges." F. R. MCBERTY, L. POLINKOWSKY & WESTERN ELECTRIC Co. April 15th.

PUBLISHED SPECIFICATIONS.

1913.

27,646. CIRCUIT ARRANGEMENTS FOR TELEPHONE SYSTEMS. Siemens & Halske Akt. Ges. December 1st. (November 30th, 1912.)

1914.

17,175. PROCESS FOR ELECTRICALLY SEPARATING SUSPENDED BODIES FROM ELECTRICALLY INSULATING FLUIDS, ESPECIALLY GASEOUS FLUIDS. E. Moller. July 20th. (July 22nd, 1913.)
24,537. ELECTRO-MAGNETS. H. Grob. December 23rd.
24,841. MACHINES FOR CUTTING THE GLOBES OF ELECTRIC INCANDESCENCE LAMPS AND THE LIKE. Allies' Electric Lamp Co. (le Naour). December 31st.

1915.

882. DYNAMO-ELECTRIC MACHINES AND INSTALLATIONS. Soc. Anon. des Etablissements L. Bleriot. January 19th. (February 7th, 1914.)
1,221. ELECTRIC ARC-LAMP CARBON FERRULES. T. Moore. January 26th.
4,582. TELEPHONE SYSTEMS. A. B. Smith. March 24th. (March 25th, 1914.)
4,593. MEANS FOR ESTABLISHING POSITIVE ELECTRICAL CONNECTION BETWEEN AN AEROPLANE OR THE LIKE AND ITS BASE. H. A. Von Post. March 24th.
4,849. APPARATUS FOR ELECTRICALLY DETECTING VIBRATIONS. F. Gottschalk. March 29th.
4,862. ELECTRIC OSCILLATING SYSTEMS. H. R. Rivers-Moore. March 29th. (Addition to 1,649/10.)
4,896. ELECTRIC SWITCHES AS APPLIED TO STOP MOTIONS ON TEXTILE MACHINERY P. Sharp. March 30th.
4,953. SOUND-MAGNIFYING APPLIANCE FOR TELEPHONIC AND TELEGRAPHIC PURPOSES. H. Smith. March 31st. (April 18th, 1914.)
5,240. JOINTS OF PIPES AND COUPLINGS APPLICABLE TO ELECTRICAL CONDUIT FITTINGS AND LIKE PURPOSES. H. F. Joel, Sen. April 7th.
6,895. STARTING SWITCHES FOR ELECTRIC MOTORS. A. H. Curtis, A. H. Mackley & Igranic Electric Co., Ltd. May 8th.
7,080. WINDINGS OR CONDUCTORS OF ELECTRICAL APPARATUS. British Thomson-Houston Co. (General Electric Co., U.S.A.). May 11th.
7,081. ELECTRICAL APPARATUS PROVIDED WITH WINDINGS. British Thomson-Houston So. (General Electric Co., U.S.A.). May 11th.
8,019. LIFTING ELECTRO-MAGNETS. Steel, Peech & Tozer, Ltd., and H. E. Bowen. May 31st.
9,101. REGULATING MECHANISM FOR CONTROLLING THE FLOW OF FLUIDS. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 21st.
9,957. PREPARATION OF ELECTROLYTES FOR USE IN THE ELECTROLYTIC DEPOSITION OF METALS. P. Marino. July 8th. (Patent of Addition not granted.)
11,262. COATING METALS. British Thomson-Houston Co. (General Electric Co., U.S.A.). August 4th.
11,515. TURBINE APPARATUS. Westinghouse Machine Co. August 9th. (October 17th, 1914.)
17,411. ELECTRICAL APPARATUS FOR HEATING LIQUIDS. W. H. Smith. December 13th.

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THE

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THE DEARNESS OF THE LOWEST TENDER.

It is a common saying, and one that is full of sound wisdom, the fruit of long experience, that "the best is the cheapest in the end." Unfortunately, in purchasing plant, the buyer too often ignores this maxim, and appears to believe that the best is that which is cheapest in the beginning; that is to say, he accepts the lowest tender, on the faith of the assurances that he receives that the plant is "just as good" as its more costly rivals, or a bit better, and is "guaranteed" to have high efficiency, long life, and all the other virtues of high-class productions. The lowest tender is not always unworthy of consideration; when made by a firm of high standing, whose reputation is an asset that it cannot afford to depreciate, it may be, and often is, both safe and wise to accept an attractive offer. But in general the lowest tender should be most carefully scrutinised, and considered in all its bearings, before it is preferred to a somewhat higher-priced tender of unquestionable merit.

Private purchasers, of course, are able to exercise their discretion with absolutely unfettered freedom, but municipalities in this country have always before them the fear on the one hand of the Local Government Board, which is apt to give little heed to explanations justifying the payment of a higher price than the very lowest terms, and on the other of the intelligent ratepayer, who sees in any departure from the minimum price basis either an opportunity for making political capital out of the transaction, or evidence of corrupt practices which he is not slow to denounce. It is sometimes the duty of the conscientious engineer to advise his committee to brave these dangers and pass over the lowest tender, but occasions arise when even he can see no adequate reason for such a recommendation, and price must rule the choice; yet the risk remains that the bargain may turn out to be a bad one.

Such a case is recorded in the annual report of Mr. T. H. U. Aldridge, engineer-in-chief to the Municipal Council of Shanghai, which has just come to hand. Mr. Aldridge states that, in view of the price and guaranteed efficiencies of the German turbo-alternators which were installed two years ago at the Riverside generating station, the German tenders were "theoretically" the best offers received, and could not easily have been passed over. In practice, however, they proved to be most disappointing, for a crop of troubles has been experienced since they were put to work. It cannot be too widely made known in neutral and Allied markets that serious breakdowns of the German-built machines took place, and at one critical period two-thirds of the turbine plant was unavailable for service, owing to serious defects. The trouble was traced to the employment of unsuitable material for the turbine blading, but other mechanical defects were discovered later, and a serious electrical burn-out also took place, almost simultaneously with the blade troubles. The consequence has been that while the average cost of repair of six British turbo-alternators at Shanghai, aggregating 4,200 KW., which have been running for five to nine years, was under £40 each per annum, the two 2,000-KW. turbo-alternators supplied by the A.E.G., of Berlin, which have been running less than two years, have cost respectively £318 and £267 per annum, an

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average of £293 each. In addition there was a serious loss of revenue whilst the A.E.G. machines were under repair. Mr. Aldridge adds: "Since those turbines were installed, troubles with machines of similar make have come to light in connection with machines in Australia and England. Not only have the German turbines proved defective in Shanghai, but several transformers have also shown marked inferiority to either British or American ones in service." Whilst we condole with Mr. Aldridge on his unfortunate experience with German generating sets, we must, in passing, once more congratulate him on the splendid progress that his undertaking has again recorded. A 52 per cent. increase in units sold, following on successive increases of 46, 80, and 50 per cent., and a load factor of 40.8 per cent., are achievements to be proud of; the units sold now exceed 50 millions per annum, and the installation of generating plant of 25,000 KW. capacity is in hand.

Possibly one of the Australian breakdowns to which reference is made above is that of the Sydney City Council, which in 1913 bought an A.E.G. turbo-alternator for £21,233, the lowest tender by £2,077. This set was supplied through the Australian Metal Co., and broke down in 1914. It would be interesting to know whether the resulting loss to the Council had swallowed up the difference between the price quoted and that of a set of reliable make. We know that certain large A.E.G. turbines installed in this country have turned out so defective that they have had to be rebuilt.

From the foregoing data we deduce the obvious moral which forms the subject of this article—that the cheapest may be far from the best, and may be found the dearest in the long run. The danger of too readily accepting the lowest tender was emphasised by Dr. Ferranti at one of the Beama conferences last winter, and is particularly to be feared in connection with German plant, even though it be made by the greatest of the German companies. In the course of a discussion at the Royal Society of Arts not long ago, Mr. J. Swinburne said that the more the Germans dumped goods into this country, the more we should get in the way of an indemnity; dumping was a splendid thing for the countries that received the goods, and very bad for the countries sending them. But if the dumped goods prove to be more costly in maintenance than higher-priced goods made in this country, even Mr. Swinburne will surely admit that dumping is a bad thing for both parties. In this country we want neither Germans nor German machines; it has been proved that British machines are the better and the cheaper in the end, hence there is nothing to be gained by importing the inferior article.

Patents in War-time.

The primary object of the law of letters patent is to secure to the public the benefit of new inventions, by inducing inventors to disclose the details of their processes and apparatus, instead of endeavouring to surround them with a veil of secrecy. The inducement offered to the inventor is the privilege of monopoly, guaranteed by the State, for a term of years. Incidentally, by retaining inventors and their discoveries in this country, the public derive advantage not only after the lapse of the term of monopoly, but also during the life of the patent, for employment is given to a number of persons in working the processes, in distributing the products, and in other ways, extending over a wide and complex range; the importance attached to this aspect of the subject by the State is well exemplified by the provisions introduced into the Patent Law a few years ago for the purpose of compelling British patents, not only of native but also of foreign origin, to be substantially worked in this country as a condition of the maintenance of the monopoly.

It would seem, therefore, that the State gets the best of the bargain, and would be acting wisely if it were to offer rewards to the originators of successful ideas, in addition to the monopoly of which so few are in a position to take advantage. But on the contrary, far from recognising its indebtedness to the inventor, the State demands that he shall pay an annual tribute for the privilege of owning letters patent—a tribute increasing from year to year, just as the public benefits derived in other ways from successful inventions increase as time goes on. Surely this is an unjust and unwise policy. At the very least, the State should grant the patents free of charge.

Are we exaggerating the position in favour of the inventor? By no means. The truth of our contention is recognised, confirmed, and published abroad to all the world by the State Government, which has organised several departments for the express purposes of inviting the submission of ideas of all sorts, good and bad—of sifting out the former from the latter with the aid of experts of the highest standing and ability—and of carrying into effect those which afford any prospect of advantage to the nation, at the same time offering rewards to the inventors. Our readers are familiar with the constitution of these departments, which were organised first for the specific purpose of increasing our military efficiency, and afterwards to develop our industrial interests.

Yet side by side with this admittedly revolutionary innovation, the Patent Office pursues its normal course, demanding fees from inventors for the maintenance of their privileges—whilst, moreover, other departments of the Government commandeer factories and workshops, and thus render it impossible for the inventor, during the continuance of the war, to utilise the scanty term of his patent to secure his just reward.

The manufacture of munitions must proceed with the utmost energy, and must take precedence of all private interests; but, at the very least, steps should be taken to suspend the payment of fees for the renewal of patents which are thus hung up, and to prolong the lives of the patents to a corresponding extent.

Our attention has been called to this matter by a letter which appears in our "Correspondence" column to-day; we cordially sympathise with the views of our correspondent, and should be glad to see a movement set on foot to secure justice for the inventor.

Electrical Propulsion of Ships.

Elsewhere in this issue we commence an abstract of a paper by Mr. R. S. Portham, which at the same time adds to our information with regard to the Ljungström steam turbine—one of the most interesting and admirable engineering achievements of the age—and bears witness to the growing attention that is being given to the electrical propulsion of ships. This is one of the most important fields that still await conquest by the electrical engineer, hardly second in importance even to the railway field, and the excellent results attained by the s.s. *Mjölner*, in comparison with her sister ship *Mimer*, inspire the confident hope that in no long time marine engineers, for their own advantage, will be compelled to adopt the electrical method of transmission of power from the prime mover to the propeller. The small electrical losses in transit are completely swamped by the gain due to the possibility of adopting the most economical turbines, running at their most efficient speeds, and taking advantage of the latest developments of high steam pressures and high superheat; reversing turbines are dispensed with, and the control is reduced to its simplest terms, while all auxiliaries throughout the vessel, as well as lighting,

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heating, and cooking, can be efficiently and cheaply operated by electrical means. We understand that already the application of the system to very large merchant vessels—which, running almost all the time at constant speed, are able to derive the greatest advantage from turbo-electric drive—is in hand, and when the shipbuilding boom which is certain to follow the war commences, we hope that the opportunity will be taken to increase the splendid lead which our merchant marine already possesses over all its rivals, by this means.

Rubber.

The recent setback in the price of crude rubber has proceeded to an extent which has certainly tended to keep the trade demand going at a pretty satisfactory rate considering the rather drastic restrictions imposed by the authorities on the exports to the United States. The reason for this policy is rather obscure, especially in view of the fact that unsold stocks have been accumulating for some time past, while it is understood that proper regulations are in force on the other side under the co-operation of the Consular agents in order to preclude the possibility of leakages in the way of contraband trading with the enemy. However this may be, it is generally inferred that the present restrictions as to permits are merely ephemeral, and must therefore soon or later be modified, or otherwise trade will suffer to some extent. Meanwhile, there is no denying the fact that this adverse feature has had something to do with the recent weakness of the market. Not only have export buyers had to resort to a more conservative policy in the placing of new orders so as to avoid unnecessary additional charges in the way of storage or interest, but the attitude of home consumers has been of a more discriminating character, all of which, including quite large arrivals, have contributed to the depression. Prices, nevertheless, now appear to arouse more interest on the part of consumers, and it is not really surprising that the market is now exhibiting a little more backbone, although there is as yet no robust confidence as to its stability. It is, however, worth noting that the rubber estates are not anxious sellers, and that quotations for forward deliveries covering the remainder of this year have been remarkably well held, mostly at a trifling premium over spot rubber. For the present, dealers are disinclined to carry stock, but it is probable that as soon as the issuance of permits is restored to the normal, a stronger feeling will assert itself and have a stimulating effect upon the general demand. The lower qualities of crepe rubber are now comparatively cheap, and once again attracting a little more attention. The inevitable result of the recent break in the price of plantation descriptions has been an adjustment in values for wild rubber, in which there has not been much activity. The price of fine hard Para has dropped to below 3s. per lb. in the absence of any notable demand, but supplies are fairly well concentrated, and the chances are that, given a revival of buying, the market will readily respond alongside of a change of feeling in plantation rubber. Having regard to the progress of general consumption, the outlook is satisfactory enough, prospects across the Atlantic being quite good, and pointing to the probability of the importations being maintained on a big scale for an indefinite period. American manufacturers have doubtless still good stocks to go on with, so that a temporary falling off in the imports can hardly impair the progress of their operations. As regards the home manufacturing trades, things are now quieter, the pressure of Government work having relaxed, which is enabling the works to make up somewhat for their arrears of deliveries against export orders. The outlet for ordinary cycle tires is, for the time being at any rate, not so large as it used to be.

An Important Detail

It seems that American traders are not so alert as their hustling reputation might lead some people to expect. One of their own Consuls (at Pernambuco) has been writing home emphasising the importance of stating one's telegraphic address and the names of codes used, on letterheads, in catalogues, &c. A case is mentioned of a firm for whom a cable order was waiting, but neither the firm's letterhead nor any available directories gave the information required. Needless messages were in consequence sent, and valuable time was lost, and the business eventually had to be abandoned. This order was not one for electrical machinery or supplies—it was for candies, but the lesson it teaches is the same whatever the article of trade. We need not give the Consul's figures showing the American trader's remissness in the above matter except to state that out of 144 letters examined only 26 gave cable addresses, 50 the address and code, and 68 gave *nothing*. In our opinion the left-hand side of business notepaper can be most profitably occupied by giving essential information of this kind, especially when dealing with buyers abroad. We believe that most of our leading electrical export firms are alive to the importance of such matters. In some cases their catalogues are models of what an export trade publication should be, but the matter wants attention, not only on correspondence paper and in catalogues and trade circulars; it should be especially attended to in advertisements appearing in trade organs. For example, a copy of the Electrical Review lies on the table of a given Consular office abroad—it is to be found on many of them—the Consul receives an inquiry: he turns over our advertising pages and "spots" just the thing the inquirer wants, but the inquiry is an urgent one and the cost of cabling is so many shillings per word. The advertisement gives neither cable address nor code, and the name of the concern is Brown and Johnson's Electrical Accessories Manufacturing Company, Limited, of Little Huddlesdon Works, Partingchester, near Manton—is the inquirer not likely to be discouraged to the point of exasperation if, as is as likely as not, he have no directory of British manufacturers at hand? The illustration may seem an extreme one, but we use it as the simplest way of getting home the need for placing before the buyer essential export trade particulars. Whether the inquirer be a trader in a big business centre, or a caller at the Consulate, or a buyer in an out-of-the-way corner of the globe, when he gets the Electrical Review with the complete trade advertisement in it, he will find it a time-saver and the advertiser will get business which might otherwise pass him by. We have no first-hand figures available concerning the practice followed in British export papers as a whole, but the American Consul gives some interesting information that he has compiled as the result of a survey of the advertisements in a number of publications. He does not say whether these journals are all American; we should judge that they are not so, for the weakness is certainly not peculiar to the States. He says:—

> One of the best-known export journals circulating in Central and South America contained in a recent issue 135 advertisements, and of these 9 had address and code, 4 address only, and 122 no telegraphic information. The same is true of the announcements in other export magazines. Of 70 machinery catalogues examined, 10 gave address and code, and, in addition, their own private code; 15 gave address and code; 5 gave address only, 4 gave private code only, failing to state cable address and other codes used; 36 gave no telegraphic information.

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ELECTRICAL EQUIPMENT OF THE PHŒNIX ASSURANCE CO.'S BUILDING.

One of the finest of the recently-completed modern London office buildings is that erected for the Phœnix Assurance Co., in King William Street, E.C., which houses not only the company's own staff, but also the Bank of Egypt and certain other tenants. The building, which is in the classical Renaissance style, covers an area of 12,000 sq. ft., and is eight storeys in height, the two lower storeys being basements.

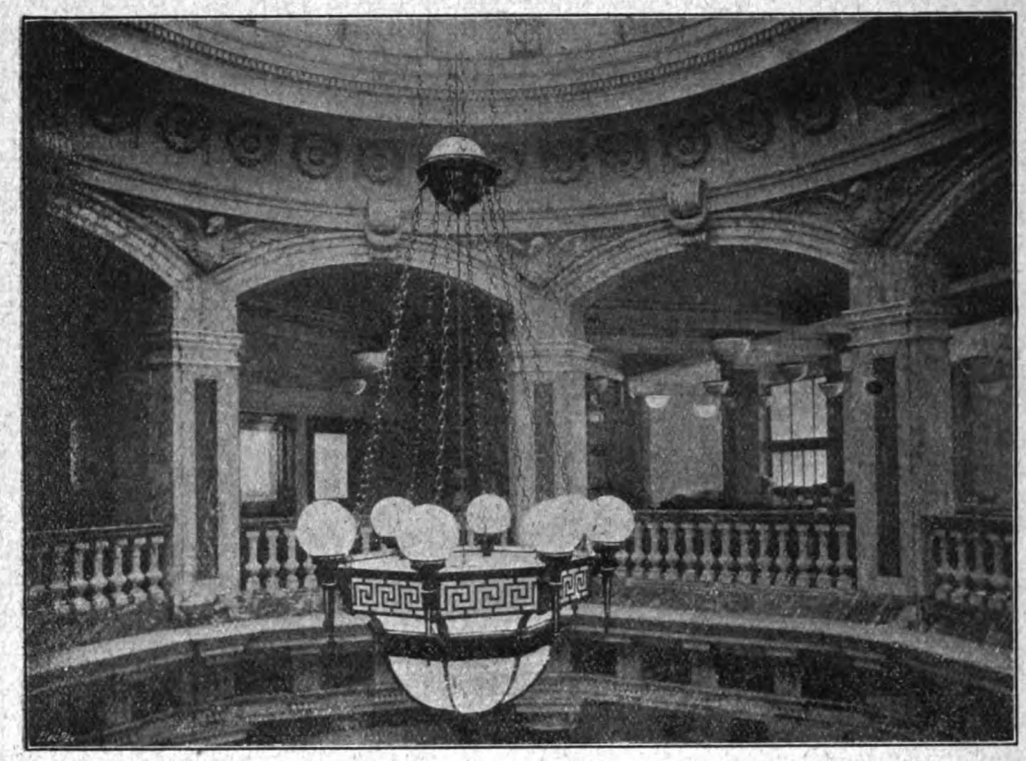

Fig. 1.—Large Central Fitting, Phœnix Assurance Building; also Indirect Office Lighting.

The consulting engineer for the whole of the electrical work in connection with the building was Mr. S. G. Castle Russell, M.I.E.E., who has courteously allowed us to place on record the principal features of interest in the installation.

Although the services to, and installations in the Phœnix Company's premises, and those of the Bank and east and west ends (tenants' portions), &c., are kept distinct, the general type of installation is uniform throughout and can be gathered from the description of the work carried out at the Phœnix Co.'s premises, which follows.

The electric supply for the whole of these premises is controlled from a switchroom in the sub-basement, this supply at 400 volts being obtained from two independent sources, viz., the Charing Cross and City of London Electric Supply Cos., and this division of service is carried out wherever practicable throughout the whole building, approximately half the lighting in all large or important rooms and on each floor being supplied by each company, and the well pump, ventilating, lift and pneumatic tube motors being served by both companies as a precaution against total interruption of the supply. The switchroom is a departure from usual practice, the main switchboards being built up of ironclad gear attached to the glazed brick walls, with the interconnecting cables carried in heavy-gauge screwed gas barrel, with rectangular cast-iron junction boxes.

On entering the switchroom, each company's service — the neutral being divided — is led to two two-way terminal boards (positive and negative) through a 350-amp. D.P. switch and fuses.

From each terminal board a 200-amp. service is led through a D.P. switch and fuses to a 200-volt main distribution board for lighting, fitted with D.P. switches and fuses for controlling individual services to the various floors and basement and sub-basement; a 100-amp. heating service is also taken off, similarly controlled in each case by a D.P. switch and fuses — these services running in the case of one company to

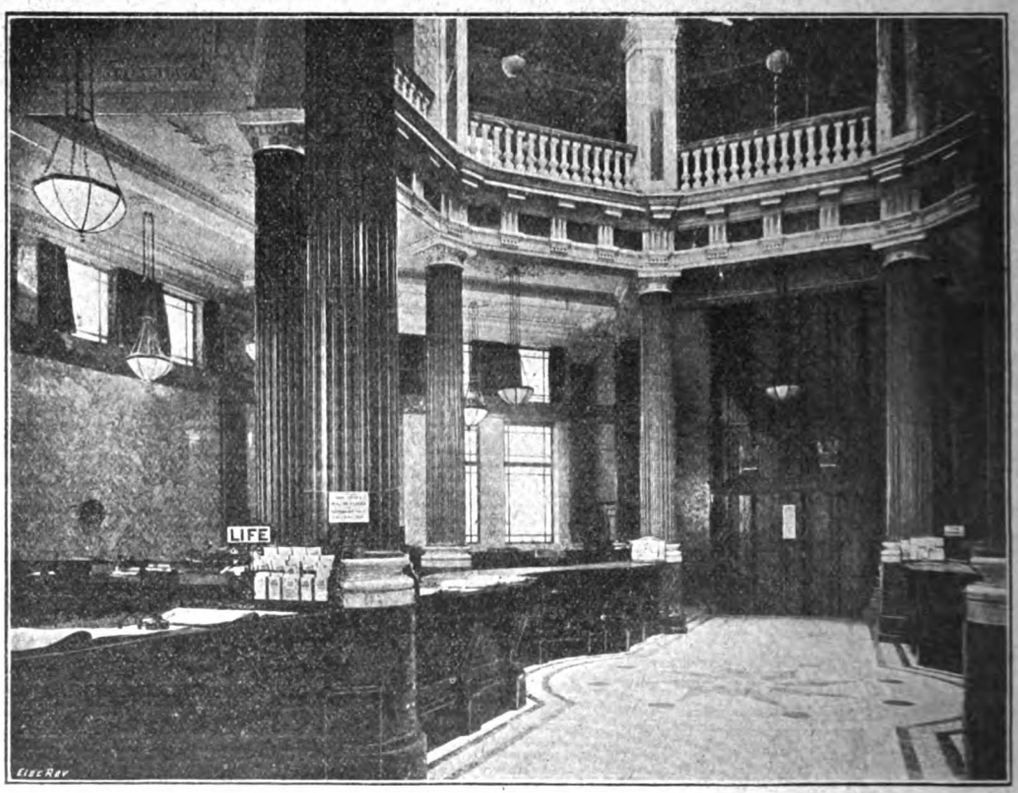

Fig. 2.—Phœnix Assurance Co.'s Offices, showing "Half-Watt" Indirect Lighting.

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the ground and fifth floors, and in the case of the other to the first and second floors.

From the outers of each pair of terminal boards a 200-amp. power service is taken to a main power distribution board, fitted with D.P. switches and fuses, which controls the various motor circuits in the building; each of these

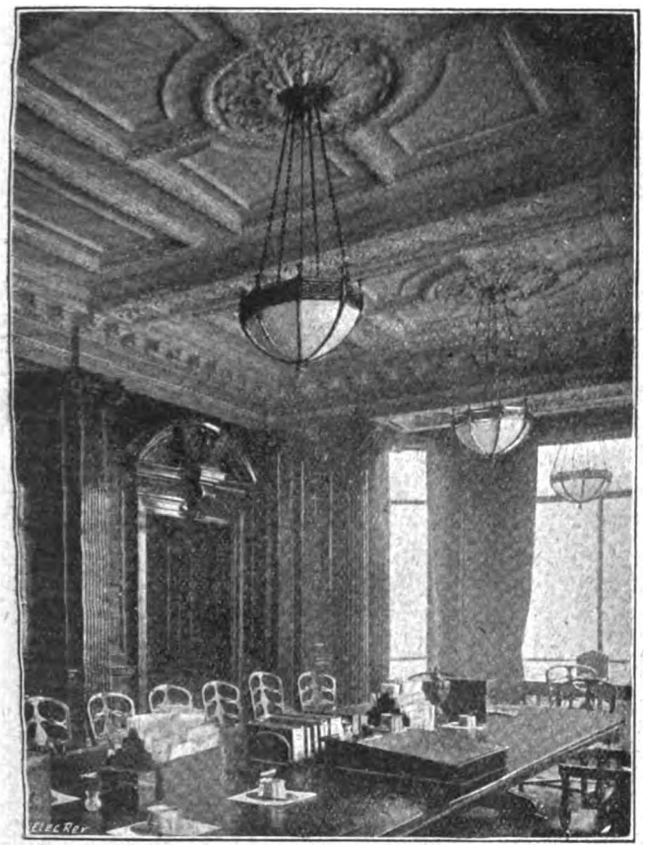

FIG. 3.—VIEW IN BOARD ROOM, SHOWING SPECIAL LIGHTING FITTINGS.

boards is also controlled by a D.P. switch and fuses in the switchroom.

The pair of lighting distribution boards on each company's service are on facing walls, but all the heating and power circuits are in close proximity.

As previously mentioned, the switchgear is of the ironclad pattern throughout, the D.P. switches being mounted on marble bases, two inches clear of the case all round for the main switches which are lined with Uralite, and three inches clear in the case of the main distribution boards which are also Uralite lined and have plate glass fronts and front bus-bars.

The whole of the switchgear is white enamelled and clearly labelled; its general appearance is shown in figs. 4 and 7.

To provide for the services to the various floors, four chases are provided running from bottom to top of the building; and adjacent to the chase on each floor are provided sub-distribution fuseboards and D.P. switches of the ironclad type, as shown in fig. 8.

The whole of the wiring, as far as possible, is carried out on the looping-in system, special cast-iron looping boxes with porcelain interiors being provided where necessary. This wiring, consisting of 2,500 meg. braided V.R. cable, is run throughout in heavy gauge-screwed galvanised gas barrel, which was erected complete, with the plaster in position, before any wire was drawn in.

Cast-iron junction boxes with screwed lids are provided where necessary and similar boxes are used in place of tee-pieces and elbows throughout.

All the lamp-fittings, switches, &c., are screwed direct on to the iron junction boxes connected to the tubing, and the ends of all tubes throughout the installation were fitted with brass bushes, screwed on before the wire was drawn in.

The method of illumination adopted is of particular interest owing to the extent to which semi-indirect lighting is being used.

The imposing ground floor office depends entirely on the light provided by twenty-two 100-watt half-watt lamps in diffusing bowl reflectors suspended from the ceiling, as shown in fig. 2. In addition, a large central bowl-fitting is provided on a level with the gallery under the dome, which is a feature of the ground floor office; this fitting contains a 150-watt half-watt lamp in the bowl, with 60-C.P. lamps in spherical globes round the periphery, as shown in fig. 1, which also shows the semi-indirect lighting in part of the actuarial department. The illumination of the counters of the ground floor office is from 3 to 4 ft.-candles, while that of the desks behind varies from 4 to 6 ft.-candles.

The suspended bowl type semi-indirect lighting fitting has been generally adopted throughout the building, having been specially designed by the makers in bronze and in Georgian style, to harmonise with the principal apartments.

In all, we understand that some 1,200 lamps of from 20 to 100 watts each have been installed in the building.

Turning to the other matters of electrical interest, an extensive mechanical ventilating plant has been provided, which includes a 25-in. motor-driven fan for forcing fresh air into the basement and sub-basement, the incoming air being passed through the heating chamber in order to slightly warm it in the winter: a 15-in. motor-driven fan for extracting used air from parts of the basements; two 25-in. motor-driven fans for extracting air from the upper floors and several smaller extractor fans in various positions.

The general heating of the building depends on hot water radiators, fed from boilers in the basement, but this is supplemented by a number of 1,500 watt electric radiators, each controlled by D.P. iron clad switch and fuse and plug.

The water supply for the building is obtained from two artesian wells, bored to a depth of 450 ft. below the lower basement level. Each well is provided with its own electrically-driven pump and each of the latter will supply about 12,000 gallons, or the estimated requirements for one day, with eight hours' running. The water is raised in two lifts to storage tanks on the roof of the building.

The Phœnix premises proper are equipped with two Waygood-Otis electric passenger lifts placed centrally; three other lifts of a similar type are also provided to

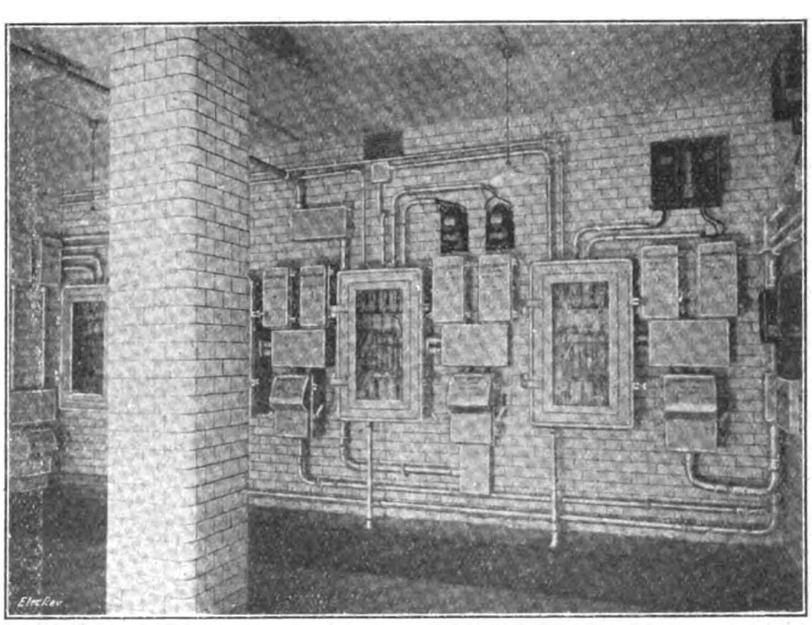

FIG. 4.—VIEW IN SWITCH ROOM, SHOWING MAIN DISTRIBUTION BOARDS, &C.

serve the Banking and other tenants in other parts of the building.

A small electric cooking installation, comprising some 35 KW. of Jackson equipment, is installed on the fifth floor.

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This apparatus, shown in fig. 6, includes a double oven with hot-cupboard between, and a boiling plate with six rings over it; a grill with hot-cupboard over it; stock pot, fish

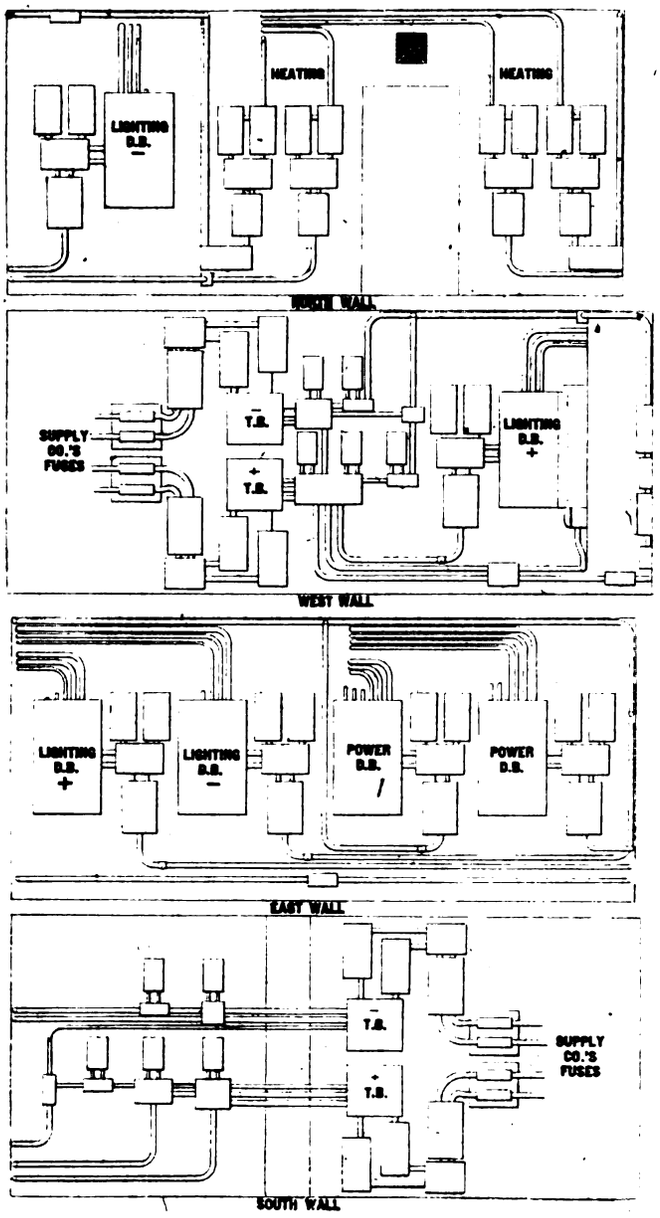

FIG. 5.—DIAGRAMMATIC ARRANGEMENT OF IRONCLAD SWITCHGEAR IN SWITCH ROOM.

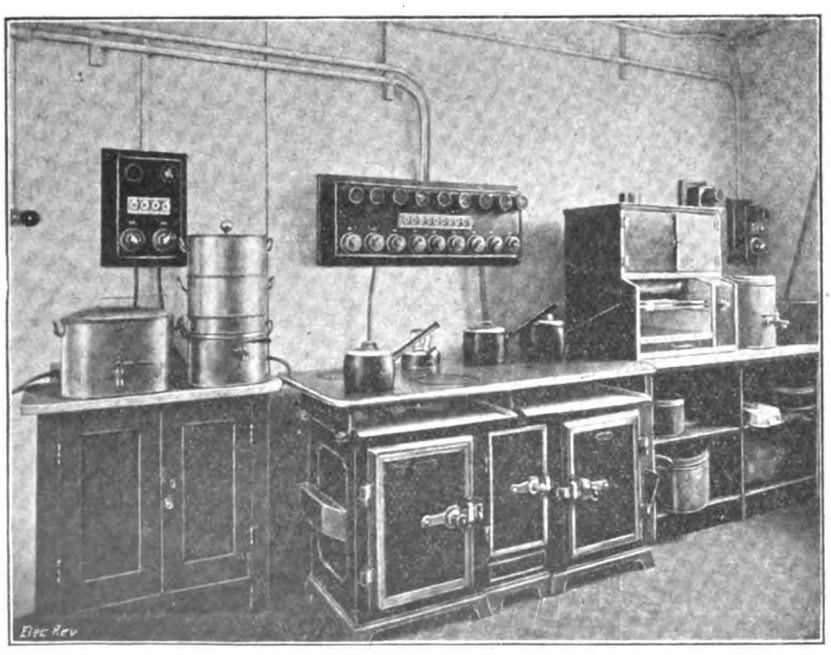

FIG. 6.—ELECTRIC COOKING APPARATUS IN KITCHEN.

fryer, tea and coffee urns, &c., the average week-day requirement being from 17 to 31 dinners and 70 teas.

A private telephone exchange is also provided in the building, this consisting of two 50-line P.O. boards and a 120-line private internal board. There is also a very complete electric-bell installation for the inter-departmental use of the Phœnix Co.'s staff.

The principal contractors in connection with the carrying out of the work for light and power wiring were: Phœnix Co.'s offices, Messrs. Belshaw & Co.; tenancies and Bank of Egypt, Messrs. Finch & Wheeler, which firm also carried out the internal telephones and electric bells. The special electric light fittings were designed and supplied by Messrs.

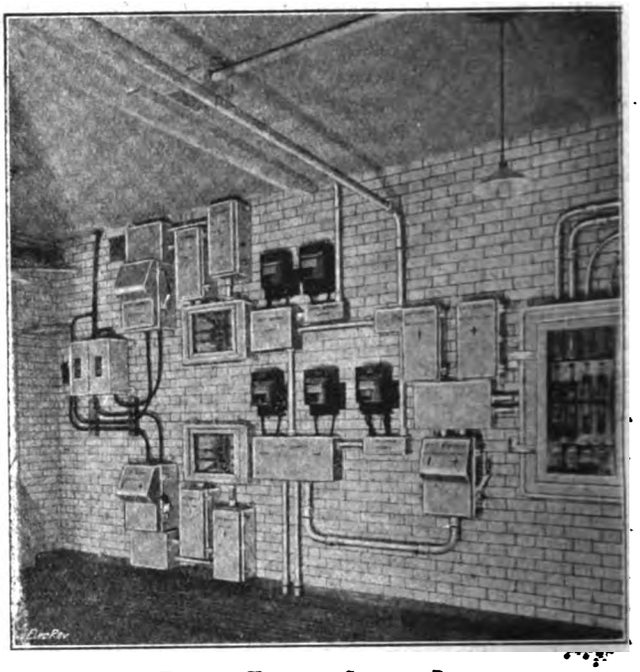

FIG. 7.—VIEW IN SWITCH ROOM.

Veritys, Ltd., who also were responsible for all the ironclad switchgear and motors. The ventilating plant was supplied by Messrs. Strode & Co.; and Messrs. A. Williams & Co. were responsible for the artesian-well work, under the supervision of Mr. Albion T. Snell.

As previously mentioned, the whole of the electrical work was carried out under the direction and supervision of Mr. S. G. Castle Russell, M.I.E.E., who was also responsible for the electric lifts, low-pressure hot water and ventilating systems; and Mr. C. W. Catt acted as clerk of works for the whole installation.

THE ELECTRIC COOKER IN INDIA.

BY CHARLES S. JEFFREY, A.M.I.E.E., A.Amer.I.E.E.

IN reviewing the possible applications of electricity for domestic cooking and heating in India, we may leave out of consideration the greater part of the population. There can be no question whether the poorer classes will ever use electricity in their homes, because these people live in a state of poverty unknown in colder climes. Perhaps "poverty," which suggests distress, is not the best word to use; although the majority of Indian natives have the absolute minimum of worldly possessions, they are usually happy and contented. "A state of simplicity" better describes their circumstances. One does not expect to find electric fittings in a bamboo hut, or in a shed made of old kerosene tins, where the entire furnishings consist of a mat on the floor

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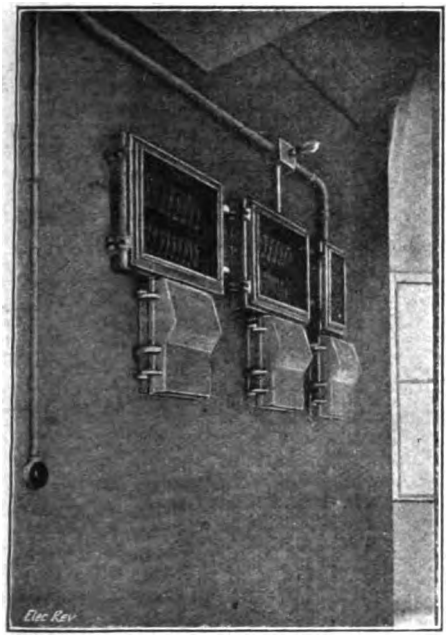
and one or two cooking pots, and, perhaps, a few treasures in the shape of empty cigarette tins or the illustrated calendars of bygone years.

It is only necessary, therefore, to consider the classes who use or are likely to use electricity for lighting. In one of the largest towns in India, where there is no gas supply, the number of consumers on the supply company's mains is only 1 per cent. of the total population. This number includes all business premises. Of course, in India the number in each household is usually greater than in England, but the total number of users of electricity is not likely to exceed 10 per cent. of the population in the large towns.

It is the custom in all European and the better-class native households, in which may be included all those wherein electricity is used, to keep a cook. In most self-contained residences the kitchen is situated a short distance from the main part of the house, with a covered way between the two. The advantages of this arrangement in a hot country are obvious, but it has the effect of isolating not only the kitchen, but also the cook from the rest of the household. The kitchen becomes not so much a part of the house as the abiding place of the cook; its usually gloomy fastness is seldom invaded by the mistress of the house, and, except on a punitive expedition, by the master, never. To the careful housewife in England it may seem incredible, but very few Memsahibs visit their kitchens more than once per day, and many not once per week. And perhaps it is better so.



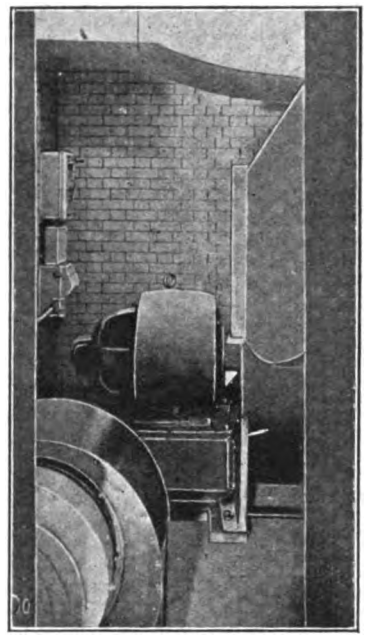


Fig. 8.—Typical Set of Sub-distribution Boards and Switches.

Fig. 9.—Ventilating Plant in Basement.

Phœnix Assurance Co.'s Installation (see page 500).

Be as enthusiastic as they may, it is not possible for white women in the East to do much work in the house if they take proper care of their health. It is evident, therefore, that no matter what appliances are used, the greater part of the cooking must be done by the native cook.

The writer may be unduly pessimistic, but he fears that the task of educating Mr. Dorosawmey in the economical use of an electric cooker is an insuperable obstacle. If one could be certain of keeping one's cook, it might be done, but it is likely that the knowledge that he alone could operate the cooker would give the cook courage to become more and more extortionate in his daily bazaar accounts. It is seldom that one keeps a servant for more than a year in India, and good cooks are usually the most difficult to retain.

In Rangoon the cooking is usually done on a charcoal fire. The writer, who had a coal fireplace in his kitchen, had the greatest difficulty in persuading the cooks to use it, and whenever a dish was spoiled the cook invariably blamed the fireplace. A letter received from one of our cooks may be of interest. The errors in spelling are omitted:—

highly respected memsahib with due respect and humble submission this petition humbly sheweth that your petitioner is a poor man and humbly requests you to forgive the trouble your ladyship is my father and my mother and my children and their children look to you for bread I good cook man and my father good cook man and pray that your ladyship will have pity on my hard case my father cook with charcoal and his father cook with charcoal madras cookman cook with charcoal bombay cookman cook with charcoal memsahib say cook with coal fire not can do I giving notice leaving at end of month by your favourness have pity on my hard case my children will have no bread for which act of kindness shall ever pray for your ladyship's long life and happiness please I waiting your ladyships reply your most obedient servant cook dorosawmey.

It should be remembered that native servants spend all their spare time, of which they have much, gossiping about their mistresses and the doings in the households to which they belong. Should the electric cooker one day develop a fault and reveal the thousand devils of which it is possessed, the news would go round to every cook in the town, and no eloquence would prevail on one of them to touch it again. Everyone connected with the business of electric supply in India knows that if a native receives an electric shock he vanishes "like the snowfall on a river" and the place thereof knows him no more.

In support of cooking by electricity, much has been written about the saving in weight effected by roasting joints in an electric oven, but the opinion seems to be gaining ground that this saving is really due to cooking at a lower temperature, and the only advantage attributable to the electric cooker is the closer regulation that can be effected. A study of Indian methods of cooking supports this theory, as one cannot fail to observe that the apparatus used appears to be of comparatively little importance. A good cook will prepare the most elaborate meal with the most primitive utensils. The cooking place in a typical Indian kitchen consists of a square of brickwork in which are made several small charcoal fireplaces, about 6 in. square and 4 in. deep. That is the whole permanent equipment of the kitchen. There is no oven provided. If the cook wishes to be disagreeable, he may insist on having a portable cast-iron oven which he can place over one of these fireplaces, but usually all the baking and roasting is done in an old kerosene tin. Most cooks will bake excellent cakes in a stewpan only a little larger than the cakes themselves.

She who presides over the writer's household informs him that to cook well, one must cook slowly. Undoubtedly herein lies the secret of the Indian cook's success. He is superlatively slow. To his credit, it must be said that he also has infinite patience. For example, when baking a cake he will surround his kerosene tin or stewpan with glowing charcoal, and will stand over it from the moment the cake is put in until it is taken out, carefully fanning the fire and readjusting his charcoal, piece by piece, in order to concentrate the heat just where it is required. So long as the cooks stick to these methods, and that is probably as long as the present generation of them survives, it is unlikely that much progress can be made in the adoption of electric cookers for general purposes.

In India, another very important drawback from

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the supply company's point of view is that the principal meal of the day in all European and better-class native houses is served between seven and nine o'clock in the evening, and since, in India, even in the northern provinces, there are no long evenings such as we are accustomed to in the summer months at home, it is invariably served after dark. This means that the peak cooking load would almost coincide with the peak lighting load, and with a poor diversity factor it is, of course, impossible to offer very attractive rates.

So far this article is so pessimistic that it is, perhaps, more suited to the pages of the *Journal of Gas Lighting* than those of the ELECTRICAL REVIEW, but the writer hastens to add that there is a brighter side to the picture. Although there is not much likelihood of electric cookers being adopted for general purposes, their cleanliness and freedom from external radiation make them valuable auxiliaries for domestic purposes. Apart from the attitude of the cook, the isolation of the kitchen and its uncomfortable environment are sufficient to deter most Memsahibs from practising the culinary art; but if the home is equipped with a small electric cooker which can be fitted in the dining room or verandah, there is no reason why the husband domiciled in India should any longer be free from the danger which is reputed to lurk in his young wife's first cake. There are many people who cannot enjoy food prepared by the native cook, because they know too much about his methods, and electric cookers make it possible for them to prepare an occasional meal for themselves.

Once an electric kettle has been used in any household it becomes indispensable, not only because of its convenience at the tea table, but because it provides a means of obtaining hot water after the cook has departed from the kitchen. Electric toasters also are in great demand. Even those of us who accept all that comes from the kitchen, provided it passes the test of smell and taste, without permitting our imaginations to dwell on disagreeable possibilities, enjoy our toast better when we have positive knowledge that the hands which prepare it are clean.

When we leave the kitchen for the laundry, we find another invaluable article to be the electric iron, because by its use it is possible to save many delicate fabrics from that ruthless destroyer, the dhoby or washerman. The dhoby's method of washing is to dip the article to be cleaned into a bucket of soap and water, swing it round his head, and bring it down with a smack on a block of wood or a flat stone. If the wood has a nail in it, what cares he? Mark Twain described him as the man he saw "breaking stones with a shirt."

When ironing, in order to impart to the clothes the moisture which we are told is necessary to obtain a good surface, he uses his mouth as a reservoir and ejects water upon the garment with an accuracy of expectoration that no Englishman and few Americans could equal. Fortunately for their peace of mind, many Memsahibs are in ignorance of this little practice of the dhoby's, because the ironing is usually done in his own quarters. When an electric iron is part of the household equipment, it is possible to have the more delicate articles washed and ironed under the eye of the Memsahib. Even if the dhoby will not do the work in this way, there are few women who will grudge the time it takes to do a little laundry work for themselves, when by so doing they are spared the distress of witnessing the rapid disintegration of their most cherished "chiffons."

In the rainy season small electric heaters are very useful for drying out wardrobes, cupboards, &c., and thereby preventing much destruction by mould and mildew. In many pianofortes a carbon lamp or small heater is permanently fitted for this purpose. Obviously, in a hot country it is essential for comfort that the heat should be localised to the articles to be dried, and the advantage of the electric heater in that connection is at once apparent, since it can be used in situations where any form of combustion heater would be out of the question.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

"Doing His Bit."

We sing of Tommy Atkins, the "man behind the gun,"
Of workers in the factories, making bullets by the ton;
But think of the man in the power-house, amid the turbines' roar,
For there he's doing his duty, they'll let him do no more.

He cannot join the Army, they say he can't be spared;
They won't put him in khaki, for then he'd not have cared.
He's trying to do his little bit, it isn't much, I know,
It's one of those silent, unknown jobs that doesn't get much show.

Men from munition factories pour out each day in streams,
But they would be no good at all if they weren't supplied with means
To turn their massive turret lathes and make the motors run,
But they get the extra cash, while the other chap gets none.

The man who runs the power house works seven days a week,
He gets no overtime, but has to pay more for his keep;
And when "Take air-raid action" comes he has to do his bit
For the safety of the public, and the chance of getting hit.

So when you pass a power house and hear the turbines hum,
Give a thought to the man inside, whose work is so hum-drum
He isn't a khaki hero or a sailor boy in blue,
But his King and Country need him, and he'll see his duty through.

P. Gordon Hieatt.

York.

Justice to Inventors.

Whilst to many in this country the war has brought increased work and remuneration, there are others who have been very hardly hit, and none, I venture to say, more than inventors and patentees.

Before an invention reaches the stage when it begins to bring in a return, a large amount of work, trouble, time, and money has, as a rule, been expended on it.

When the war broke out, there must have been large numbers of engineers, and others, owning patents which had just reached the stage at which it might reasonably be expected that the income to be derived from royalties or sales would begin to repay the time and money expended in development.

In the majority of cases, alas! the inventors soon found that, owing to the works being required for munition purposes, it was no longer possible to manufacture their patented articles, and their royalties fell off very considerably, or in many cases ceased altogether.

Under these circumstances, it seemed a natural step to ask the Patent Office to postpone payment of the renewal fees and to prolong the life of the patent by a period corresponding to the duration of the war, or to the time during which the pressure of Government work rendered it impossible to manufacture the patented article.

The reply of the Patent Office is, however, that they have no power to grant either request, and that, as far as the Office knows, no fresh legislation is contemplated.

It is, of course, always open to any patentee at the expiration of the life of his patent to apply for an extension, but what assurance has he that his application will be favourably received? Meantime, he must either drop payment of the renewal fee, and thus forfeit his rights, or pay the fees in the hope that after the war is over his application for an extension of his patent may receive favourable consideration.

Now, Sir, this is neither justice, nor in the public interest.

It is, surely, not just that the Patent Office should take fees from inventors when, owing to the needs of the nation it is impossible to get the patented articles made; nor can it be in the public interest to discourage inventors in this way.

In the industrial war to which the nation is committed we shall need to utilise to the very utmost all the inventive skill of our people, and we cannot afford to risk the loss of useful inventions simply because inventors, owing to want of proper support, cannot afford to nurse their ideas through to fruition.

Even if the inventor does receive any royalties, the authorities show their appreciation of his work by demanding the payment of income-tax at the full unearned-income rate without allowing any deduction for development expenses.

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May I beg, Sir, the hospitality of your columns to ventilate the matter, in the hope that a body of public opinion will be formed sympathetic to securing fair play and encouragement to our inventors.

Fair Play.

[We refer to this matter in our leading columns to-day.—Eds. Elec. Rev.]

WAR ITEMS.

German Goods in New Zealand.—The "Auckland Weekly News" publishes the following:—"A trade catalogue has been shown to a Dunedin reporter which states explicitly of a certain magneto that it is manufactured in America. The old German-looking title of the company is replaced by a word that is characteristically American, and the catalogue expressly states that the concern is purely of American make. So one would also gather from the lettering on the cover of this magneto 'Made in the United States of America.' It is this lettering that the customer reads, probably he looks no further, but the repairer, in remedying defects, looks inside. It was in the course of such an examination that a repairer found a betraying brand on the magneto 'made in Germany.' The outer lettering, in small type and newly cut, declares that the magneto is made in America, the inner and bolder and older inscription inside states that the make is German. Information placed at the disposal of the reporter leads to the belief that such magnetos are still being imported into the Dominion, via America."

Controlled Works.—The number of establishments controlled by the Ministry of Munitions has been increased by 156 to 3,493.

Exports to Liberia.—In the "London Gazette" for April 28th there is published a list of persons authorised as consignees of articles exported to Liberia.

To be Wound Up.—Under the Trading with the Enemy Amendment Act, the Board of Trade has ordered the following to be wound up:—Alphons Custodis Chimney Construction Co., Ltd., 119, Victoria Street, London, S.W.; constructors of chimneys, &c.; controller, D. H. Allan, 20, Copthall Avenue, London, E.C. The Phonotas Co., Ltd., 125, High Holborn, W.C.; sanitary system for cleaning telephones; controller, Alfd. Hartley, 9, Ironmonger Lane, E.C.

Trade After the War.—A Reuter dispatch from Sydney states that the annual conference of the New South Wales Chamber of Commerce has unanimously passed a resolution in favour of the encouragement of trade within the Empire, recommending among other things the imposition of a surtax on enemy goods, and also that enemy goods after the war shall be indelibly marked with the name of the country of origin.

The Chairman of the General Steam Navigation Co. says that in considering the question of new tonnage, a great factor must necessarily be how far and how long the bitter feelings engendered by the war would be extended after its close to commercial intercourse between the belligerent nations. As reported by the "Evening News," he added: "I think that trade between this country and Germany will be vastly reduced in volume—for sentimental reasons because the British will not easily forget the many acts of ruthlessness of which the Germans have been guilty, and for economic reasons because the spending power of this country and the Central Powers must be restricted for years. It is clear that additional revenue to meet our indebtedness must be sought from other sources than direct taxation, and those will be found in the imposition of duties on all imported manufactured goods. It is not to be assumed that a complete commercial boycott of the Central Powers will be effected, as, in my opinion, international business is too interlaced to make this either possible or desirable."

At the close of the International Inter-Parliamentary Commercial Conference in Paris (says a Reuter dispatch in the "Morning Post") the meeting unanimously adopted resolutions regarding the following:—(1) The establishment of preferential postal, telegraphic, and telephone rates between the Allied nations. (2) The constitution of a permanent body charged with determining the conditions of the transport of merchandise and the introduction of a tariff on enemy goods so as to avoid delays in the transport of goods from Allied States. (3) Reduction of freight rates, with recourse if necessary to general requisition of merchant vessels with indemnification in order to assure victory by the economic solidarity of the Allies.

Exemption Applications.—At Maidstone, on April 25th, the manager of the Corporation tramways renewed an appeal for exemption for three car-drivers. A month ago the matter was deferred to see if ineligible men could be found, and Mr. Lambert now said that he had engaged a discharged naval man and a discharged military man, but two other drivers had left, and he was in the same position as he was a month ago. Next month, however, he expected two discharged army men formerly in the service of the Corporation. One man, who has been on the tramways since the opening, was conditionally exempted; the cases of the others were put back until May 25th.

Before the West Kent Appeal Court, on April 27th, an appeal by Mr. J. Vince, electrician at the Turkey Paper Mills, Maidstone, for exemption, was refused.

At Ryde (Isle of Wight), the Isle of Wight Electric Light Co. applied for exemption for a shift engineer and fitter in sole charge of the engines and electrical plant while running, and claimed to be indispensable. The tribunal granted conditional exemption.

The Rugby tribunal has granted conditional exemption to an employé of Messrs. Willans & Robinson, who wished to go to Nigeria to erect machinery at tin mines there.

Before the Devon Appeal Court, on April 26th, an appeal was made for an electrical engineer and wireman employed by Messrs. Garnish, Lemon & Co. The local tribunal had refused exemption, considering that the appellant was not indispensable to the business. The tribunal granted adjournment until applicant's group was called up.

At Wallasey, on Monday, Colonel Greene, tramways manager, applied for further exemption for 28 married car drivers. The tribunal decided to defer consideration of all married men's cases until single men "combed out" of reserved occupations had been dealt with, and granted conditional exemption for one month to all the married tram drivers. An appeal was also made for the exemption of a motor controller, single, aged 36, who was stated to have taken the place of a skilled man, and who was essential for the maintenance of the tramway service. It was remarked that the man came under the head of those engaged on the maintenance and repair of plant and machinery, but a member of the tribunal said that the skilled man had been allowed to go and the handyman had taken his place, whereas the handyman ought to have been allowed to go at the onset, and not the skilled man. The appeal was disallowed.

Trading with the Enemy.—The "London Gazette" for May 2nd contains further additions and amendments to the lists of persons or bodies with whom trading is prohibited in Argentina, Brazil, Chile, Netherland East Indies, Norway, Philippine Islands, Portuguese East Africa, Spain, Sweden, &c.

Exports to China.—The "London Gazette" for May 2nd contains further lists of persons and bodies in China and Siam to whom exports may be consigned.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Annual Report, &c.

The report of the Council for the past year is published in the issue of the *Journal* for May 1st. It states that the membership at April 1st was 6,676, showing a net decrease of 141; additions during the year numbered 212 (including 142 Students), and deductions 353 (79 deceased, 96 resigned, and 178 lapsed). Members numbered 1,500, Associate Members 3,466, Associates 520, Graduates 382, and Students 801, the remaining 7 being Honorary Members. During the year 49 candidates for Associate Membership, of whom 27 were non-members, were approved by the Council subject to complying with the examination regulations. The Council elected M. Maurice Leblanc an Hon. Member, and the King conferred a baronetcy on Sir H. Norman, M.P., K.C.B. upon Lord Moulton, and knighthoods upon Sir W. Slingo and Sir G. Franklin. Numerous military distinctions were awarded to members, including the Victoria Cross to Lieut.-Com. E. G. Robinson, R.N., and 34 members lost their lives in the war. Other members deceased included Mr. C. E. Spagnoletti, Prof. E. Gerard, Mr. Robt. Hammond, Lord Alverstone, Mr. E. Danvers, Mr. H. A. Mavor, Sir A. Rücker, Capt. E. G. Tidd, Mr. F. H. Varley, and Mr. Thos. Parker.

On account of the war, the annual dinner and conversazione will not be held this year.

Premiums for papers have been awarded to Messrs. J. R. Beard, H. H. Harrison, N. W. Storer, A. Campbell and D. W. Dye, A. E. Clayton, and Professors A. B. Field and G. W. O. Howe. No Students' premiums have been awarded, and the David Hughes and Salomons Scholarships will not be awarded this year.

Twenty-two societies have held meetings at the Institution.

The Wiring Rules have been revised, 24 meetings of the Committee having been held and over 500 amendments considered; no fewer than 13,500 copies of the 1911 edition were issued, and the seventh edition has been adopted by the whole of the fire insurance companies of the United Kingdom.

The Council applied to the Committee of the Privy Council for grants for research, and has received £840 for a year's

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work on the heating of buried wires, and £250 for research in the properties of insulating oils; Mr. J. S. Highfield has been appointed representative of the Institution on the Engineering Committee of the Advisory Council for Research.

The number of members that are or have been serving in the Navy or Army since the outbreak of war is over 1,300. The Council has taken steps towards facilitating the employment of disabled soldiers and sailors in electrical undertakings, and arrangements are in progress to that end; a guarantee fund of over £300 has been established for the purpose by past and present members of Council.

The accounts show a surplus of income over expenditure of £1,847, compared with £1,623 in 1914. The assets amount to £116,748, against liabilities £43,013, leaving a balance to the good of £73,735, an improvement of £2,165; the building fund amounts to £43,946, and the general fund to £23,619.

At the end of 1915 the capital account of the Benevolent Fund stood at £4,642; donations and subscriptions amounted to £777, and seven grants were made, amounting to £126.

The same issue of the *Journal* contains a further list of promotions, transfers, &c., of members on military service, and the result of the "voting" on the proposals adopted by the informal meeting of Corporate Members on March 8th. The number of cards issued was 3,244, and of these 1,470 were returned. The proposals were as follows:—

	For.	Against.
(*a*) To expel members who are subjects of enemy countries or States	1,320	88
(*b*) To expel members who being naturalised British subjects have retained enemy nationality	1,307	79
(*c*) *Not* to expel members who are naturalised British subjects and were formerly subjects of a country or State now at war with Great Britain and Ireland but who have under the laws of such country or State definitely lost their alien nationality, provided they are able to prove this to the complete satisfaction of the Council	1,081	264
(*d*) That no person shall after the.....day of ....., 19..., be eligible for election as a member of the Institution who is a subject of any country or State with which the United Kingdom of Great Britain and Ireland is or shall have been at war on or after the date mentioned	1,120	200

A resolution has been drafted to carry out the objects proposed, and in due course the necessary meetings of Corporate Members will be called to consider it.

The ballot paper for the election of Council has been issued; the list of names is identical with that published in our issue of March 31st, with the exception that the name of Mr. C. H. Wordingham has been added to those of Messrs. R. A. Chattock and J. S. Highfield as candidates for election as Vice-President, on the nomination of 17 members, whose names are given, in accordance with the Articles of Association.

The annual general meeting will be held on Thursday, May 11th, at 8 p.m.

SHANGHAI ELECTRICITY REPORT.

The annual report of Mr. T. H. U. Aldridge, engineer-in-chief of the Shanghai municipal electrical undertaking, for the year 1915, shows that continuous progress is being made, and that the forecasts of previous years are in process of realisation.

During 1915, 49,787,397 units were sold, including, roughly, 14 millions for private lighting, 1 million for public lighting, 680,000 for heating, 30,633,455 for power, and 3,395,813 units for traction; the total represents an increase of 52 per cent. on the 32,633,671 units sold in 1914, and the power units included show an increase of 101 per cent.

The public lighting output showed a slight decrease, although over 100 additional lamps were connected, this being due to the general use of the nitrogen-filled metal lamp.

The maximum load on the feeders, 14,000 KW., was under the amount estimated at the beginning of the year, due to the temporary suspension of running of some large mills, and to a number of small consumers shutting down owing to trade depression. The load factor improved from 33·6 per cent. in 1914 to 40·8 per cent. in 1915. The total H.P. of motors on the mains now amounts to 14,547, representing a net increase of 2,365 H.P. during the year. The report points out that 6,210 H.P. of motors in 10 different oil, flour, and cotton mills have been negotiated for in the coming year.

As to heating and cooking, 1,216 radiators, of 2,432 KW. capacity, are now connected, practically all hired out by the department at 1s. 3d. per month.

This form of heating has become popular amongst foreigners and Chinese alike, but electric cooking has been held back because the cooking ranges ordered could not be procured. It is found that 2 KW. is the minimum satisfactory size of heater in Shanghai.

At the end of the year there were 44 arc and 1,422 metal lamps in use for street lighting and practically all the latter are of the nitrogen-filled type, in 60-C.P. to 400 C.P. sizes. During the typhoon last summer, in several cases the street lighting was interrupted by branches of trees falling upon or among the wires forming the street lighting circuits; the typhoon was, however, of exceptional severity, and Mr. Aldridge points out that failures are rare and the price paid for the lighting service is very low. There were 16,992 meters and 1,092 current limiters in use at the end of the year, and 18,104 connections to the mains.

The generating plant capacity in use at the two stations (Fearon Road and Riverside) was 19,600 KW.; 62,291,443 units were generated, the modern Riverside plant providing 54,845,415 units.

The works cost per unit fell to ·534d:

The net increase of transformer capacity for the year was 5,394 KW., bringing the total transformer capacity in use to 18,284 KW. A new sub-station in Tonquin Road has been completed and partly equipped; it will ultimately be supplied with 6,300 and 22,000-volt current and have a capacity of 15,000 KW. Seven three-phase sub-stations for an ultimate capacity of 10,000 KW. are under construction.

Financially, the undertaking made a net profit of £32,363, after providing £27,877 for loan interest and £38,087 for depreciation. The profit represented 8·91 per cent. on capital outlay, having increased from 6·98 per cent. in 1914. The profit for 1916 is estimated at £39,567, and £44,573 will be set aside for depreciation.

The report contains a short description of the new Riverside extensions, to which reference has already been made in our pages.

The present type of steel frame building with corrugated iron walls will be adopted, with a turbine room 90 ft. long by 60 ft. wide, and a boiler house 130 ft. long by 90 ft. wide. Coal bunkers will provide accommodation for 1,000 tons of coal, and will be supplied by coal-handling plant with a capacity of 60 tons an hour, either direct from an 11,000-ton coal store or from river barges.

A 20-ft. bay containing pumps, fans, &c., will separate the turbine and boiler rooms, and a separate reinforced-concrete switch and transformer house will be provided.

Two 10,000-KW. turbines (by Parsons and the G.E.C. of America) and a 5,000-KW. turbine set (Fraser & Chalmers-Vickers) comprise the first installation, and these will operate on 180-lb. steam superheated 200°. The alternators are to generate at 6,600 volts, three-phase, and by means of step-up transformers direct-connected to the generators, the pressure will be raised to 22,000 volts.

The transformers are designed with 5 per cent. internal reactance, and the use of external reactance will be avoided.

The 5,000-KW. turbine set will run at 3,000 R.P.M., and have a full-load steam consumption of 13 lb. per unit, while the 10,000-KW. Parsons turbine unit (1,500 R.P.M.) will operate on full load with 11·9 lb. per unit, the American turbine of the same size and speed, but of the impulse type, being rated at 12·85 lb. steam per unit; the latter machine was adopted on account of the short time of delivery.

For the 22,000-volt switchgear, the tender of the B.T.H. Co. was recommended, and for the transformers that of the Westinghouse Co.

Eight new Babcock marine type boilers, each of 40,000 lb. normal steaming capacity, are to be installed; six of the boilers will have Babcock chain-grates and two Taylor underfeed stokers. All the boilers will operate with mechanical draught.

To connect the Riverside and Fearon Road plants, four 0·15 sq. in. 22,000-volt underground cables, of the split-conductor type, will be provided, and the necessary step-down transformers and switchgear at Fearon Road, and, as previously mentioned, at the Tonquin Road sub-station.

The B.I. & Helsby Co.'s tender for 22,000-volt cable was recommended.

The Copper Position.—At the meeting of the Namaqua Copper Co., according to a *Times* report, Mr. T. V. Anthony, a director, stated that the world's production of copper in 1915 was estimated to have been a little in excess of 1,000,000 tons—of which the United States were responsible for some 635,000 tons—and a recent estimate put the present rate of the world's output at 100,000 tons a month. To-day they were face to face with a position for which no parallel could be found in the history of the metal—on the one hand a production far in excess of anything ever hinted at hitherto, and, on the other hand, a price which had not been reached within the memory of any of those present, and, what was still more phenomenal, no visible limit to either. He would, indeed, be a bold man who would venture to predict the point to which prices might yet be taken, in view of the undoubted fact that, huge as the production had become, consumption was keeping pace with it and could hardly be relaxed so long as the war endured—a comforting reflection for producers like themselves, however much it was to be regretted that the result had not been attained by other means.

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A ROTARY CONVERTER INSTALLATION.

By E. P. AUSTIN, A.M.I.E.E.

Amongst the various ways of linking up two individual generating systems that employ different periodicities, and are also generating direct current, the following example possesses several interesting features.

A certain generating station supplies energy for public supply and traction, the former being on the three-wire system. The same generators are available for each system, and are used as shunt machines for the lighting supply, and compound for the traction work, two distinct switchboards being used for the purpose.

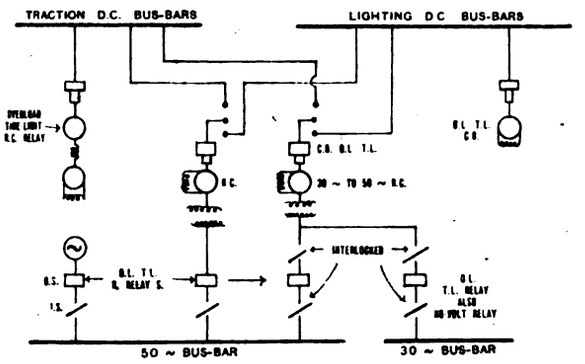

Fig. 1.

A booster rotary converter is installed, capable of running inverted off either D.C. system, and supplying three-phase energy at 50 periods, 6,600 volts, through a step-up transformer. It will also, when required, convert A.C. to D.C. in parallel with either D.C. system.

It became necessary to take a bulk supply from a neighbouring system at 30 cycles, and receive it in such a manner that either D.C. system could be supplied. It was also desirable that the machine installed for the purpose could be run inverted at 30 or 50 cycles off either D.C. bars, and thus form a complete stand-by unit for all conditions of running. The several conditions were met by installing a booster converter capable of running at two different speeds on shunt field adjustment, and giving its rated output at each speed.

A 50-cycle, 6,600-volt alternator has been added to the system to synchronise with the rotaries at 50 periods. This machine is controlled by a voltage regulator acting on the field of the exciter, which is chain-driven off the alternator shaft.

From this description it will be seen that considerable complication has been introduced in order to obtain maximum flexibility. A schematic diagram of the system is shown in fig. 1, and a detailed wiring diagram of the 50-cycle to 30-cycle rotary is given in fig. 2. There are two distinct control panels and cubicles for this machine, all the switches being mechanically interlocked to prevent mistakes in switching and synchronising. Each rotary is fitted with interpoles and is compound-wound, the shunt excitation being obtained normally from the exciter mounted on the rotary shaft. A separate compounded booster is also mounted on the same shaft and connected on the A.C. side, and provided with a potentiometer and rheostat to give a wide range of voltage regulation.

From the diagrams it will be seen that the compound windings of main and booster fields are connected in series, and that it is necessary to change these windings, or short-circuit them as required in accordance with the direction of power supply and the bus-bar to which they are connected. The switching arrangements on the D.C. side provide, therefore, for the following changes :—

Lighting bus-bars, D.C. to A.C. ... Compound machine with compounding reversed.
A.C. to D.C. ... Shunt machine.
Traction bus-bars, D.C. to A.C. ... Compound machine with compounding reversed.
A.C. to D.C. ... Compound machine with equaliser in circuit.

The interpole winding reverses its polarity with the direction of armature current, and therefore requires no switch control.

The rotaries are started up from the D.C. end and synchronised in the usual manner.

The operation of No. 2 rotary is somewhat different. It is usually started from the traction bus-bars as a compound motor, synchronised at 30 cycles, and immediately tripped off the D.C. bars. The compounding is then reversed and the machine is paralleled with the D.C. bars.

The various combinations possible for reliability of supply and efficient running have made the effective protection of all generators a complicated matter, and the relay gear, therefore, deserves a special description. The nature of the load demands short-time overload capacity on the traction and A.C. systems, which sometimes reach 100 per cent. overload for several seconds.

Time-limit overload relays have, therefore, been fitted on all circuit-breakers, and are capable of adjustment on both elements to suit running conditions. As the rotaries can run direct or inverted, the D.C. overload trips are operated off shunts on the main circuit or through change-over switches. On the A.C. side of the rotaries and also on the alternator, inverse time-limit overload relays are used, connected to a D.C. trip circuit, and also three-phase reverse power relays actuate the same tripping element of the oil switches. The latter are necessary to prevent complications when rotaries and alternator are supplying power in parallel, and they will also prevent undue disturbance of the D.C.

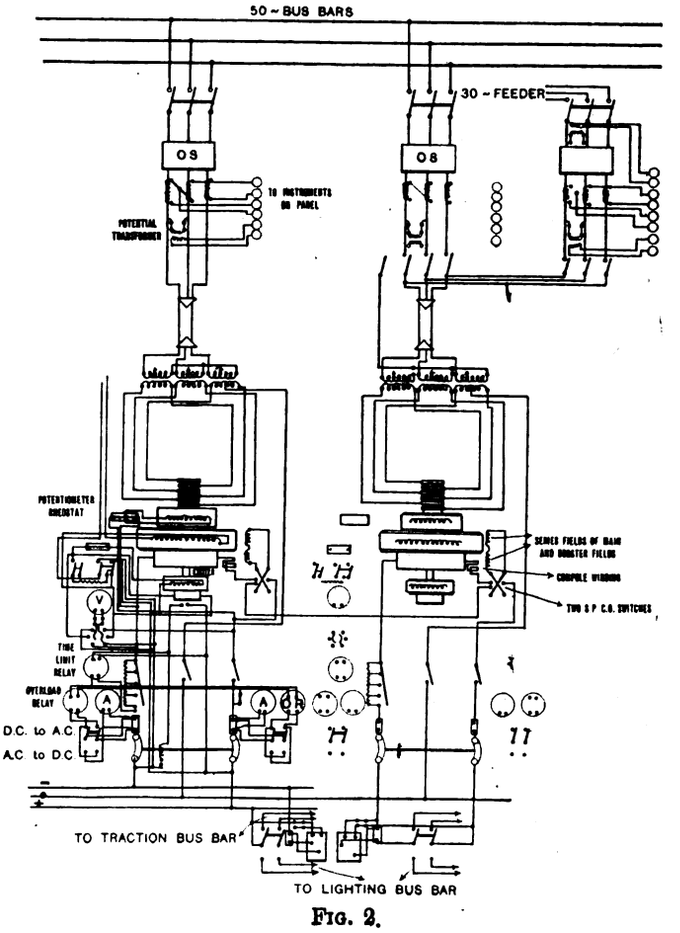

Fig. 2.

supply in the case of bad synchronising. A snap switch is used to cut the reverse power relay out of action when the rotaries run direct.

The protection of No. 2 rotary when taking 30-cycle energy in bulk is still further complicated. Normally, No. 2 runs on the D.C. traction bars in parallel with a steam-driven generator. When the bulk supply temporarily fails, the

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rotary A.C. switch must be instantly tripped to prevent the supply from being restored out of phase. A simple no-volt coil is not sufficient, since the rotary will continue running off the D.C. bars and maintain voltage on the A.C. line.

To overcome the difficulty a sensitive D.C. reverse-current relay is used to trip the oil switch immediately energy flows from the D.C. bars. It was also found necessary to install a very sensitive A.C. no-volt relay coil to open the no-volt coil circuit if the supply fails when the rotary is not in parallel with other machines. The situations of all these devices are indicated in the diagram fig. 1, and fig. 3 shows the detail connections of the no-volt protection gear for No. 2 rotary. The general working of this system is quite satisfactory, due in large measure to the careful study of the conditions and the design of the rotary converters to meet them. The A.C. voltage and frequency is maintained very effectively on varying loads. Frequent

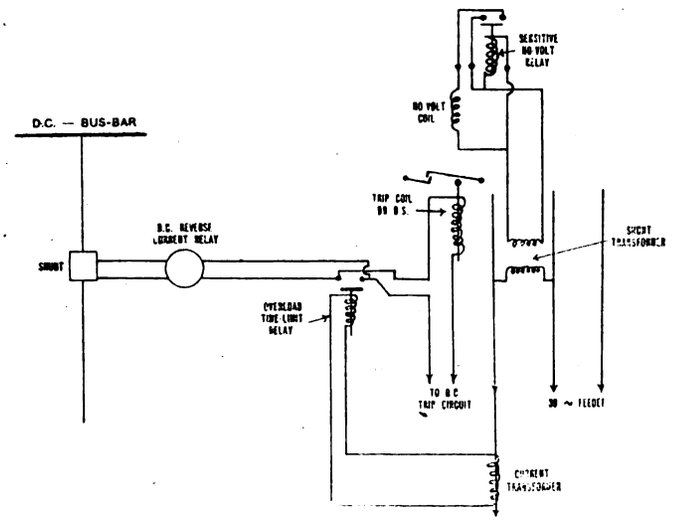

FIG. 3.

adjustment of the compound and interpole windings by means of diverters was necessary, to obtain the best results, in conjunction with the characteristics of the prime generators and engine governors.

Some difficulty was experienced in the parallel running of the rotaries and alternator, owing to the practically flat characteristic of the former combination and the drooping characteristic of the latter. Sudden fluctuations caused uneven divisions of load, and curious divisions of power factor. The use of the previously-mentioned voltage regulator, and the experimentally-determined value of the rotary exciting current, which has been proved to be best at some 20 per cent. lower value than that necessary for running alone, has resulted in very satisfactory operation up to 60 per cent. overload on the combined machines.

BUSINESS NOTES.

Electrochemical Industries in South Africa.—We recently summarised an important report issued by the Development of Resources Committee of the South African Institute of Electrical Engineers, on the possibilities of establishing in South Africa, on a commercial basis, certain electrochemical industries. *The Board of Trade Journal* states that a factory has been established at Vryheid (Natal) for the production of ammonium sulphate. Plant, stated to be capable of producing 5,000 tons annually, has been laid down at a cost of £350,000.

Book Notices.—"*Journal* of the Institution of Electrical Engineers." Vol. 54. No. 259. May 1st, 1916. This issue contains the following papers:—"The Use of Continuous Current for Terminal and Trunk Line Electrification," by Mr. N. W. Storer; "Hire and Maintenance of Continuous Current Motors," by Mr. H. Joseph. Also the Reprot of the Council and the Statement of Accounts for the past year.

"The B.E.A.M.A. Journal." April (Quarterly). 1s. London: The British Electrical and Allied Manufacturers' Association.

Better Times for Working People. By James Glass. London: British Manufacturers' Association' 1916. 16s. 8d. per 100.—This is described as "a straight talk with British working men," and it is written by one who, from birth and experience, is able to understand the position of Labour. The author touches in an interesting way upon many matters. In the main, he tries to show the worker that the Home producer and his work should be protected against the foreign manufacturer and the importer, and that in the councils of the nation business men should have a larger influence. Working men are urged to ask Parliamentary candidates whether they stand for the Protection of British industry, and whether they are in favour of State Insurance of Labour, and to vote against them unless they are sound on these matters. Mr. Glass looks forward to industrial peace and national prosperity being secured, but while we have no desire to throw cold water upon so well-meaning an effort to deal with what threatens to be a somewhat serious situation, we have to recognise that there are still mountainous difficulties in the reformer's path, and that, notwithstanding the war, the defects of our human nature are still very present with us. The pamphlet has been prepared for distribution by employers among their workpeople, and if the latter can be induced to seriously read it, and weigh up its arguments, some good may be done in paving the way for a better understanding between Capital and Labour.

"Post Office Electrical Engineers' Journal." Vol. IX, Part 1. April, 1916. London: H. Alabaster, Gatehouse & Co. Price 1s. net.

"Exporters' Hand-Book and Glossary." By F. M. Dudeney. London: Sir Isaac Pitman & Sons, Ltd. Price 5s. net.

"Mechanical Handling and Storing of Material." By G. F. Zimmer. London: Crosby Lockwood & Co. Price 42s. net.

Bankruptcy Proceedings.—STEEL BROS., 206, East India Dock Road, E.—The first meeting of creditors was held last week at the London Bankruptcy Court, under a receiving order. Mr. Egerton S. Grey, Official Receiver, reported that no one had surrendered under the proceedings. A representative of the petitioning creditor stated that an appearance to their writ was entered by "Sidney Steel, trading as Steel Bros." When the writ was issued the name outside the premises was "The Steel Electrical Engineering Co., Ltd.," but the word "Limited" was subsequently struck out. The same heading appeared on the note paper of the firm. The chairman added that from inquiries made by his inspector, it appeared that the debtor, Sidney Steel, joined the Army in November last, and that a cousin of his had stated that the business now belonged to the company. The case was left with the Official Receiver to be wound up in bankruptcy.

J. W. & T. W. TATTERSALL, electrical engineers, London.—Second and final dividend of 1¼d. in the £, payable at Carey Street, W.C.

Russia.—The French Commercial Attaché in Russia calls attention to the importance of certificates of origin for French and other imports into Russia. This document should bear the *visa* of the Russian Consul in the circumscription where the certification has been made, for this *visa*, which is the simple legalisation of the signature of the Chamber of Commerce which issues the certificate, is absolutely needful to avoid claims by the Russian Customs for dues 100 per cent. increased, notwithstanding the production of a certificate of French origin. French merchants and manufacturers, says the Attaché, do not appear to attach that importance to this *visa* which it really possesses. In short, to have full effect abroad, the certificate should bear the *visa* of the country whither the goods are destined.

Traders' Demands.—At the National Chamber of Trade Conference, on Monday, at Cardiff, resolutions were passed calling for improved technical and business education, for the declaration of a Government policy of trade with enemy countries after the war, and the appointment of a Ministry of Commerce consisting of business men.—*Daily Telegraph.*

A Strike at Pittsburg.—A Central News dispatch from Pittsburg, dated April 26th, says:—"The Westinghouse air-brake plant has been closed down on account of labour trouble. The dispute also involves the Westinghouse electric plant. The total number on strike is 20,000."

Consular Reform?—It is stated in the *Times* that Lord Robert Cecil has informed the Associated Chambers of Commerce that the Foreign Office is prepared to enter into consultation with a Committee of business men in regard to the changes which may be necessary in the Consular Service. Before doing so, however, the Foreign Office find it necessary to discuss the matter with the Board of Trade, but as soon as that preliminary inquiry is concluded the Foreign Office will be happy to receive the views of the Committee of business men and if possible to invite their co-operation.

Patents and Alien Enemies.—Application has been made to the Board of Trade for the avoidance or suspension of patents Nos. 9,499/12, and 13.903/12, issued to Siemens & Halske A.-G., for radiographs and Röntgen-ray tubes, by Messrs. Watson and Sons (Electro-medical). Ltd. Licences have been granted by the Board of Trade to the British Thermit Co., Ltd., in respect of patents Nos. 26,297/04, 21.750/09, 24,389/10, 19,473/11, 16,165/12, 218/13, 1,179/13, and 25,180/13, issued to Th. Goldschmidt A.-G.

The application of Messrs. Belliss & Morcom, Ltd., with respect to Patents Nos. 8,487/06 and 30,101/10, granted to Roglar, for licences has been granted by the Board of Trade.

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Catalogues and Lists.—BRITISH INSULATED AND HELSBY CABLES, LTD., Prescot.—Illustrated leaflet, showing their *Helsby* pattern zinc rods for Leclanché cells.

SIEMENS BROS. & CO., LTD., Woolwich, S.E.—Priced circular respecting "Woolwich" tape of improved type.

ELECTRICAL SUPPLIES CO., 233, Tottenham Court Road, London, W.—Twenty-page price list of electrical accessories. Copies will be sent on application.

Maximum Iron and Steel Prices.—A detailed list of maximum prices fixed, until June 30th, by the Ministry of Munitions, after conference with trade associations, for materials used and produced in the iron and steel industries, is published in the *London Gazette* for May 2nd.

Patent Restoration.—An order has been made restoring Letters Patent No. 10,774, of 1910, granted to Nathaniel Baldwin for "Improvements in sound reproducing devices of the telephone receiver type."

Liquidations.—EXCELSIOR ALUMINIUM SOLDER CO., LTD.—This company is winding up voluntarily, with Mr. J. R. Atkins, 14, St. Ann's Square, Manchester, as liquidator. Meeting of creditors, May 12th.

STOLZ ELECTROPHONE CO. (1913), LTD., London, E.C.—First and final dividend, 7d. in the £, payable at 33, Carey Street, W.C.

Trade Announcements.—MESSRS. J. H. WOOLLISCROFT & CO.—Mr. J. H. Woolliscroft, A.M.I.E.E., who is well-known to many of our readers, and has for some years been general manager of Messrs. H. T. Boothroyd, Ltd., has commenced business for himself under the style given above, at Queen's Buildings, 20, New Quay, Liverpool (telegrams, "Energy" Liverpool; telephone, Central 2341), as manufacturers and suppliers of A.C. and D.C. machinery, switchgear, &c., specialists in repair work, contractors for power plants, factory and ship-lighting installations, &c. Mr. Woolliscroft, who was the inventor of the rotary liquid starter, intends to put on the market the improved patented pattern which we described in our issue of March 3rd; he will be pleased to receive lists and catalogues from supply firms. We wish him all success in his new venture, to which his genial personality will contribute in no small measure.

MESSRS. F. RYMAN & CO., are extending their works at 116, Livery Streeet, Birmingham, and are carrying a larger stock of general electrical accessories. They wish to inform the trade in Glasgow that their agreement entered into in 1912 with Messrs. Paterson & Service for the sale of fuseboards in Glasgow, is not now in force, and orders can be sent direct to Birmingham.

LIGHTING AND POWER NOTES.

Aberdeen.—A report in connection with the supply of electricity to the Caledonian and Great North of Scotland Railways has been submitted to the Electricity Committee, and approved. The report recommends an increase of 20 per cent. on the present charges. It was reported that the output generated in March was 1,423,730 units, an increase of 304,260 units over the same month last year.

Australia.—The Melbourne City Council has decided to establish a depôt for the storage of coal, with a view to placing the electricity undertaking in a more secure position in regard to its coal supply. A site is to be utilised in Arden Street, North Melbourne, to hold 10,000 tons. The capital cost of establishing the depôt, including machinery, is estimated at £8,785, and the annual cost of operation, including interest and depreciation, at £2,242.—*Melbourne Age.*

The Sydney (N.S.W.) City Council has offered to supply the proposed electric steel plant of the Australian Electric Steel Co., at a special rate of ½d. per unit, for not less than 500,000 units per annum, provided the load is restricted to certain hours; a further reduction in price will be made later if the company agrees to increase its load.

The N.S.W. Public Works Department, which proposes to install a generating plant at Port Kembla to supply Wollongong, has offered to extend the line to Bowral, Moss Vale and Mittagong, for pumping and lighting purposes, the local authorities to undertake distribution.

The Inverell (N.S.W.) Municipal electricity works extensions have been formally opened. During the past five years the enterprise has contributed £4,000 to the relief of the rates.

NORTH SYDNEY ELECTRIFICATION.—The Sydney City Council has informed the Council of North Sydney that the delay in supplying electricity to the district was due to the extraordinary conditions affecting the manufacture of electrical apparatus and the transportation of materials. No definite date could be fixed for this supply until the required materials reached Sydney, which would probably be in the course of a few weeks.

A large quantity of lead-covered insulated cable which was to be used for one portion of the North Sydney supply had been delivered in Sydney, but the Federal authorities declared it supplied by an enemy firm, and they had been unable to obtain its release from bond.—*Sydney Evening News.*

The Kilmore (Vic.) Shire Council has decided to take over the undertaking of the Kilmore Electric Supply Co. for £2,500, providing the money can be borrowed at 6½ per cent. The value of the plant has been put at over £3,000. The Council pays £160 per annum for street lighting. The present charge for private lighting is 7d. per unit.

According to *Melbourne Age*, proposals have been made for using the Hobart, Tasmania, hydroelectric power scheme for providing current to operate an electrolytic plant for manufacturing spelter from zinc concentrates. In the event of the negotiations now in progress coming to a head the first unit of a big plant will be erected.

Carlisle.—The County Property Committee has decided in consequence of the saving in the number of lights used and the improved efficiency in the lighting by the partial introduction of electric lighting in the county offices, court houses and committee rooms, to continue the installation throughout the whole of both buildings.

Chelmsford.—E.L. CHARGES.—The T.C. having protested against the minimum charge for E.L. to private consumers introduced by the Electric Supply Corporation, the latter has replied that it sees no reason to alter its decision, the charge being based on a clause introduced into practically every prov. order.

Darwen.—There was a loss of £900 on the working of the Council's electricity undertaking for the past year.

Edinburgh.—There is a considerable deficit in the revenue of the Corporation electric supply department, caused by the lighting restrictions, and the Electric Lighting Committee has decided to increase the rate for current for lighting by ½d. per unit, raising the charge to 3½d.; also to charge 5 per cent. in addition to the present power rate where there is no contract.

Greenock.—PROPOSED LOAN.—The Corporation has decided to apply to the Scottish Office for sanction to borrow £45,000 additional capital. It was stated that the Corporation had been unsuccessful in its endeavour to get the Admiralty to agree to pay any share of the money required.

Halifax.—The Electricity Committee proposes to extend the high-tension mains to Messrs. Goodall's premises, *viâ* Lower Shaw Hill, &c., at an estimated cost of £1,123, subject to certain guarantees.

Haslingden.—During the year ended March last, the total units sold were 892,495, compared with 677,017 units in the previous year, an increase of 215,478 units. The maximum demand was 398 KW. last year, compared with 339 KW. two years ago.

Arrangements have been made for obtaining a supply of electricity from Rawtenstall, and application is to be made to the L.G.B. for sanction to borrow money to cover the cost of the necessary cable and switchgear.

Heston and Isleworth.—The District Council is to apply for sanction to borrow £787, the extra cost of laying feeder cables over and above the sum of £3,569 sanctioned before the war. Sanction has been received to the borrowing of £175 for extending cables.

London.—The B. of T. was to hold a conference on Wednesday to consider the proposal of the Charing Cross Co. to increase for the period of the war its statutory charges for electric current; this proposal, as mentioned in this column, has aroused considerable opposition amongst the company's consumers.

Manchester.—WAGES.—The Workmen Special Committee of the Corporation has considered an application by workmen (other than tradesmen) at Stuart Street generating station, for a special war bonus of 3s. per week. A motion recommending the Electricity Committee to grant the war bonus asked for, was negatived. With regard to another request from another Union on behalf of workmen in the electricity, tramway and other municipal departments that a minimum wage of 30s. per week be instituted without war bonus, in place of the 26s. rate for labourers, the Committee has decided that it cannot see its way to accede to the request.

Nelson.—YEAR'S WORKING.—Mr. G. F. Naylor, the borough electrical engineer, reports that, instead of a small estimated profit on the year's working, there is a deficit of £298.

The Electricity Committee has decided to recommend increases in the price of electricity per unit, of one-eighth of a 1d. in the case of power, and 1d. in the case of lighting.

Nova Scotia.—The proposal to harness the tides of the Bay of Fundy, at Cape Split, Nova Scotia, by means of a current motor, which would pump the water into huge reservoirs on the cliffs above, the descending water furnishing the power, has been followed by a suggestion to utilise the Reversing Falls at St. John, New Brunswick, in a like manner. The suggestion has come from the acting resident engineer of the Public Works Department, who says that a stronger current is available at the Falls than at Cape Split, and that there would be a longer period between tides for a motor pump to operate. All attempts to utilise their tremendous energy have, so far, failed, but by the application of a current motor such as has been suggested at Cape Split, and by the erection of reservoirs on the height above, it is thought that, at last, a way has been found by which the Falls may be harnessed.

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Rawtenstall. — Year's Working. — The electricity undertaking has made a surplus during the past year of £1,762, compared with a surplus of £2,005 in the previous year. The result is regarded as satisfactory, having regard to the increased cost of coal (over £1,100), and the increased rates and taxes.

Salford.—During the past month the Electricity Committee has authorised agreements to be entered into for supplying electricity to the premises of the General Electric Co., Ltd., the Broughton Copper Co., Ltd., and Messrs. Richard Haworth & Co., Ltd.

Sevenoaks.—The Electricity Co. has applied to the U.D.C. for permission to use overhead cables in part of the town for the supply of current to consumers.

Stalybridge.—At a meeting of the Joint Tramways and Electricity Board on April 27th, the seal was affixed to the precept on the four Corporations (Stalybridge, Hyde, Mossley and Dukinfield) for the amount of the deficiency in the net revenue for the past year, £7,000, which is to be apportioned in equal shares.

Stoke-on-Trent.—Public Lighting.—The Electricity Supply Committee of the Corporation has decided, owing to restricted lighting, to allow a reduction at the rate of £1,000 per annum on the public lighting account for the current year.

Wimbledon.—The Council has been informed that the Fixed Price Light Co. has paid the amount due in respect of transformer losses in connection with its supply from the Corporation.

TRAMWAY and RAILWAY NOTES.

Australia.—It was recently announced that Messrs. Norton, Griffiths, Ltd., had commenced tunnelling operations in Macquarie Street in connection with the Sydney City Electric Railway scheme.

At a recent meeting of the ratepayers of Port Adelaide it was decided to approve of the Council borrowing £12,000 for electric tramways, as set out in the specifications approved by the Council.

Argentina. — The Government has authorised the Buenos Aires Western Railway to construct in its own workshops, with the assistance of the Great Southern Railway, the coaches required for the company's electric service between the stations of Once and Moreno. The Western Railway had originally contracted for these coaches in Germany, but the war naturally involved the rescission of this contract. British firms were then approached but had to decline the business owing to pressure of war orders.—*Review of the River Plate.*

Belfast.—Year's Working.—The annual report of the general manager of the City tramways, just published, is considered very satisfactory under the present exceptional circumstances. The total revenue for the year ending March 31st, 1916, was £280,641, and the working expenses were £159,800, showing a trading profit of £120,340. After interest and other charges are met, there remains a net profit of £56,735. The sinking fund and depreciation fund absorb £32,434 and £17,000 respectively, £5,000 goes to the general purposes fund for 1915-16, and the balance to the same fund on account of the £15,000 promised for the current financial year. War pay and bonuses amounted to £10,081, and therefore, if it had not been for this special expenditure, it would have been possible to make a large contribution in relief of the rates. For the present year the net revenue is estimated at £69,180, and deducting £52,000 for appropriation charges, a surplus will remain of £17,180.

Bolton.—Wages.—Application has been made for an advance of one halfpenny per hour for motormen, conductors, overhaulers, cleaners and day labourers, and on the standard rate for men working on machines, and the Tramways Committee, while holding the belief that an understanding was arrived at when the last advance was given that there should be no further application before July, 1916, has decided to receive a deputation from the workers' Union.

Certain lengths of track are to be relaid, in accordance with recommendations of the borough engineer.

Bournemouth.—Year's Working.—The report of the working of the Corporation tramways for the past year shows a profit of £14,132, as against £9,083 in the previous year.

British Columbia.—According to the *Electric Railway Journal*, an exceptional record of snowfall was shown during January and February this year, amounting to 76 in. in the city of Victoria and about 60 in. in the city of Vancouver. Despite these severe conditions, the B.C. Electric Railway Co. maintained its city and interurban services on the mainland; in Victoria, however, the service was tied up for two days, due to the breaking of one of the transmission lines under the heavy snowfall. Power was only interrupted for one hour, but the cars were snowed up in that time. It appears that the "jitney" competition shows a great reduction, compared with a year ago, in Vancouver city.

Continental.—Spain.—It is intended to electrify the tramway running from Irun to Fuentarrabia, at present worked by horses.

Sweden.—With a view to electrifying the Eastern and Midland Railway lines of Sweden, the question of utilising the falls at Mjölarp on the Swartan River has been for some time under consideration. The question has been taken up again recently, and guarantees have been given that the station shall be in working order by 1920. The electrification of the Lund-Bjarred Railway is also well advanced, although it has been delayed by the Telegraph Administration owing to arrangements connected with the telephones.

Dublin.—Tramway Stoppage.—In connection with the recent Sinn Fein Rebellion, brief reports to hand show that the tramway system was seriously damaged by the rebels, who obtained possession of the power station, and destroyed portions of the overhead system. It also appears that the electric lighting of the north side of the city has been shut down, owing to damage done, and there has been no gas supply since the commencement of the outbreak.

Haslingden.—Year's Working.—The traffic receipts for the Council's tramway undertaking amounted to £8,105 for the past year, against £7,804 for the year ended March 31st, 1915, with a reduction in mileage of 18,569 and an increase in the number of passengers of 54,692. The average receipts per car-mile were 13·18d., as against 11·30d. for the previous year.

Hull.—Year's Receipts.—The receipts on the Corporation tramways for the year ended March 31st last were £161,945, an increase on the previous year of £195. The total receipts this year to April 22nd were £9,687, a decrease of £1,038 as compared with the corresponding period of 1915.

Manchester.—Through Cars.—Arrangements have been made with the Stockport Corporation Tramway department for the temporary through running of Manchester cars to Reddish in the mornings and evenings to meet the requirements of factory workers employed in the Reddish district.

Nelson.—Year's Working.—The Corporation Light Railways department has made a net profit during the past year of £1,124; the receipts amounted to £10,151, compared with £9,299 in the previous year. The tramway manager reports that the popularity of the discount tickets has been marked. During the coming year it is hoped to add another top-covered car to the rolling stock.

Newcastle-on-Tyne. — Proposed Fare Increase.—The Tramways Committee has been considering the question of increasing the revenue of the City tramways, and has decided to recommend the revision of some of the fares, including the minimum of one halfpenny for soldiers, which is suggested should be raised to one penny. The workmen, it is stated, will have to pay more for their books of coupons.—*Newcastle Journal.*

New Zealand.—The directors of the Takapuna Tramways and Ferry Co. have decided to grant to Mr. P. Hansen an option over the rights to raise the requisite capital for the electrification of the Bayswater-Takapuna tramways.—*Auckland Weekly News.*

Rawtenstall.—Speaking at a meeting of the T.C., Councillor Taylor said that, with the rate-in-aid of £2,000, the tramway undertaking had a surplus of £2,380, the whole of which was to be placed to the credit of the renewals fund. The financial result was very satisfactory, but the amount to the credit of the renewals fund was not sufficient to meet the expected expenditure in the near future.

Rotherham.—Year's Working.—The total receipts from the Corporation tramways during the past year were £52,243, and the total number of passengers carried 11,705,785. There was a gross profit for the year of £19,155, an increase of £4,759 on the previous year.

Salford.—Female Labour.—At this week's meeting of the Council a resolution was to be moved by Ald. Jackson to the effect that the Tramways Committee be instructed to pay all females employed on the cars and in the sheds a war bonus equal to that paid to men performing similar duties.

Sheffield.—Electric Vehicles.—The Midland Railway Co. has placed in service three electric delivery vans of 2 to 3½ tons capacity, for serving the outer areas of the city.

Stalybridge.—Female Drivers.—*Apropos* the recent protests of local Trade Councils against the suggestion that women should be employed as tramway drivers in the district, Councillor Fowden stated at a meeting of the Joint Board, on April 27th, that women should only be employed in the last resort, and that no women should be put to the work without the matter having been brought first before the General Purposes Committee. Ald. R. Wood replied that if the G.P.C. was to take charge of the matter, that should be stated at once, because it was no use the Tramways Committee training women as car drivers if the Board was not going to approve them in the end. There was no idea of dispensing with male labour now or in future, and women drivers would only be employed if male drivers could not be obtained, and then only on safe routes and after thorough training. The discussion dropped.

U.S.A.—The report of the Pennsylvania Railway for the year ended December 31st last mentions that the electrification of the main line suburban zone from Broad Street Station to Paoli was completed, and that multiple-unit electric trains started running on September, 1915.

Pending the obtaining of further experience in the handling by electric traction of heavy freight trains, the proposed electrification of the main line across the Alleghany Mountains between Altoona and Conemaugh, has been deferred.

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Walthamstow.—A new formula has been adopted by the District Council for the calculation of the amount to be charged by the electricity undertaking to the light railway undertaking for energy for the year ending March 31st last. In succeeding years monthly payments will be made on the basis of the last annual charge, such payments to be subject to adjustment on the issue of the accountant's certificate after the making up of the annual accounts.

TELEGRAPH and TELEPHONE NOTES.

A U.S. Story.—According to the *Telegraph and Telephone Age*, Mr. Thomas D. Lockwood, general patent attorney of the American Telephone and Telegraph Co., and an old time telegrapher, is responsible for the following anecdote:—

An Irishman who had returned from a visit to the old country was telling a friend of the sights that had impressed him. "The funniest of all," he said, "is the telephone. It's a queer little instrument that you put up to your ear, and one to your mouth, and then you say, 'Are you there?' And the fellow at the other end answers 'Yes' or 'No,' as the case may be."

Cable Censorship.—An agreement has been made between the Danish Merchants' Guild and the British Government, according to which telegrams to America and England concerning business transacted in accordance with the Anglo-Danish Agreement are allowed to pass through the British Censor's Office without delay.

Norway.—A new wireless station is to be erected at Coresäter, with masts 100 m. in height, to communicate with other long-range stations in Europe; it will be constructed on the same scale as that of Nauen, near Berlin, and will be ready for operation next autumn. A contract has just been made with a Berlin company for the execution of the work. A smaller station near it will be provided for communication with ships.—*La Lumière Electrique.*

Portsmouth.—An automatic telephone exchange was brought into operation on Saturday last at Portsmouth; it is said to be the largest of its kind in the country.

The Telegraph Service.—The Postmaster-General has issued an important announcement to the effect that, on account of the depletion of the Post Office staff by the withdrawal of men for service with the Colours, the hours of public telegraph business at many post offices have been curtailed. Some of the larger telegraph offices, and a number of the smaller offices, both in town and country, now open at 9 a.m. and close at 7 p.m. for the reception and delivery of telegrams; and senders are warned that telegrams handed in after 6 p.m. may not reach their destination until the following morning.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—May 24th. N.S.W. Government Railways and Tramways. 16 600-volt D.C. motors for tramway stores, Randwick.*

June 20th. Sydney Municipal Council. Supply of a two-ton electric lorry. City Surveyor, Town Hall.

MELBOURNE.—May 31st. Victorian Government Railways. Transformers for five years. First order, 220 transformers in six months.*

June 14th. Victorian Railways. Electric lamps and lampholders for signal system.*

Canada.—May 15th. Ten knots of single-conductor submarine telegraph cable (107 lb. copper, and 150 lb. gutta-percha per knot) with iron wire sheathing, for Canadian Government Telegraph Service Department of Public Works, Ottawa.*

Ingleton (Yorks.).—Electric light installation at St. Mary's Church. Rev. J. Llewellyn, Vicar.

Manchester.—May 10th. Coal slack for 12 months. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall.

May 17th. Electricity Committee. Automatic coal-handling plant at Stuart Street station. See "Official Notices" to-day.

New Zealand.—June 23rd. Oamaru Borough Council. Overhead mains and street-lighting equipment (Contract No. 2); power-station equipment (Pelton wheels, alternators, &c.) (Contract No. 3); service meters (Contract No. 4); line transformers and accessories (Contract No. 5).*

Salford.—May 8th. Electricity Department. High-pressure steel steam pipes and separator, also cast-iron pipes and valves. See "Official Notices" April 21st.

Spain.—May 15th. Municipal authorities of Bellcaire (Province of Gerona). Tenders for the concession for the electric lighting of the town during ten years.

May 18th.—Municipal authorities of Villalbarbe (Province of Valladolid), for the concession for the electric lighting of the town.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Australia.—Sydney City Council has accepted the tender of Messrs. Noyes Bros. for insulated wires and cables, at £7,181, the basis price of copper being taken at £110 per ton.

Bolton.—Electricity Committee. Accepted tenders:—
J. & N. Dickinson, Ltd., construction of a sub-station near Melrose Mill in connection with the supply of current to Lostock Mills.
D.C. motors for 12 months: McClure & Whitfield.

Manchester.—The Tramways Committee has reconsidered the question of the tenders for the supply of electric lamps, referred back at the last meeting of the City Council, and has decided to accept the following tenders:—
Drake & Gorham, Ltd.—Half-watt lamps and drawn-wire filament traction lamps, manufactured by B.T.H. and Edison & Swan.
General Electric Co., Ltd.—Carbon-filament lamps, half-watt lamps, and drawn-wire filament lamps, manufactured by the Osram-Robertson Lamp Works, Ltd.

The Electricity Committee has accepted the following tenders:—
Cable.—Callender's Cable & Construction Co., Ltd.; Pirelli General Cable Works, Ltd.; Chas. Macintosh & Co., Ltd.; Western Electric Co., Ltd.; B.I. & Helsby Cables, Ltd.; Liverpool Electric Cable Co., Ltd.
Crane for sub-station.—Vaughan Crane Co., Ltd.
Low-pressure water and exhaust steam pipes, &c.—Staveley Coal & Iron Co., Ltd.

Salford.—Electricity Committee. Accepted tenders:—
J. Gerrard & Sons, Ltd.—Alterations and additions to buildings and foundations for one 5,000-kw. turbo-alternator, £1,650; extensions to H.T. switch house, &c., £1,060.
British Westinghouse Co., Ltd.—Transformers, £1,088.
Albion Motor Car Co., Ltd.—Four-ton Albion petrol motor-wagon, £896.
Underfeed Stoker Co., Ltd.—Two underfeed mechanical stokers, £1,535, for two water-tube boilers.

Walthamstow.—U.D.C. Recommended tenders:—
W. T. Henley's Telegraph Works Co., Ltd.—Cables during the period ending March, 1917.
P. R. Jackson & Co.—24 commutators, at £5 5s. each.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Friday, May 5th. At 5.30 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Electrical Methods in Surgical Advance," by Sir J. M. Davidson.
Saturdays, May 6th and 13th. At 3 p.m. Tyndall Lectures on "X-rays and Crystals": I, "New Methods of Research"; II, "First Results and their Applications," by Prof. W. H. Bragg, F.R.S.

Royal Society of Arts.—Monday, May 8th. At 4.30 p.m. At John Street, Adelphi, W. Cantor Lecture II, on "Vibrations, Waves, and Resonance," by Mr. J. Erskine-Murray.

Faraday Society.—Tuesday, May 9th. At 8 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W. Ordinary meeting.

Illuminating Engineering Society.—Tuesday, May 9th. At 5 p.m. At the Royal Society of Arts, John Street, Adelphi. Discussion on "A Report to be presented by the Research Committee of the Society." Annual meeting.

Institution of Electrical Engineers.—Thursday, May 11th. At 8 p.m. At Victoria Embankment, W.C. Annual general meeting.
(Yorkshire Local Section).—Wednesday, May 10th. At 7 p.m. At the Philosophical Hall, Leeds. Paper on "The Economical Production of Power from Waste Gases," by Mr. G. Dearle.

Chemical Society.—Thursday, May 11th. At 8 p.m. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

Physical Society of London.—Friday, May 12th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Papers on "The Latent Heats of Fusion of Metals and the Quantum Theory," by Mr. H. S. Allen; "Lenses for Light Distribution," by Mr. T. Smith; "The Choice of Glass for Cemented Objectives," by Mr. T. Smith.

NOTES.

Bribery Prevention.—A letter has been issued by the secretary of the Bribery and Secret Commissions Prevention League (Inc.), 9, Queen Street Place, London, E.C., appealing for members and associates from the various branches of the engineering profession. The letter reads:—

It is expected, judging by past experience, that when the war is over, and there is eager competition for new business amid the general dislocation of trade, the utmost vigilance will have to be maintained to guard against bribery. Now, and in the near future, there seems to be special need for the work of the League in combating corruption in official, commercial and private life. It is recognised, however, that the demands of the war, directly or indirectly, are such that many persons may be unable to become members of the League at the present time. It has been decided, therefore, as a temporary measure, due to the war, to consider those who give not less than 5s. as associates, for 12 months. Similarly, trade organisations which wish to help the League but lack the funds for affiliation, or shrink from the responsibilities involved, will be grouped as associated organisations, on making an annual payment of one guinea.

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The Business Languages of South America.—There are two business languages used in South America: the language of Brazil, with about 20,000,000 people, is Portuguese; the language of the rest of South America, comprehending an equal number of people, is Spanish. Portuguese and Spanish—these are the business languages of South America. The business man must use in his correspondence and through those who represent him the language of the people he wishes to reach.

Under no conditions should a letter addressed to South America be written in English, unless the writer is positive that the person to whom it is addressed reads and speaks English fluently. If the writer does not know that the person he is addressing possesses this qualification, the letter must be in Portuguese if sent to Brazil and in Spanish if sent to any other South American country. On the other hand, it is always safe to answer a letter from South America in the language in which it is written.

The racial traits of courtesy possessed by all South Americans tend to make them lenient of errors in language, provided the attempt to make oneself understood is genuine. Thus, a letter written in poor Portuguese or poor Spanish is far better than one written in good English. The English letter would probably reach the waste basket without an attempt being made to read it. On the other hand, the letter in understandable, though inelegant, Portuguese or Spanish would be read and its contents grasped.

All business letters written by South Americans are most courteous in style. They are cordial and even gracious. To us, both the salutation and the closing greetings are effusive. Scattered through the body of the letter are frequent phrases of direct address to the one who is to receive the letter, worded in the most polite terms. When reading such expressions, one can almost imagine the courtly raising of the hat that accompanies the meeting and parting of business men in South America.

Three examples of common salutations in Spanish business letters are herewith given, each being followed by a rather literal translation into English: *Muy Senor mio*—My dear Sir; *Distinguido Senor*—Distinguished Sir; *Illustrisimo Senor*—Most Illustrious Sir. Three endings for letters, similarly translated, are also given: *Quedo de Vd. atto. y S. S.*—I remain to your Grace your attentive and obedient servant; *Me repito de Vd. atto. y S. S.*—I repeat to your Grace that I am your attentive and obedient servant; *Esperando sus ordenes S. S.*—Awaiting your orders, I am your obedient servant.

From these few phrases it is easily imagined how offensive our brusque North American style of letter writing must be to anyone who naturally, and by association and training, uses most courteous forms in addressing others.

The importance of using the language of the country in dealing with South America has been realised and acted upon by both the British and the Germans. The German has acted from his usual disposition to take advantage of everything that might count; the Englishman has accommodated himself to necessity. The final result is that the salesmen representing German and British houses are well equipped with a knowledge of the language of the countries with which they are doing business, the customs of the people, and the niceties and refinements of business intercourse. These qualifications give them a decided advantage over North Americans who have failed to appreciate and learn these important things. In the case of the British, however, it must be confessed that this acquirement is a veneer, for when Englishman meets Englishman, or Englishman meets American, the brusque Anglo-Saxon ways again come to the surface.

This subject of business languages in South America is so important that everyone who is exporting to that continent should see to it that only Portuguese and Spanish are used, and that the courteous forms of expression which enter into the daily business intercourse of the peoples of those countries are scrupulously observed.—*American Machinist.*

Electric Winding in South Africa.—In a paper read by Mr. J. Norman Bulkley, before the American Institute of Mining Engineers, on the application of electric power to mining work in the Witwatersrand area, some particulars are given of electric winding plants in South Africa. The area contains 143 electrically-driven hoisting engines, exclusive of winches. The combined continuous rating of these hoists amounts to 74,000 H.P., or an average of 517 H.P. Although exact comparisons of costs with steam winding plants are not possible, investigation favours the use of electric winding, especially in deep shafts. One result is a marked decrease in the cost of maintenance of shaft guides, owing to the steadier turning moment of the electric winder, while greater safety and reliability are also found with the electric hoist.

A comparison of the efficiency of two winding plants operating under similar conditions, but one equipped with a geared three-phase rheostatic winder, and the other with a Ward-Leonard winder, shows that where the latter has been kept working steadily, its efficiency exceeds that of the rheostatic set by about 5 per cent., but where the shaft H.P.-hours have dropped, the efficiency of the Ward-Leonard set has dropped with them, showing the bad effect of intermittent winding due to the practically constant losses of the motor-generator set, while with rheostatic control the only loss, when the hoist is standing, is that due to the controller pump motor, which is negligible.

In the case of a mine under Mr. Bulkley's charge, a complete change from steam to electric drive was made, and, at the same time, the milling capacity was increased from 15,000 to 17,000 tons a month, and the air-compressor plant by one-third.

A comparison of the last two years of steam operation and first year of electric service showed a saving in favour of electric drive of $12,000 per annum, without making any allowance for the increased capacity of the plant.

American Electrical Exports in January.—The electrical exports for January were surpassed in recent months only by the record shipments in November. In the four electrical classes for which the numbers of articles exported are given in the Government Report, there were shipped in January the following:—Electric fans, 1,433; arc lamps, 154; carbon-filament lamps, 128,522; metal-filament lamps, 507,527. The detailed figures for last January and for the corresponding month in 1915 are given below:—

	Jan., 1916.	Jan., 1915.
Batteries	$115,354	$100,946
Dynamos or generators	56,983	309,868
Fans	16,010	17,221
Insulated wire and cable... ...	265,622	83,728
Interior wiring supplies, &c. (including fixtures)	87,611	72,104
Arc lamps...	1,203	759
Carbon-filament lamps	14,667	5,802
Metal-filament lamps	109,720	38,504
Meters and other measuring instruments	75,352	40,556
Motors	389,380	205,140
Telegraph instruments (including wireless apparatus)	5,802	17,326
Telephones...	69,050	184,556
Transformers	55,708	57,122
All other	1,058,360	640,306
Total	$2,320,822	$1,773,938

Electric locomotives are separately listed in the report. In January eight of these, valued at $151,245, were exported.—*American Electrical Review.*

Society for Electrical Development, U.S.A.—To effect closer co-operation between the Jovian Order and the Society for Electrical Development, reigning Jupiter Thomas A. Wynne has appointed James M. Wakeman, General Manager, Harry W. Alexander, Director of Publicity, and George W. Hill, of the Field Co-operation staff, as Statesmen-at-Large in the Jovian Order. The Jovian Order, with its nearly 20,000 members, has substantially the same object as the Society for Electrical Development, but its functions are different. The recent appointments will effect better co-operation which will consistently complement the work of both organisations, such as the founding and fostering of local Jovian Leagues, and the harmonising of relations between local electrical interests. During the "America's Electrical Week" campaign next autumn, it is expected that the Jovians will exert great force in the handling of local sales, committee work, and celebrations. The Society will, however, conduct the national campaign as it did the Electrical Prosperity Week.

Electrical Rain-making in Australia.—Upon the recommendation of the committee of investigation into Mr. Balsillie's proposals for rain-making, the Premier of New South Wales is communicating with Dr. G. C. Simpson, of Simla, India, and also with Prof. Bragg, through the Agent-General. Dr. Simpson has been selected on the ground that he has carried out the most recent and the most comprehensive investigations into the scientific principles involved in water precipitation from vapour, which have come under the notice of the Committee. One or two English scientific men at times have investigated the subject to some extent in its relation to rain-making; and Prof. Bragg, who is in a position to get reliable advice at once, will be invited to assist the Committee. The Premier has altered the title of the Committee, on its own recommendation, to the "Rain Precipitation Investigation Committee."

Cheap Power.—In a letter to *Met. and Chem. Engineering*, Mr. W. E. Herring, of the Puget Sound Traction, Light and Power Co., Seattle, states that his company has water-power plant of 74,000 H.P., supplemented by steam plant of 34,000 H.P., and the regular commercial power rate for loads above 101 H.P. for continuous use is ½d. per KW.-hour. Still lower terms are offered to concerns that use large powers continuously, and the company is about to develop from 75,000 to 150,000 additional H.P.

Daylight Saving.—It is reported that the Government will probably accept a motion put forward by Sir Henry Norman, on the lines advocated by the late Mr. W. Willett, to advance the public clocktime by one hour during the summer months, with a view to effecting economy in the use of fuel. The French Chamber of Deputies has already passed a Bill giving the Government power "until the end of the year when the treaty of peace is signed" to vary the legal time; whether the Senate will agree to it remains to be seen. It is estimated by the supporters of the Bill in France that a saving of two millions sterling will result. Similar measures have been adopted by Germany, Austria, and Holland as from May 1st.

American Reconstruction Work in Belgium.—We read in the *American Electrical Review* that Mr. Nevil Monroe Hopkins, as chairman of the Belgian Scholarship Committee, Washington, is making an appeal to the professional and scientific men of the United States for assistance in providing a fund for the reconstruction of Belgian educational facilities and opportunities for development in arts and science. The Committee includes among its members the Presidents or Chancellors of the following Universities:—Johns Hopkins, Princeton, Michigan, Missouri, Leland Stanford, Pennsylvania, George Washington, State of New York, Nebraska, Rice Institute, Western Reserve, and many other leading men of the country. It is proposed to establish a fellow-

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ship upon the basis of $1,000 a year for the duration of the war and two years thereafter, a sustaining membership of $100 and an associate membership of $10 each year under the same circumstances.

Volunteer Notes.—ENGINEERING INSTITUTIONS' V.E.C.—Orders for week commencing May 8th, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25.

Monday, May 8th.—Sections 1 and 2, Technical; Sections 3 and 4, Squad and Platoon, Signalling Class and Recruits.

Tuesday, May 9th.—School of Arms, 6 to 7 p.m.; Recruits' Drill, 7.15 to 8.15 p.m.

Thursday, May 11th.—Shooting for Sections 3 and 4; Recruits, 5.45 to 7.45 p.m.

Friday, May 12th.—Sections 3 and 4, Technical; Sections 1 and 2, Squad and Platoon; Signalling Class and Recruits.

Saturday, May 13th.—Adjutant's Instruction Class at 2.30 p.m.

E. G. FLEMING,
Company Commander and Acting Adjutant.

3RD BATT. (OLD BOYS) CENTRAL LONDON VOLUNTEER REGIMENT.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, May 4th, 1916:—

Week-End Parades.—Saturday.—The Battalion will Parade at Baker Street Station, at 2.30 p.m., and proceed by train to Wembley Park for Battalion Drill, under the Adjutant.

Sunday.—The Battalion will Parade at Victoria Station, Wilton Road entrance at 10.20 a.m., and proceed by train to Orpington, for Field Operations with the 3rd Batt. West Kent Volunteer Fencibles. The Battalion will leave Orpington on the return journey at 5.12, reaching Town at 6.4 p.m.

Musketry.—Inter-Battalion Cup Competition. There will be practice at Bisley for above Competition on Saturday, May 6th. The range will also be open to other members. Names to be sent in to the Musketry Staff by Friday midday. Members to report themselves, in Uniform, at 12.45 p.m., to Sergeant Cotter, No. 6 Platform, Waterloo Station.

A. G. JOINER, *Major and Adjutant*, O.B.C.

Appointments Vacant.—Junior engineers-in-charge (45s.), for the Borough of Newport (Mon.) electricity department; assistant engineer (£150); jointer (£2), for the Borough of Gillingham (Kent) electric light and power department. See advertisement pages to-day.

Institution and Lecture Notes.—University of London, University College.—The following, among other, public lectures are announced:—Tuesday, May 9th, at 5 p.m.—"The School of Chemistry at University College: Turner, Graham, Williamson, Ramsay," by Prof. J. Norman Collie, F.R.S. Monday, May 15th, at 5.30 p.m.—"The Manufacture of Nitrates from Air by Electric Power," by E. Kilburn Scott, M.I.E.E. Tuesday, May 16th, at 5 p.m.—"The Rôle of Chemical Science in Civilisation," by Prof. F. G. Donnan, F.R.S.

Institution of Electrical Engineers.—The annual general meeting of the contributors to the Benevolent Fund will be held at the Institution on Thursday, May 11th, at 9 p.m., to receive the report of the Committee of Management and the statement of accounts and balance-sheet to December 31st, 1915. At this meeting the names of the Committee of Management for 1916-17 will be declared. A general meeting of the contributors to the Fund will be held as soon as the business of the annual general meeting is concluded, for the purpose of considering alterations to Rules 9 and 10 of the Fund.

Society of Engineers (Inc.).—On Monday a conference of engineers, convened by the Society, was held to discuss the subject of "Engineering and Scientific Research." Dr. J. A. Fleming, F.R.S., who opened the discussion, showed that there were three main divisions of such researches:—

1. Those bearing on the determination of physical constants or specific qualities of materials required as an aid to design.
2. Researches which provide new methods of testing materials or structures.
3. Researches which involve new appliances or processes of manufacture.

He said that there were no cut-and-dried methods by which we could engender originality, but it was of the utmost importance to foster it in anyone who gave evidence of its possession. A totally changed attitude in the public mind towards scientific research was required. Until we produced more men who could do new things, and not merely know about old ones, it was futile for Great Britain to hope to gain pre-eminence over Germany in scientific industries. The advantages which we had in greater originality of mind and better workmanship were neutralised to a large extent by the want of a sufficiently thorough and broad scientific education to enable us to see the practical value of, and work out exhaustively, especially with reference to trade purposes, the openings given by scientific discoveries. Our post-war policy could not be simply defensive. No tariff wall could be built so high, no boycott of German goods could be so thorough, as to defend our position in the absence of a positive and vigorous policy of attack.

Roentgen Society.—It is proposed to conclude the Session in June with an exhibition of apparatus employed in radiography, radiotherapy including radium technique, electromedical appliances, and photographic apparatus to illustrate technique as applied to medical science.

Royal Institution.—At the annual meeting of members held on Monday afternoon the report of the Davy Faraday Research Laboratory Committee was read. Fifteen new members were elected in 1915. Sixty-two lectures and 19 evening discourses were delivered in 1915. The following officers were elected for the ensuing year:—President, the Duke of Northumberland; treasurer, Sir James Crichton-Browne; secretary, Col. Edmond H. Hills; managers, Sir Thomas Barlow, Bart., Sir W. P. Beale, Bart., Dr. H. T. Brown, Sir J. Mackenzie Davidson, Lord Grenfell, Charles Hawksley, Col. Sir F. Nathan, the Hon. R. C. Parsons, Sir J. Reid, Bart., Sir Napier Shaw, Alexander Siemens, Dr. S. P. Thompson, Lord Wrenbury, Sir A. F. Yarrow, Bart., Sir Robert Younger. Visitors, H. Ballantyne, S. G. Brown, J. F. W. Deacon, W. Duddell, Lieut.-Col. H. E. Gaulter, Dr. J. Dundas Grant, J. W. Jarvis, H. R. Kempe, F. Legge, E. R. Moon, H. G. Plimmer, Sir W. Wyndham Portal, Bart., A. W. Porter, H. Munro Ross, Joseph Shaw.

Institution of Civil Engineers.—The Council has awarded a George Stephenson Gold Medal to Mr. F. W. Carter, M.A. (Rugby), for his paper on "Electric Locomotives."

West Ham Municipal Technical Institute.—A special course of seven lectures on "Some Industrial Applications of Electricity," with practical work, will be given in the Institute, Romford Road, West Ham, on Monday evenings, from 7 to 9 p.m., commencing May 15th. Fee for the course, 2s. 6d. Particulars are given in our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The following members of the staff of the Leicester electricity department have received advances in salaries:—Mr. W. E. BARTON, superintendent of the Aylestone station, from £300 to £325 per annum; Mr. G. MORRIS, car-shed superintendent, from £260 to £285; Mr. E. J. RILEY, chief clerk, from £200 to £215; Mr. H. E. ROGERS, mains superintendent, from £190 to £225; and Mr. G. E. PURDY, draughtsman, from 40s. 6d. to 50s. per week.

General.—Mr. WARE, Accrington Fire Brigade and lighting superintendent, is to have his salary increased from £160 to £200 per annum, and is to take charge in future of the whole of the public electric lighting of the town, and not, as at present, of the Blackburn Road section only.

Mr. P. J. PRINGLE, M.I.E.E., M.I.M.E., has been appointed consulting engineer and assessor to the Melbourne Tramway Board, recently formed, and will act in connection with the transfer of the Melbourne Tramway & Omnibus Co.'s undertaking to the Tramway Board. Mr. Pringle is general manager and chief engineer of the Electric Supply Co., of Victoria, Ltd., and will continue to discharge these duties.

Mr. LEONARD FREDK. ALLDAY, who was married at St. Clement's Church, Boscombe, on April 24th, to Miss I. H. Sanbrook, was presented by his colleagues in the electrical department of Devonport Dockyard with an oak-cased chiming clock.

Official notice from the *London Gazette*.—Territorial Force. Royal Engineers, London Electrical Engineers, Temporary Second-Lieutenant T. S. WALLIS, from R.E., to be Second-Lieutenant.

Mr. C. F. BUTLER, A.M.I.E.E., late acting manager and engineer of the Gravesend and Northfleet Tramways, has taken up an appointment under the War Office as station engineer to the group of electric generating stations at Fovant, Salisbury.

Roll of Honour.—Sergeant NORMAN GREEN, of the Durham Light Infantry, who has died in hospital at Boulogne of wounds received in action, was, prior to the war, engaged with Messrs. W. E. Dove & Co., Ltd., electrical engineers, of Darlington.

Obituary.—MR. FREDERICK WALKER.—The death of Mr. Frederick Walker, at Cheltenham, at the comparatively early age of 62, will recall to many of those with whom he was associated in the early eighties, and since, a personality almost unique in the engineering and electrical world. In his profession he was a genius, and on the subject of aerostatics his judgment and versatility were pronounced. In the book published by him in 1910, *Aerial Navigation*, his remarks, read in the light of recent events, may be considered almost prophetic. In the preface to his last book, Mr. Walker said:—

> The advent of the aeroplane as a medium for sport has commenced a new era of trade, and the exigencies of the preparations of foreign Powers for aerial war apparatus needs must stimulate our own Government to action in the same direction.
>
> But whatever is done in the matter of aerial navigation in the way of trade and inventive genius, should be done by the British people themselves; I cannot believe that the race has deteriorated to such a degree that we should depend upon foreign invention and manufacture for what we need at home. There is no need, for ages to come, to fear a social revolution or the destruction of civilisation by the advance of aerial navigation. This could only be effected by the discovery and application of the neutralisation and regulation of the force of gravity. Given this as a secret under the control of a peaceful and highly-civilised Power, and war and its concomitant horrors would be a story of the past.

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Another extract from this book goes on to say:—

There is a great future before the aeroplane, and also before the airship, which is built as a rigid combination between the aerostat and the aeroplane.

It is certain that with such an airship, having controllable vertical movement, with fuel and provision for eight men for one month, no spot upon our planet may remain unexplored and uncharted.

It must be conceded, however, by the most pacific of teachers, that it is well for every nation to prepare for defence, and, without going so far as to entertain or encourage a possible "war in the air," a fleet of properly constructed airships is a necessary adjunct to a navy, more especially for that of a nation like Great Britain, with an insular centre, so dependent upon the command of the elements surrounding it.

Born at Charlton, Kent, in 1853, he served an early apprenticeship of seven years as a millwright. His workshop training at Bryan, Donkins, Easton & Anderson's, &c., and a ripened world-wide experience gained as a sea-going engineer in the P. & O. service, peculiarly fitted him in later years for the profession of a consulting engineer and patent agent. He was employed, among other things, in first installing the electric light on the Suez Canal, the designing of the *Volta* (the first electric launch to cross the Channel) in conjunction with the late Anthony Reckenzaun, and was the patentee of the first dry battery in 1881, and closely identified with the "Jarman" electric road cars in 1880. He was also associated with the early beginnings of many well-known engineering and allied firms, and in particular with the late Gustav Binswanger in the inception of the G.E.C. Mr. Walker was a well-known contributor to the technical Press, and author of many works, including *Practical Dynamo Building, Tables and Memoranda for Electrical Engineers, Electricity in the Engine Room, Design and Equipment of Launches*, &c. In his later days Mr. Walker for many years practised the profession of a consulting engineer and patent agent, until, through failing health, he retired into the country, near Cheltenham, where he was much sought after by those who valued his mature knowledge, gained by his practical experience and naturally scientific mind.

Wills.—The late Lady Kelvin left £5,000, to be applied for promoting research and the teaching of physical science in connection with a natural philosophy chair, and all the decorations and medals conferred upon Lord Kelvin, to Glasgow University.

The late Sir C. Rivers Wilson left unsettled estate £10,091 and net personalty £8,528.

REVIEWS.

Atmospheric Circulation and Radiation. By F. H. Bigelow, M.A. London: Chapman & Hall. Price 21s. net.

This is a meteorological treatise on the circulation and radiation in the atmospheres of the earth and of the sun, by a member of the Argentine Meteorological Office, who was for many years Professor of Meteorology in the U.S. Weather Bureau, and, therefore, is exceptionally well equipped for the task which he has set himself of adjusting the thermodynamic equations employed in meteorology to a uniform basis in accordance with the non-adiabatic system prevailing in the atmospheres above-named. Obviously this is not the place to discuss the author's work at length; we are mainly concerned with those chapters in which he deals with the electrical and magnetic phenomena connected with the atmosphere. Numerous references to authorities are given, and the author does not go into particulars with regard to instruments and methods of measurement, but briefly states the formulæ employed, with their significations and some examples of their applications. The cause of the wide discrepancy between the values obtained by different methods for the conductivity of the atmosphere is discussed, with the aid of numerous observations, and the difference is ascribed to a difference in the conditions of experiment; it is stated that the absolute values of the dissipation coefficients must be obtained by ion-counters, the Elster and Geitel apparatus being suitable for giving relative, but not absolute, values. The characteristics of the atmospheric electric potential are ascribed to ionisation of aqueous vapour by the incoming radiation, producing a normal charge of 150,000 volts at a height of 5,000 metres. A chapter is devoted to terrestrial and solar relations, in connection with the diurnal phenomena, especially the variations of the electrical and magnetic elements; these are influenced by the convective movements of the atmosphere, and react upon one another also. The author remarks that the evidence is very strong that the magnetic variations depend upon ionisation in the lower strata, and not upon any system of ionisation currents in the upper strata. The aperiodic variations are also studied, and the author infers that there is a marked tendency to correspondence with the rotation of the sun in 26.68 days; there is also a semi-annual change in the phenomena, and the author remarks that the problem of the solar radiation and its effects throughout the earth's atmosphere is an exceedingly complex phenomenon. He is not without hope that the development of meteorology and solar physics will eventually enable us to predict the seasonal climatic conditions likely to prevail during the coming year in the great agricultural regions of the earth. While his work is mainly of use as a reference book, it is highly original in character and aim, and should be found of great value to meteorologists.

Handbook of Instruction for Wireless Telegraphists. By J. C. Hawkhead and H. M. Dowsett. London: The Wireless Press, Ltd. Price 3s. 6d.

This is a second edition of Mr. Hawkhead's book, which has been taken in hand by Mr. Dowsett for revision and enlargement. A very marked improvement in the appearance, quality, and illustrations has been effected. With the exception of amplification in a number of places, and a much more complete description of the Marconi portable sets, the text remains of the same general standard. In Part II, covering the theory of waves, the faulty illustrations have been replaced and considerable revision has been effected in the text. Of the two or three additional illustrations, one gives an original conception of the shape of electric strain lines as they are stated to exist in the waves thrown off by an antenna. The object of this departure from the Hertz diagrams is not clear, and it is hardly a success. The sharply-pointed waves shown do not, of course, exist in reality.

While the information given is generally sound, it is hardly of the standard suited to high-class instruction, but will undoubtedly be valuable to operators using the Marconi apparatus. The latter appears to be the object of the work.

Examples in Alternating Currents. Vol. I. By Prof. F. E. Austin. From the Author, 11, South Park, Hanover, N.H., U.S.A. Price $2.40 (in America).

The first thing which strikes one about this book is that it is printed in green ink. Possibly some readers may like this; personally, we do not like it, and we find that it makes indices, subscripts, and small lettering on figures difficult to decipher. The next thing to strike one is the high price, but the cost of setting up mathematical matter is notoriously high, and the setting is done well in this instance, so we are prepared to forgive the rather high price, especially as the author is honest enough to say in his opening sentence that "one object of the book is to make money"! So many authors pretend to be philanthropists.

These initial prejudices vanish rapidly on a closer examination of the work, the scope of which is, perhaps, best explained to British engineers and students by saying that it gives a "pocket-book treatment" of alternating-current problems, the electrical principles involved by the latter, and the mathematical methods required for their solution. The treatment is sufficiently detailed to make the book readable and of value to students, as well as a work of reference for those wishing to refresh their memories on a particular point. Though there is, naturally, no particular "plot" in the book, its sections are arranged so that a student could start at the beginning and follow it right through intelligently. Previous knowledge of fundamental electrical matters and mathematical methods is, however, necessary unless the book is to be used as a class manual and supplemented by oral explanation. In this connection it should be particularly valuable.

The preliminary sections include a well-arranged collection of trigonometric formulæ, geometrical relationships, and clear rules for differentiation and integration. Good definitions of A.C. quantities are given, and there is a good treatment of the fundamental formulæ bearing on the generation of E.M.F. and of the constants and properties of sine curves. Instructive examples are given and supplemented by sufficient hints to make them really useful. A good deal of space is devoted to methods of determining the area under various curves, particularly as applied to A.C. problems, to addition and multiplication of sine forms, and so on. The student should be enabled by these pages to deal confidently with any problem concerned with wave form.

Inductance in straight conductors and in coils, impedances in series and in parallel, pure capacity, the properties of various arrangements of condensers, and the characteristics of A.C. circuits containing various mixtures of resistance, inductance, and capacity are all dealt with very clearly, frequent use being made of vector diagrams to supplement analytical results and methods. The author adopts different types of arrow heads to distinguish between pressure, current, admittance, and impedance; this device is successful where the vector diagrams are reasonably large. A series of tables at the end of the book gives values of $2\pi f$, for frequencies from 1 to 151 cycles, and corresponding values of $1/(2\pi f)$, $(2\pi f)^2$, and $1/(2\pi f)^2$. Here are also tables showing the capacities in farads necessary to neutralise inductance from 0.1 to 0.99 henry, and from 1 to 25 henries, and produce resonance at frequencies of 15, 25, 60, and 100 cycles. These and other special tables form a valuable feature, and it is a pity they are blemished by as many as 10 or 11 figures being given without any spaces to facilitate transcriptions.

The illustrations in the book are good, save that the lettering is generally much too small and is, consequently, illegible in some cases. On the other hand, there is an excellent index, and the arrangement of the text and mathematical matter is exceptionally clear. All the resources of the printer have been called upon to discriminate between main essentials and amplifications and examples. Revision seems to have been done very carefully, and we notice no misprints, though we cannot claim to have checked every calculation. One soon grows accustomed to the green ink, and the book is one which must be more appreciated the longer one has it in use. It should circulate freely amongst students, teachers, and practising engineers.

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Directions for Designing, Making, and Operating High-pressure Transformers. By Prof. F. E. AUSTIN. From the Author, 11, South Park, Hanover, N.H., U.S.A. Price 60 cents (*in* America).

This book gives quite a good treatment of the fundamental principles of transformer action and construction. The figures given after the introductory section are intended primarily to assist those who wish to build a step-up transformer, but the data are useful in helping those who study the subject without going in for practical work, to a better understanding of the principles of transformer design and operation. Transformer losses are dealt with at some length, data being given to enable the reader to calculate the losses in any particular case. Sections are devoted to power factor and transformation ratio, and the author then works through the chief steps in designing a 1-KW. transformer operating at 110/20,000 volts on 60-cycle supply; this is done fully so far as concerns the losses, weights of material, iron and copper sections, &c. Directions and data are then given for building a 3-KW., 110/20,000-volt, 60-cycle transformer; the instructions are so complete that the reader should have no difficulty in building any other small transformer of the same order of magnitude, and for about the same working pressures. The cost of materials for the transformer described is about £6 10s. A short section is devoted to oil-immersed transformers, and attention is, very properly, drawn to the precautions to be observed in working with step-up transformers. The author's statement that the transformer he describes will pass "enough (current) to kill a person several times," contains a little unintentional humour, but the warning is none the less convincing.

In the concluding sections of the book there are data relating to a 4,000-volt transformer, a discussion of the use of transformers as frequency changers, notes on obtaining unity power factor by the use of condensers, and notes on connecting primary coils to produce different secondary pressures. The book is interesting and instructive.

The Practical Design of Steel-framed Sheds. By ALBERT SPENCER. London: Constable & Co., Ltd. Price 10s. 6d. net.

The war has caused the springing up of an unprecedented demand for steel-framed sheds, such structures being needed all over the country in connection with the production of munitions. According to Mr. Spencer's calculations, it would seem likely that in many cases such sheds are unskilfully designed. In fact, his complaint is that owing to the designing of sheds being left almost entirely to the manufacturers of such structures, who are often working on a severely competitive basis, many designs are open to serious objection on the score of capability to withstand all stresses with a good factor of safety. The trouble, the author is convinced, lies mainly in the fact that in most treatises on this subject, and also in the instruction provided at our technical colleges, too much attention is devoted to the design of the various units without proper regard to the structure as a whole. He, therefore, presents, in a clear and coherent manner, methods which, if adopted, should greatly facilitate the practical design of trustworthy shed framework and foundations. An intimate knowledge of the theory of structures and of practical designing is assumed to be already in the possession of the reader, and, given this, a student on the subject should find much food for thought in Mr. Spencer's calculations.—G. S. S.

NEW COMPANIES REGISTERED.

Harlesden Lamp Co., Ltd. (143,701).—This company was registered on April 26th, with a share capital of £10,000 in 9,800 pref. shares of £1 each and 4,000 ord. shares of 1s. each, to acquire and turn to account any invention relating to electric and other lamps, or any lenses, reflectors, or other component parts or accessories for use in connection therewith, to carry on the business of manufacturers and repairers of, and dealers in, electric lamps, reflectors, lenses, or other articles, electricians, opticians, glass-blowers, &c., and to adopt an agreement with C. B. Leake. The subscribers (with one pref. share each) are: C. B. Leake, Red House, Harefield, Middlesex, gentleman; J. M. Longe, St. Margaret's, Hallowell Road, Northwood, Middlesex, gentleman. Private company. The number of directors is not to be less than two or more than five; the first are C. B. Leake and J. M. Longe. Qualification (except first directors), 500 shares. Remuneration, £200 per annum, divisible. Solicitor: W. E. Craigen, Cromwell House, Fulwood Place, Holborn, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

W. E. Dove & Co., Ltd. (72,630).—Capital, £3,500 in £10 shares. Return dated March 13th, 1916. 320 shares taken up; £2,000 paid; £1,200 considered as paid. Mortgages and charges: £1,100.

Carville Site & Power Co., Ltd.—Issue on April 20th, 1916, of £10,000 debs., part of a series of which particulars have already been filed.

CITY NOTES.

German Electrical Companies.

The Deutsch-Atlantische Telegraphen Gesellschaft proposes to pay a dividend of 6 per cent. for 1915, as contrasted with 6½ per cent. in the previous year.

The Osteuropaische Telegraphen Gesellschaft, of Cologne, which owns the cable between Constantza and Constantinople, records net profits of £15,600 for 1915, as contrasted with £12,300 in the preceding year, when a dividend of 7 per cent. was paid on the share capital of £50,000. The method of disposing of the profits available for 1915 is not disclosed.

The report for 1915 of the *Welter Elektrizitats und Heberzeug Werke, of Cologne,* states that activity became greater and more uniform on the completion of the changes in working for the execution of Army contracts, and the company was also well occupied on the construction of lifting plant. The net profits of £3,300 permit of the payment of a dividend of 5 per cent., this result contrasting with a loss in the previous year.

The report of *Gebr. Korting A.G., of Linden,* states that the company was able to deal with the increasing requirements for electrical machinery in 1915. No information was forthcoming in regard to the subsidiary companies in enemy countries, but the turnover in Austria-Hungary expanded considerably. The gross profits advanced from £147,000 in 1914 to £253,000 last year, and the net profits from £37,000 to £112,000 in the two years respectively. It is intended to pay a dividend of 10 per cent. on ordinary share capital of £950,000, as compared with no distribution in 1914 and 8 per cent. in 1913.

The Elektrochemische Werke, of Bitterfeld, most of whose installations and plant at Rheinfelden and Bitterfeld are leased to the Griesheim-Elektron Chemical Works, of Frankfort-on-Main, report gross profits amounting to £87,000 for 1915, as compared with £86,000 in 1914. Including the balance brought forward, the net profits are returned at £62,500, as against £62,100, and the dividend on the share capital of £275,000 is 10 per cent., as in the previous year. The share capital has been increased to £350,000, and is held entirely by the Zurich Bank for Electrical Undertakings.

The Gesellschaft fur Elektrische Unternehmungen, of Berlin, which is an investment company having a share capital of £3,000,000, and loans amounting to £1,997,000, states that the considerable interests held in enemy countries resulted in a reduction of £90,000 in the profits realised from dividends and interest in 1915, which was only partly equalised by profits of £40,000 resulting from sales of securities. The net profits and balance forward declined from £266,000 in 1914 to £216,000 last year, although the dividend is maintained at 6 per cent. for 1915, as in the previous year, whereas the rate in 1913 was 10 per cent.

The directors of the *Hamburg Hochbahn A.G.* report that the branch line to Rotenburgsort was handed over to the company by the Hamburg State on May 21st, 1915, and on that day the 40 years' concession commenced for the working of the circle line and the three branches to Eimsbuttal, Ohlsdorf, and Rotenburgsort. The electrical equipment of the last-mentioned line was accelerated, and the service started about the end of July. During the first four months of 1915 troops comprising 2,200,000 were carried free of charge, whilst the paying passengers transported numbered 35,800,000 in the whole year, as compared with 36,480,000 and 39,000,000 in the two previous years respectively. After meeting interest charges and placing £27,000 to the renewal fund, as against £28,000 in 1914, the accounts show a loss of £900, as contrasted with net profits of £32,000, and a dividend of 4 per cent. in 1914 and 5½ per cent. in 1913.

The report of *Voigt & Haeffner A.G., of Frankfort-on-Main,* states that the company was engaged during the whole of 1915 on the manufacture of parts of munitions, although the production of the customary peace articles was maintained to a satisfactory extent. Neutral countries were much larger purchasers than in former years, partly influenced by the favourable rate of exchange. It was possible to find substitutes for the requisitioned metals in materials produced in the country in the case of many classes of manufactures turned out, and the delivery of these materials was so much facilitated that the company was able to secure a satisfactory turnover towards the end of the year, particularly in products made in bulk. The net profits were £97,000, as against £49,000 in 1914, and a dividend of 12 per cent. has been declared on share capital of £250,000, as contrasted with 8 per cent. in 1914.

West London & Provincial Electric Supply Co., Ltd.—The credit balance for 1915 is £3,038, and after paying 6 per cent. on the cum. pref. shares the balance is to be carried forward.

Chiswick Electricity Supply Co., Ltd.—After paying debenture stock interest, a dividend of 5 per cent. for 1915 is to be paid, carrying £435 to depreciation reserve fund account.

Calcutta Electric Supply Corporation, Ltd.—The units sold during the five weeks ended March 31st were 2,122,507, compared with 1,579,169 units in 1915.

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Austrian Electrical Companies.

The Elektrizitats A.G. (late Kolben), of Prague, has decided to pay a dividend of 9 per cent. out of net profits of £52,000 in 1915, as compared with 7 per cent. and £38,000 respectively in 1914.

The Kabelfabrik und Draht Industrie A.G., of Vienna, reports gross profits of £124,000 for 1915, and net profits of £56,000, as compared with £43,000 in the preceding year. It is proposed to pay a dividend of 12 per cent., as against 10 per cent. in 1914.

The accounts of the *Kabelfabrik A.G., of Pressburg*, which has a community of interests with the before-mentioned Kabelfabrik, of Vienna, show net profits amounting to £31,000 for 1915, as contrasted with £24,000 in the previous year. The rate of dividend is 12 per cent., being an increase of 2 per cent. over 1914.

The accounts of *Felten & Guilleaume, of Pesth*, show net profits amounting to £20,000 for 1915, as compared with £17,900 in the preceding year. It is intended to distribute 12½ per cent., as against 10 per cent. in 1914. The directors' report states that the works are satisfactorily employed, chiefly on orders for the Army and Navy.

Swiss Electrical Companies.

The Elektrizitats Gesellschaft Alioth, of Basle, which two years ago transferred its manufacturing departments to another company, and then became purely an investment undertaking, reports gross profits of £17,000 for 1915, as against £14,000 in 1914, and net profits of £13,000 and £11,000 in the two years respectively. It is proposed to pay a dividend of 5 per cent. on the ordinary share capital of £240,000, as contrasted with 4 per cent. in 1914.

The Société Franco-Suisse pour l'Industrie Electrique, of Geneva, which is in close association with the group of the Banque de Paris, is unable to pay any dividend for 1915, as also was the case for the previous year, on the ordinary share capital of £1,000,000. The company is interested in railways and tramways, hydro-electric works, and electro-metallurgical undertakings, all of which are situated outside the war area. After meeting the interest service on the loans, amounting to £898,000, the accounts show net profits of £16,000, as against £4,600 in 1914. Most of the profit has been carried forward.

Johnson and Phillips, Ltd.

MR. R. W. BLACKWELL, presiding on April 27th at the annual meeting, referred to the improvement in the accounts, which showed a trading profit of £69,077. In regard to the dividend of 5 per cent., free of tax, on the ordinary shares, he said that the conditions under which the business must be carried on for a considerable period to come did not admit of a larger distribution. They must carry very heavy stocks of material to meet the requirements of the Government. The position of the company was thoroughly sound and steadily improving. During 1915 they had spent on additions to buildings and plant £8,414. They had good reason, under existing conditions, to be satisfied with both the present position and the future prospects of the concern. So long as the war endured, it was more than probable that a large part of their plant would run at full pressure, but a considerable proportion of their machinery and plant which was not susceptible of adaptation to the present requirements might have to lie idle until normal conditions were again reached. He did not believe that their company had been either advantaged or injured financially by the war to any special extent. Their turnover might be somewhat higher than they might reasonably have expected, but the difficulties of doing business, prices and costs of all kinds, had greatly increased, and their margin of net profit decreased. A part of the new machinery that they had built would be of real utility to them when the demand for war material no longer existed. They proposed to continue in their endeavour to bring every part of the works and plant up to the best modern standard. Their stocks, though large, as they must necessarily be in these days, when there were great difficulties in securing material, had been well bought, and stood in the accounts at a safe figure. The chairman laid stress upon the fact that in the present abnormal state of all business the command of ready money was a first essential to the business of the concern. However quickly they might be paid for their goods when finished and delivered, the fact remained that they must buy their material well ahead, and on practically cash terms, and must carry its cost, plus labour charges, for the period of manufacture—say, an average of at least three months on every order received. The comparatively small dividend and the substantial carry-forward that they recommended were most advisable in view of the conditions under which their business must necessarily be carried on for an indefinite, but certainly a considerable, period.

Bath Electric Tramways, Ltd.

SIR J. SIVEWRIGHT presided on April 27th at the annual meeting. He said that 1915 could not fairly be compared with any other year. The traffic and other receipts showed a decrease of £5,558. The decrease, however, was largely attributable to the reduction of the company's motors in the latter part of 1914, when a large number of them were transferred to the Government for military service. Economies in operation and in the expenses of the company more than offset the diminution in receipts, so that they had actually a greater net revenue for 1915 than they had in 1914. The foundry belonging to the company had been engaged on most useful work, and continued to give capital results. Operating, as they had been, for the whole of the year 1915 without a large part of their torpedo fleet, the results compared most favourably with those of the previous twelve months, for nine months of which they were working the whole of their torpedo cars. In 1915 the weather during the spring and summer was very unfavourable, but there was a decided improvement in the autumn, and of this the company felt the benefit. A lot of money had again been spent in repairs and renewals, and everything had been kept in good order. He did not refer merely to replacements or repairs such as were done annually; what had been carried out would last for many years. The company was in a position not only to pay its debenture interest and preference dividend, as well as to redeem debentures, but also to pay something off the loan from the Union of London & Smiths Bank, which had been very substantially reduced. Originally it was £28,000, and it had now been brought down to £16,000, and, although the shareholders had had to forego that £12,000, the value of their shares was improved to that extent. There was a promising future before the company, and if they pursued their present policy they would have an improved fleet and their foundry would be extended. Mr. A. A. C. SWINTON seconded the adoption of the report, which was carried.

Western Electric Co., U.S.A.

The annual report of the Western Electric Co., Inc., which is in effect a reorganisation of the Western Electric Co., of Illinois, covers the operations of both the Illinois and the New York companies during the year 1915, thus giving the results of the continuing business without attempting to segregate that part which pertains only to the operations of the new company. The sales for 1915, the report states, were $63,852,000, as compared with $66,408,000 for 1914 and $77,533,000 for 1913. "During the latter part of the year, however," says President H. B. THAYER, "there was an increasing demand for our products, and the present prospects indicate a fair volume of business in 1916, following the general business activity of the country. The costs of our raw material have been very much inflated by the demand for similar material by manufacturers of war munitions or by interrupted supplies of such as usually come from abroad, which continually reminds us that the general business activity is largely founded upon the abnormal conditions abroad. These higher costs materially affect the costs of our manufactures, and when the return to normal conditions comes we may expect a considerable shrinkage in the value of such materials as we may have in stock at that time." The orders on hand, the report goes on to say, on January 1st, 1916, were $2,111,000 in value more than on January 1st, 1915. The average value of an order filled during 1915 was $55, as compared with $56 for 1914. The number of employés on January 1st, 1916, was 17,135, as compared with 15,650 on January 1st, 1915.—*Electrical World.*

North of Scotland Electric Light and Power Co., Ltd.

Considering the conditions, satisfactory progress was made in 1915. Lamp connections in Montrose increased from 1,114 KW. to 1,163 KW.; in Brechin from 738 KW. to 776 KW.; and in Inverness from 1,286 KW. to 1,452 KW., making a total of 3,391 KW. connected in the three towns. The gross profit, including £2,420 brought forward, is £9,458, and after meeting interest on debentures and loans amounting to £2,856, and writing off £57 from suspense account, a net profit of £6,546 remains. A dividend at the rate of 3 per cent. for 1915 is recommended, absorbing £1,500, £2,000 is to be placed to renewal reserve, £1,000 to general reserve, and £2,046 carried forward.

Babcock and Wilcox, Ltd.

The net profit for 1915 was £396,551, plus £69,492 brought forward. After paying dividends of 6 per cent. on the preference and 5 per cent. on the second preference shares for the year, 9 per cent. is to be paid on the ordinary for the past half-year, in addition to the interim dividend of 6 per cent. already paid; £150,000 is to be placed to reserve, and £10,000 to the staff pension fund, leaving £42,125 to be carried forward. The business has been a controlled establishment since August last. Additional premises were acquired during the year adjoining the Renfrew works, and other extensions have also been carried out. The company is, and has been, short of men, and is now introducing female labour in some departments. A large proportion of the staff joined the Forces, but the extra demands made on those remaining have been met with a spirit of enthusiasm. The company continued to contribute to the maintenance of dependents of the staff with the Forces. Annual meeting: May 9th.

Calcutta Electric Supply Corporation, Ltd.

During last year 21,081,928 units were sold, compared with 15,387,471 in 1914. The number of houses connected was 8,768, an increase of 588. The gross revenue was £224,206, as against £202,455 for 1914. The net revenue was £162,922 (as against £140,609 for 1914), calculating the exchange at 1s. 4d. per rupee. Adding the balance brought forward and interest received on money at deposit, the total is £176,602. After paying the interim dividend of 3½ per cent., actual, paid on the ordinary shares in November, 1915, the dividends paid and accrued on the preference shares, and the other

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items in the net revenue account, the available balance is £122,177. £52,000 is to be placed to the credit of the depreciation and renewals account, £10,000 to the reserve fund, and a final dividend at the rate of 5¼ per cent. actual is recommended, making 9 per cent. for the year, leaving £30,000 to be carried forward after providing for the directors' extra remuneration of £2,500, and a bonus of £1,629 payable to the staff in India. The reserve for depreciation and renewals will thus be increased to £229,444, and the reserve fund, with the addition of £2,184 from dividends on investments, will stand at £126,704. The expenditure on capital account during the year amounted to £122,344, making the total outlay £1,380,827. The demand for electrical energy continues to increase steadily, and the result of the working for the year must be considered satisfactory. Units generated, 27,573,446; public lamps units sold, 476,373; sold by special contract, 613,271; lighting units by meter, 4,371,865; power units by meter, 15,620,419; used on works, 5,295,156; not accounted for, 1,196,362. Annual meeting: May 10th.

Consolidated Diesel Engine Manufacturers, Ltd.

The *Financial Times* states that another half-yearly statement by the liquidator has just been issued, bringing the record of the accounts up to January 6th last. In the interval the whole of the unsecured creditors have been paid off, leaving a balance of £52,800 in hand, so that the contributories are likely to receive a small portion of their capital back, but it would appear that there are still some uncompleted contracts in hand, and the cost of these may have to be set against the value of the remaining assets. "The liquidation has now reached the unprofitable stage, and the sooner that it is finally closed the better. For the six months the costs and charges amounted to £3,200, while the total receipts were only £1,700, so that there was a loss of £1,500. The collection of book debts has been particularly disappointing, only £10,400 having been yet got in out of £28,100 marked 'good' in the secretary's original statement, to say nothing of £69,300 scheduled as 'doubtful.' How far the war is responsible for this it is impossible to say, but we are afraid that not much value can now be attached to the company's Belgian interests."

Puebla Tramway, Light, and Power Co., Ltd.

The report for 1914 states (says the *Financial Times*) that the net profit in Mexico amounted to $692,499 Mex., as compared with $736,952 for 1913. Reckoning the earnings at the parity of exchange there is a debit balance—after charging all expenses, bond interest and first mortgage bond sinking fund—of £17,154, but owing to the heavy loss on exchange, which amounted to £42,996, the final result is a debit balance of £60,150. The average exchange was 13.78d., as against 24.5841d. par value and 21d. in 1913. At the date of this report the value of the peso is about 2d. The transmission line to Vera Cruz was completed and power delivered to that city at the end of the year, and commencing with January, 1915, a regular supply of power has been given to the Vera Cruz Electric Light, Power & Traction under contract. Except for a small amount of damage done by bandits from time to time and considerable thefts of copper, the company's properties remain intact. Owing, however, to the difficulty of operating the plants at Portezuelo and San Agustin, in face of continued interferences, these were closed in August, 1914, and the Tuxpango plant has since borne the entire load of the company's output. The business has suffered during the year on account of a large number of factories having been destroyed or closed down. Owing to the disturbed conditions of trade and the heavy fall in the exchange value of the Mexican dollar a meeting of the first mortgage bondholders was convened and duly held on July 30th last, when a resolution was passed sanctioning a modification of the rights of the bondholders.

Oriental Telephone and Electric Co., Ltd.

SIR GEO. FRANKLIN presided at the annual meeting on April 26th. He said that one of their colleagues, Capt. Akers, was in France on military service. After explaining the sources from which the company derived its income, he said that the gross revenue from subscriptions, rentals, and sales was £55,336, an increase of £3,605, which was due mainly to development in Madras, Mauritius, and Singapore. Dividends and interest from subsidiary companies, £33,429, showed an increase of £1,696, due to larger dividends from the Bombay and China and Japan companies. The Bombay Co. now paid 20 per cent., and the China & Japan Co. 10 per cent. The working expenses amounted to £28,870, plus £9,656 for London expenses, which had been largely increased by heavier income-tax and excess profits duty. In regard to the charge of £5,500 against revenue for depreciation of securities, it was necessary to write off that amount in order to bring their War Loan and Cape stock well within the market prices on December 31st last. The balance to the credit of net revenue account was £61,957. With reference to the transfer to reserve, it should be borne in mind that telephone plant in tropical or semi-tropical countries was peculiarly liable to depreciation, not merely from ordinary wear and tear, but from other causes, such as the substitution of underground for overhead construction, developments in the art, typhoon storms, and many other contingencies of that kind. With regard to the Telephone Co. of Egypt, controlled by the Oriental Co., they had recently sent their consulting engineers to make a very careful investigation, and to report as to the state of the plant, &c., and its value. They hoped, also, to get much useful advice for the carrying on of the business. With the figures and the information which they hoped to get in that way they would have conclusive evidence as to the value of their plant and property, which they conceived to be very necessary at this time. Having done that with regard to Egypt, it might be necessary to extend it a little further, and to consider how far it was desirable to gain similar information as to the value of their plant, and the best means of developing other parts of the company's systems. While he did not want to commit the board to anything more than that, then, the shareholders would see the bearing that this had upon several questions which might arise out of what he was going to say. With regard to the Oriental Co., they were proposing to earmark, for the first time, £40,000 to the reserve fund for depreciation, and whereas last year they had a carry-forward of some £56,000, they were only proposing to-day to carry forward £15,000. But they were transferring £70,000 to a reserve fund account. The question as to how much, if any, of the £70,000 was profit, depended upon the investigation they were proposing to make. That investigation would enable them, first of all, to see whether their assets were worth the balance-sheet figures—the capital which had been expended on lines, exchange equipment, and telephone plant. He need hardly explain the absolute necessity of keeping the company strong and safe. One of the first things, and the last, which a telephone company wanted was new capital. It was the breath of life to it. Without new capital they were unable to take advantage of opportunities of development which were of vital importance. These were not times when they could get Treasury sanction to increases of capital. The first thing, then, was to see that the value of the assets was sound. Secondly, it would be for them to consider how far, if at all, there might be any probable distribution from this source. He referred to the difficulty which would be created if they were to deplete themselves of cash in order to make any distribution of that kind. The stores on hand and in transit had increased to £45,512 during the past year, largely due to £17,000 which was in cables for Singapore and Madras in transit on December 31st last. They had learned since that the cabling work in those two places was proceeding satisfactorily and would enable the company to meet the development from time to time. With regard to their subsidiary companies, the figures in each case showed good progress. The Telephone Co. of Egypt grew in strength and continued to pay its 10 per cent. dividend. The circumstances of the war had cast upon the company considerable responsibilities in the construction of lines for the service of the military. In Hong-Kong and Kowloon the China and Japan Co. had made good progress, the gross revenue being increased by £3,400. The Bengal and Bombay companies had each shown satisfactory development, though their figures were also somewhat affected by the war.

Anglo-American Telegraph Co., Ltd.—The three quarterly dividends on the ordinary and preference stocks paid in May, July, and November, 1915, absorbed £157,500, and including the final dividends paid in February, absorbed £262,500, being the rent paid by the Western Union Telegraph Co. for the year, equal to 3¾ per cent. on the ordinary stock, 6 per cent. on the preferred stock, and 1¼ per cent. on the deferred stock. A bonus of 1s. 9d. per cent. on the ordinary and 3s. 6d. on the deferred stock was paid on February 1st, 1916. The balance at credit of revenue account, £67,153, includes £1,528 interest received, and the balance of £65,625 is available for dividends for the quarter to March 31st. Annual meeting: May 5th.

City Electric Light Co., Ltd. (Brisbane).—For the year ended January 31st, 1916, the credit balance is £20,133, after making additions to the franchise and purchase sinking fund, and renewal, replacement and contingencies account, and allowing for depreciation. An interim dividend was paid last September absorbing £8,987, and a further 3 per cent. has been paid on the preference shares, 5 per cent. on the ordinary, and 5 per cent. on the contributing shares; these payments, together with the dividend duty and an allowance for Federal income-tax, will absorb £10,892, leaving £1,569 to be carried forward.

A. Reyrolle & Co., Ltd.—The accounts for 1915 show a profit, after providing for depreciation, &c., of £11,853, there being an available sum, including £2,843 brought forward, of £14,696. Dividends of 13¼ per cent. on the preference shares and 18¾ per cent. on the ordinary shares have been declared, £5,000 being placed to reserve for general purposes and £3,396 carried forward.—*Financial Times.*

Alderley & Wilmslow Electric Supply, Ltd.—During 1915 the total lamp connections increased from 1,036 KW. to 1,092 KW. There is a profit of £3,064, plus £1,042 brought forward, and after paying £1,665 interest on debentures and loans, £2,442 remains, of which £1,200 is to be put to reserve fund and £1,242 carried forward.

Metropolitan Electric Supply Co., Ltd.—The ordinary general meeting which was adjourned until May 2nd or such later date as the committee might agree, will be held at a later date.

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Indian Electric Supply & Traction Co., Ltd.—The surplus on working in Cawnpore during 1915, including £144 for interest accrued, was £15,932 (against £12,724 in 1914), and including further interest in England and transfer fees, the credit side of net revenue account shows a total of £15,992. London expenditure was £1,688 (against £1,537 in 1914), and after providing £3,900 for debenture interest a net profit of £10,264 is shown, plus £717 brought forward. Out of this, £2,000 has been placed to general reserve, £3,000 to reserve for depreciation and renewals, and £500 against expenses of the debenture issue. A final dividend of 3½ per cent., making 6 per cent. for the year, is recommended, absorbing £4,681, and £800 is to be carried forward. Annual meeting: May 5th.

Tramways & General Works Co., Ltd.—Including the balance brought forward, the amount now standing to the credit of the profit and loss account is £540, out of which the directors recommend the payment of a dividend at the rate of 4d. per share (less income tax), absorbing £333, and leaving £206 to be carried forward.

City of Buenos Aires Tramways (1904), Ltd.—A dividend of 1s. 3d. per share (at the rate of 5 per cent. per annum), less tax, for the three months ended March 31st is announced.

STOCKS AND SHARES.

TUESDAY EVENING.

Collapse of the Irish "rebellion" has done something to help the sentiment in the Stock Exchange, and with no more holidays in sight until Whitsun, markets should be able to settle down in earnest to such work as they can find. Business in securities may be affected to no small extent by that call to the Derby Groups which comes into operation at the end of the present month, but the Stock Exchange is not meeting difficulties half-way, and the future is left to look after itself.

Meanwhile, the pronounced strength of all issues connected with the cable industry is still the outstanding feature of the markets dealt with here, and to this must be added a readiness on the part of the public to buy most of the "chemical" shares. These last are being taken principally by Liverpool and certain of the manufacturing towns in the North, where the investor is eager for the offer of shares in companies of which Castner-Kellner may be taken as a fair example.

Continued strength is shown by the electricity supply shares. City preference and County preference are both ¼ better at 10½, though City "Lights" are ¼ easier at 11¼. There is still a demand for other good-class shares in this market, and, as we have pointed out before, comparatively little supply. A somewhat sensational rise is one of 12s. 6d. in Edison & Swan fully-paid shares, the price jumping to 1¼ upon persistent buying—or demand, rather, inasmuch as there have been few on offer and holders are by no means anxious to sell. The partly-paid rose 3s. to 12s. in sympathy. The market seems rather puzzled to account for advances so violent as these, but the buying proceeds from sources which should certainly know what they are about.

Babcock & Wilcox are firm at 2¾ bid, on the issue of the report. The raising of the dividend by 1 per cent. to 15 per cent. does not look a particularly brilliant achievement, but it has to be remembered that the distribution is made free of tax, and consequently the yield is higher than it appears. The company's net profit was actually £6,000 smaller than that for the previous year, the whole of this, and more, being due to increase in income-tax, for the gross profit showed an advance of £13,300. Castner-Kellners are better, in company with most of the chemical shares; and British Westinghouse preference hardened to 2¼. There is no quotable change amongst cable manufacturing shares, but the market is a good one.

Eastern Telegraph ordinary gained 1½, and small rises are shown by several of the other principal shares in this section. Marconis are dull, the recent bout of buying coming to an end somewhat abruptly. American Marconis are quiet at about 15s., while Canadians are 8s. 3d.

Latin-Canadian companies are doing well. The last published accounts show that satisfactory increases in earnings over the corresponding months in 1915 were secured by the Brazilian Traction, the Consolidated Gas and Electric Light, of Baltimore, and the Power companies of the Missippippi River, the Shawinigan and the Pennsylvania. From the market point of view, however, April was quiet, but there was a slight appreciation in prices on balance.

Within the past few business days has come a faint improvement in some of the Mexican prices, marked more in the railway departments than amongst utilities. The bonds of the Mexican Light & Power, and the Mexico Tramways are still all but unsaleable, though railway stocks have hardened in consequence of a jump in the price of silver that has taken it higher than it has stood for about a quarter of a century. The political situation in Mexico is little or no better, but if this were to take one of its unexpected turns—it could hardly be for the worse—Mexican utilities might make a vivid recovery. Seeing that the leading issues have suffered losses ranging from 20 to 45 points since the outbreak of war, there is at least scope for reaction, even when the succession of blows at the companies is remembered and appreciated. The period for deposit of the bonds in the Mexico Tramways Group of Companies has just been extended until the end of June.

Brazil Tractions are a point higher on the week at 56¼. Other Latin-Canadians are good. New York has got over its recent fit of apprehension with reference to the diplomatic situation between the States and Germany, and, furthermore, manages to extract some degree of confidence from the reported refusal of Washington to withdraw the American troops from Mexico at the instance of the Carranzist party.

Home Railway stocks dropped back into lethargy, for which the Irish situation was held to be responsible. Unfortunately, the market made no particular recovery upon the surrender of the rioters. It is jocularly suggested that the sudden inrush of summer weather may have something to do with the cessation of buying orders in Underground Railway stocks. These issues are all easier, Metropolitans being the principal losers. Business in the group as a whole is quiet.

Rubber shares, moreover, are much less active. The price of the raw stuff has gone back to the near neighbourhood of 3s per lb., and while such a factor would have weighed but little in an active market, it assumes importance when the upward movement shows signs of slackening. Armament shares hold their positions fairly steadily. Coppers are somewhat erratic, and in most of the other base-metal shares—silver alone excepted—the prevailing tendency leans towards dulness and rather lower values.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend 1914.	Dividend 1915.	Price May 2, 1916.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	6¾	—	£7 8 8
Charing Cross Ordinary	5	5	8¼	—	7 12 10
do. do. 4½ Pref.	4½	4½	8¼	—	6 18 6
Chelsea	5	4	7¼	—	6 8 1
City of London	9	8	11¼	—	6 14 9
do. do. 6 per cent. Pref.	6	6	10½	+ ¼	5 14 3
County of London	7	7	10½	—	6 16 4
do. 6 per cent. Pref.	6	6	10½	+ ¼	5 14 3
Kensington Ordinary	9	7	5	—	7 0 3
London Electric	4	3	1½	—	7 6 4
do. do. 6 per cent. Pref.	6	6	4¼	—	7 1 2
Metropolitan	8½	8	2⅞	—	6 6 4
do. 4½ per cent. Pref.	4½	4½	3	—	7 10 8
St. James' and Pall Mall	10	8	6	—	6 13 4
South London	5	5	2¾	—	6 13 4
South Metropolitan Pref.	7	7	1⅞	—	8 13 10
Westminster Ordinary	9	7	6	—	6 14 8

TELEGRAPHS AND TELEPHONES.

	Dividend, 1914.			
Anglo-Am. Tel. Pref.	6	98 xd	—	£6 2 3
do. Def.	33/6	21½	—	7 18 6
Chile Telephone	8	6⅞	— ⅛	6 8 0
Cuba Sub. Ord.	5	7⅜	—	6 9 6
Eastern Extension	7	14½	—	*5 12 4
Eastern Tel. Ord.	7	144	+1½	*5 11 1
Globe Tel. and T. Ord.	6	11⅜	+ ⅛	*5 8 4
do. Pref.	6	10½	+ ⅛	5 17 5
Great Northern Tel.	22	35½	—	6 4 3
Indo-European	18	50 xd	—	6 10 0
Marconi	5	2⅜	+ ⅛	4 14 4
New York Tel. 4½	4½	100⅜	—	4 9 4
Oriental Telephone Ord.	10	13	—	5 6 8
United R. Plate Tel.	8	6	—	*5 13 4
West India and Pan.	1	1⅛	—	9 1 10
Western Telegraph	7	14½	—	*5 13 4

HOME RAILS.

Central London, Ord. Assented	4	67½	— ¼	£5 18 6
Metropolitan	1½	25¼	— 1½	5 18 6
do. District	Nil	18⅜	— ⅜	Nil
Underground Electric Ordinary	Nil	1⅜	—	Nil
do. do. "A"	Nil	5/6	—6d.	Nil
do. do. Income	6	85½	—1½	*7 0 9

FOREIGN TRAMS, &c.

Adelaide Sup. 6 per cent. Pref.	6	4⅞	—	£6 3 1
Anglo-Arg. Trams, First Pref.	5½	8¼	—	7 6 8
do. 2nd Pref.	5½	6⅜	—	8 3 0
do. 5 Deb.	5	78	—	6 8 2
Brazil Tractions	4	56¼ xd	+ 1	7 1 7
Bombay Electric Pref.	6	10½	—	5 17 3
British Columbia Elec. Rly. Pfce.	5	53	—	9 8 6
do. do. Preferred	—	37	—	Nil
do. do. Deferred	—	33	—	Nil
do. do. Deb.	4½	62	—	6 17 1
Mexico Trams 5 per cent. Bonds	—	40	—	Nil
do. 6 per cent. Bonds	—	32	—	Nil
Mexican Light Common	Nil	20	—	Nil
do. Pref.	Nil	33	—	Nil
do. 1st Bonds	—	39	—	—

MANUFACTURING COMPANIES.

Babcock & Wilcox	14	2¾	—	£5 9 1
British Aluminium Ord.	5	22/- xd	—	6 7 3
British Insulated Ord.	15	10½	—	7 2 10
British Westinghouse Pref.	7½	2¼	+ ⅛	7 1 2
Callenders	15	11½	—	6 10 6
do. 5 Pref.	5	4¼	—	5 17 6
Castner-Kellner	20	2⅜	+ ⅛	6 1 3
Edison & Swan, £3 paid	Nil	12/-	+2/-	NM
do. do. fully paid	Nil	1⅜	+ ⅛	NM
do. do. 5 per cent. Deb.	5	57	—	£5 15 8
Electric Construction	6	16/-	—	7 10 0
Gen. Elec. Pref.	6	9⅜	—	6 4 8
Henley	20	14½	—	*6 15 0
do. 4½ Pref.	4½	4	—	5 12 6
India-Rubber	10	10	—	*10 0 0
Telegraph Con.	20	35½	—	*6 18 4

* Dividends paid free of income-tax.

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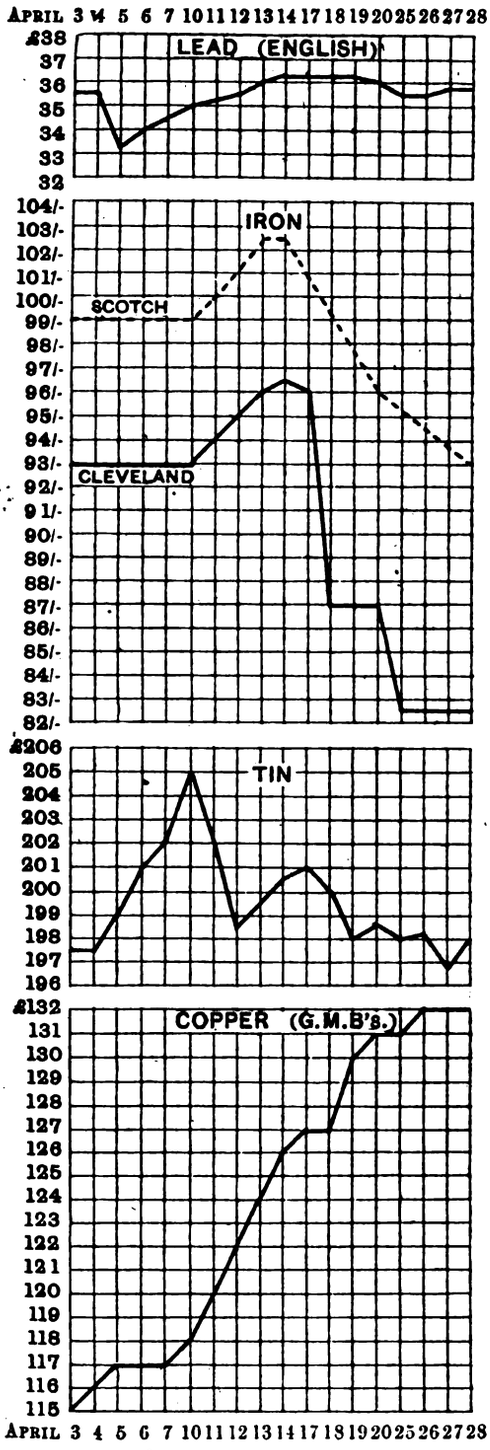
METAL MARKET.

Fluctuations in April.



The Metric System.—The secretary of the Decimal Association is informed by correspondents in the U.S.A. that at the opening of the present session of Congress, a Bill was introduced by Mr. C. H. Dillon, making the metric system of weights and measures permissive till July, 1920, after which date it is to be compulsory and exclusive. This Bill is being considered in Committee, and the members are reported to be much impressed with the facts that domestic business would be greatly facilitated by the more scientific system, and that commerce with all parts of the world, and especially with South America, would be sensibly promoted if a metric basis were accepted. It is evident, therefore, that the advantages to be gained from the adoption of the metric weights and measures are being fully considered in the U.S.A., and that we shall have to face serious competition and be more severely handicapped than ever if we remain the only civilised nation which has not adopted metric weights and measures and a decimal system of coinage. The change in the U.S.A. should be made more easily than in this country, as the people there are already accustomed to think in decimals.

Judging from the editorial comments of the *American Machinist*, many manufacturers object to the proposed reform, which carries with it punishment by fine or imprisonment for the use of weights and measures other than metric after July 1st, 1924.

THE LJUNGSTRÖM TURBINE AND ITS APPLICATION TO MARINE PROPULSION.

By ROLAND S. PORTHAM.

(*Abstract of paper read before the* Institution of Engineers and Shipbuilders in Scotland.)

Early in 1913, the favourable results achieved by the turbine associated with his name led Mr. Birger Ljungström, of Stockholm, in conjunction with his brother—Mr. Frederick Ljungström—to consider the question of electrical propulsion for commercial vessels. The pioneer ship, the *Mjölner*, of 900 s.h.p., with two generating units, each of 450 s.h.p., has been running since December, 1914, and the fuel consumption under the same conditions of deadweight, speed, and coal has averaged 38.6 per cent. less than that of her sister ship, the *Mimer*, fitted with triple-expansion reciprocating engines.

Messrs. Ljungström recognised that an important feature in marine propulsion was that the generating plant should be subdivided into at least two entirely independent units, so that either set could drive the ship at about three-quarters speed, running under relatively economical conditions. Naturally, this subdivision of power, though conducing to maximum reliability at sea, necessitates an efficient, light, and accessible turbine.

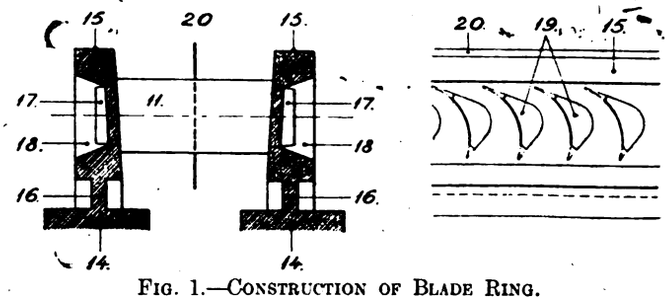


Fig. 1.—Construction of Blade Ring.

In 1907, Messrs. Ljungström came to the conclusion that the pure reaction principle offered certain advantages over the impulse type, more especially for turbines of larger output. The drawback, however, in the reaction system was the large number of rings and blades, involving a correspondingly long rotor to ensure a reasonable efficiency, and the attendant tendency to distortion of casing with varying temperatures, necessitating considerable tip clearances and corresponding leakages.

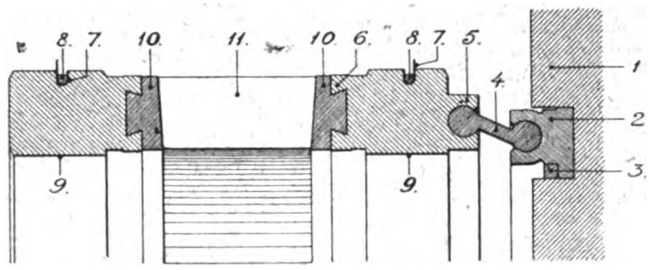


Fig. 2.—Section of Blade Ring.

With a view to reducing such excessive length, Messrs. Ljungström, experimented on various widths of blades, and found that these could be reduced to 5 mm. in the high-pressure end and to 17 mm. in the low-pressure end without affecting the efficiency. They realised, however, that shortening the turbine axially did not solve the problem of so adjusting the passage of steam through the blading as to allow it to follow its natural curve of expansion from a stop-valve volume of about 2¼ cu. ft. per lb. up to a volume of over 300 cu. ft. per lb., at a vacuum of from 28 to 28½ in. They, therefore, conceived the idea of turning the plane of the blade area through an angle of 90 deg., thus converting the direction of steam from axial to radial flow, and were thus enabled to proportion the areas of the successive blade rings so as to follow the true expansion curve of steam from turbine inlet to condenser. Simultaneously the great advantages were realised which would accrue were the guide blades in the ordinary turbine designed so as to revolve at the same speed as the moving blades, thus doubling the relative speed of the blade rings, and therefore necessitating only one-quarter the total number of rings for the same efficiency. Messrs. Ljungström concluded that the only satisfactory method of double rotation would be on the pure reaction principle of alternate concentric blade-rings, the steam reacting from the first blade ring to the next ring surrounding and concentric thereto.

As it was important that the clearance between the revolving rings should be as small as possible, the next step was

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so to hold them in their supporting disks that any distortion consequent on the variation in temperature between the blade ring and the framework should be eliminated. The original idea was, therefore, conceived of carrying each blade ring on its own expansion ring, and embodying a series of expansion or breathing rings throughout all parts of the turbine subject to temperature differences.

The period between 1907 and 1909 was spent by Messrs. Ljungström in preparing the designs of all the essential details, and the results of their careful work were embodied, in 1910, in the first turbine constructed by them of 750 B.H.P., running at 3,700 R.P.M., which gave a trial steam consumption of 8.9 lb. per B.H.P. per hour, total temperature of steam 626 deg. F., vacuum 28.6 in., and 171 lb. per sq. in. absolute pressure on the turbine inlet-valve.

Since that date an aggregate of about 200,000 B.H.P., of a design practically identical with their first turbine, has been put in operation or under construction. Fig. 3 shows a 1,500-B.H.P. turbo-alternator, 16 ft. long overall, and 4 ft. 2 in. in diameter.* Two 3-phase alternators, each of half the capacity of the turbine, are coupled to opposite ends of the turbine, and run in opposite directions, at 3,000 R.P.M., the relative speed of the blades being 6,000 R.P.M. The running speed is half the critical speed, and there is no vibration in running up to full speed. The set weighs 15½ tons. Fig. 4 shows a half longitudinal section of the turbine, the axis of which is X Y. Steam enters by the vertical pipes A A, and passes through the holes B B milled in the hub of each supporting disk to the innermost blade ring No. 1, then radially through the two series of blade rings to the last ring, No. 42, on its way to the condenser; 21 blade rings are fixed to the disk G R, and 21 to the disk G L. The disks carrying the blade rings are each divided into three sections, connected through expansion rings, to avoid the stresses and alterations in shape which would arise in a solid disk subjected to the influence of varying and irregularly distributed temperatures, as would be the case when steam was first admitted into the turbine, and when variations took place in steam pressure or temperature, or in the load. The disks are made of chrome nickel steel, and are mounted on the ends of the generator shafts, which, where exposed to heating by the steam, are hollow, so that the fluctuations of temperature in shaft and hub follow one another, and thus avoid play between the hub and the shaft.

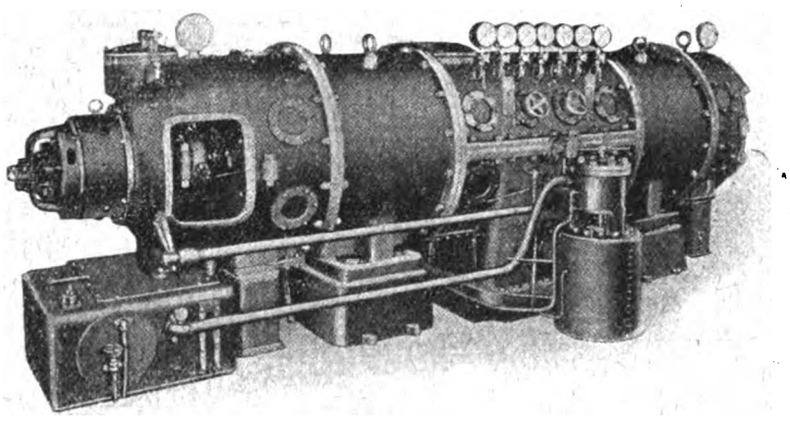

FIG. 3.—LJUNGSTROM TURBO-ALTERNATOR.

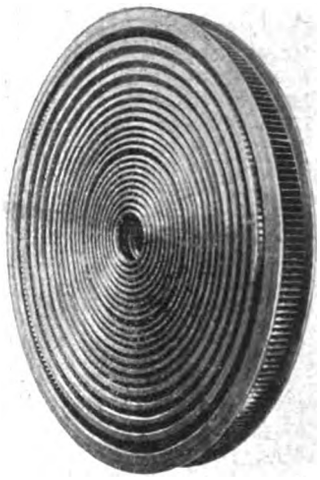

FIG. 5.—SET OF 21 RINGS.

A general inspection of the half longitudinal section shows a number of small dumb-bell-shaped sections. These are not links, but cross-sections of circular rings made of nickel steel. They are the expansion or breathing rings previously referred to, which form one of the essential features of the turbine, and are interposed between any two parts which would be otherwise liable to distortion due to variation of temperature. These expansion rings are interposed between the blade rings and supporting disks, between the component parts of the disks themselves, and between the steam chests and their supporting frames.

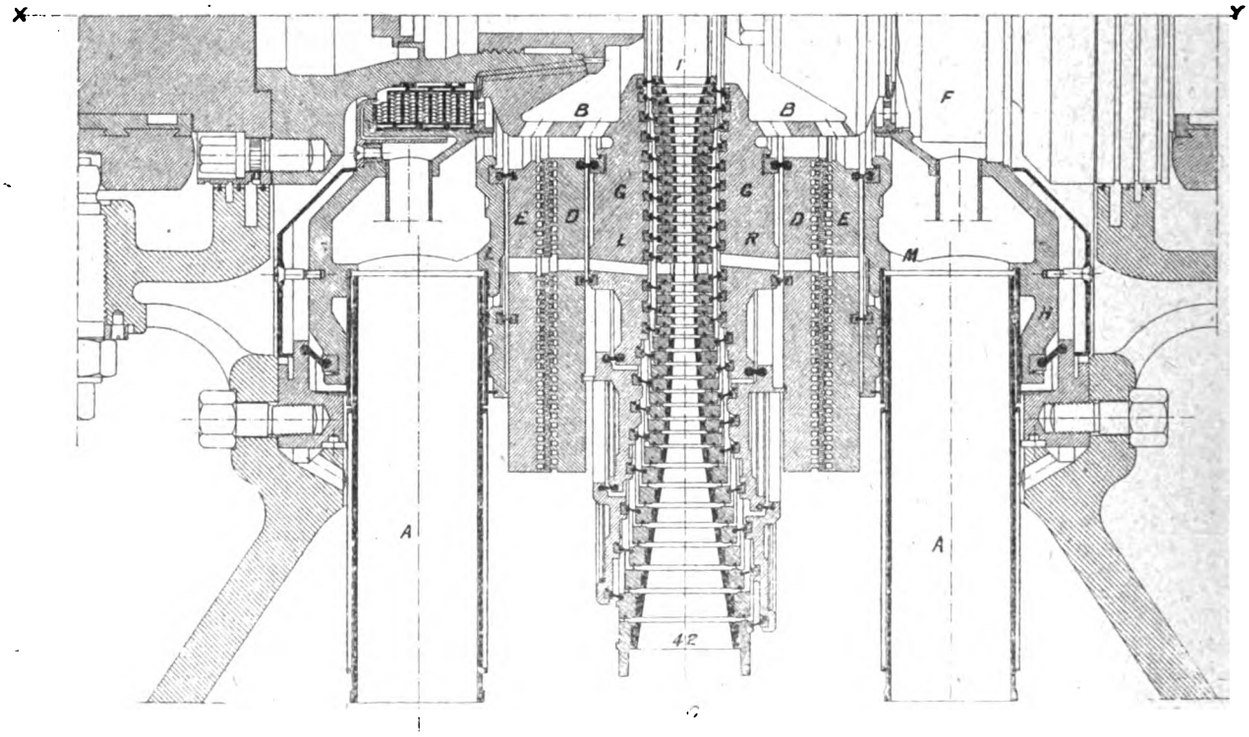

FIG. 4.—HALF LONGITUDINAL SECTION OF LJUNGSTROM TURBINE OF 1,500 B.H.P.

Figs. 1 and 2 show the method of construction of the blade rings. The blades are made of 5 per cent. nickel steel. Counting from the centre line, X Y, fig. 4, the first 33 rows are 5 mm. wide, the next five are 7 mm., and the last two 12 mm. and 20 mm. respectively. The blades are milled from solid rough-turned bars and polished to a mirror-like surface both inside and out. They are then cut into lengths (11), fig. 1, and are notched on the ends for insertion into

* An illustrated description of the Ljungström 1,000-KW. turbo-alternator as made by the Brush Electrical Engineering Co., Ltd., appeared in the ELECTRICAL REVIEW of October 10th, 1913.

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mild steel retaining frames (15). A side view of such retaining frames is shown with registers or slots to receive the blades (19). The turbine blades are retained in their positions by means of thin sheet-iron strips (20), in which are punched holes of the same cross-section as the blades, and at a distance corresponding to the pitch or spacing of the blades. These strips are applied in their places simultaneously with the assembling of the blades in the retaining frames, the angles of the blades being thus properly set, and the blades prevented from shifting during the welding operation. The blade ends are welded up solid in their frames by melting iron wire under the oxy-acetylene blow-pipe, thus filling up

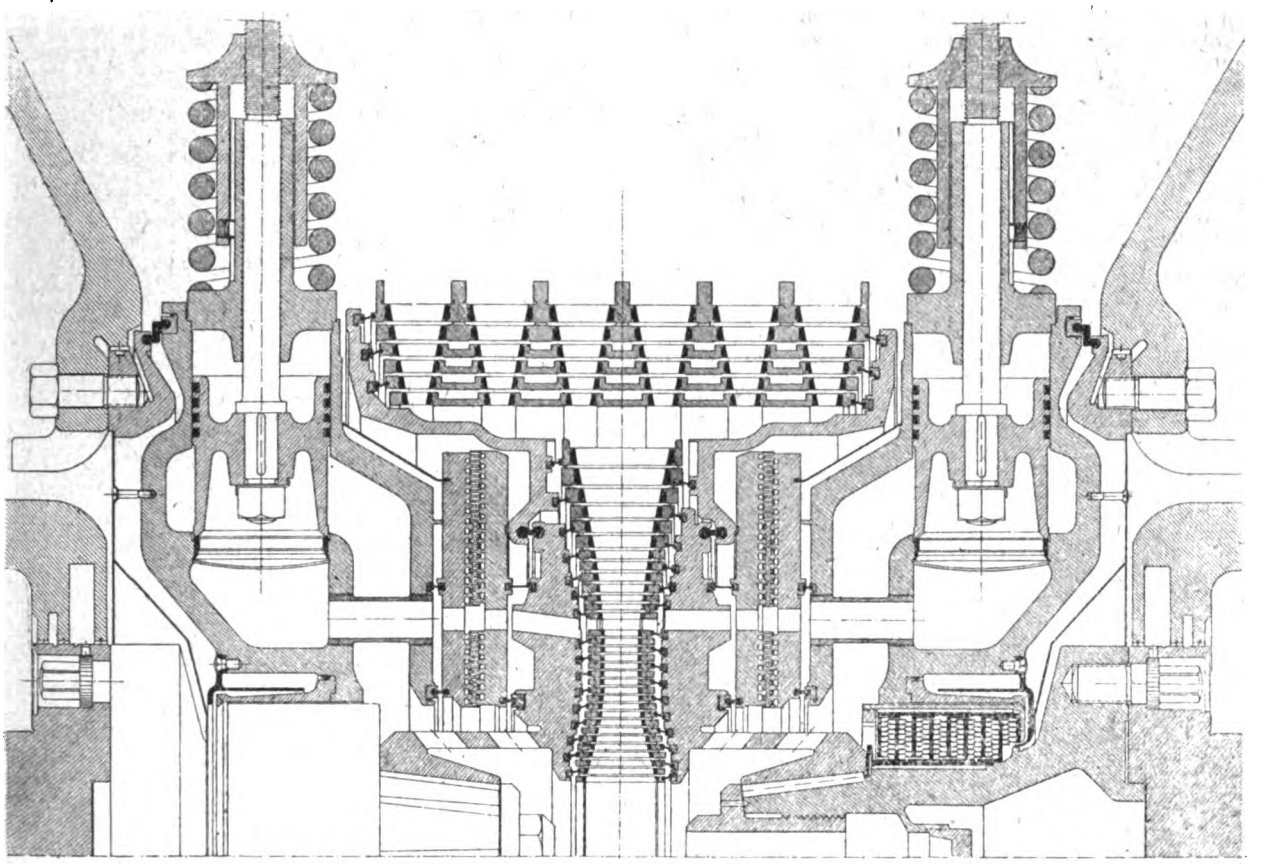

FIG. 6.—HALF LONGITUDINAL SECTION OF LJUNGSTROM TURBINE OF 10,000 B.H.P.

the channels (18). The blade ring thus obtained is then turned up in a lathe, giving the dovetail shape (10), fig. 2, and the sheet iron strips are cut away. Strengthening rings (9), fig. 2, made of the finest grade spring-steel are then dovetailed into the blade ring, and the edges squeezed in so as to grip the dovetail tightly, by means of hinged rollers carried on the lathe tool rest. A groove is formed in one of the strengthening rings (9), to receive the dumb-bell-shaped expansion ring (4), the other end of the dumb-bell being rolled into the seating ring (2), which is subsequently fixed to the supporting disk, to which it is secured by a caulking strip (3), fig. 2. Each blade ring is now complete, with the exception

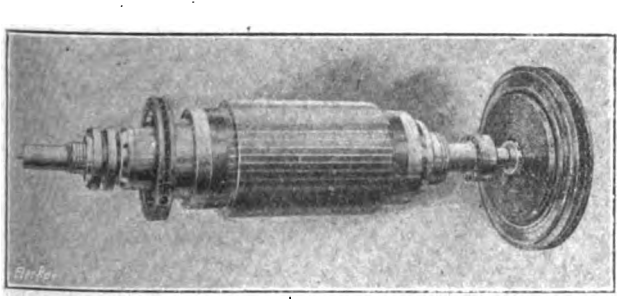

FIG. 7.—ROTOR OF 1,500-B.H.P. TURBINE.

of two pure nickel fins (7), fig. 2, which are caulked into the top surface of the strengthening rings by two pieces of soft iron wire (8). The function of the nickel fins is to prevent side leakage from any pair of counter-rotating blade rings. Fig. 5 shows the completed series of 21 rings ready for insertion in the supporting disk.

Referring again to fig. 4, it will be obvious that the steam entering the centre and flowing through the series of turbine disks to the condenser, will displace each rotating half axially outwards relatively to the other, unless this is counteracted by a corresponding reverse pressure. This is effected by a series of labyrinthic dummies E D, of which D is attached to its respective rotating disk through three expansion rings, and revolves with it; whilst E is fixed to the stationary part of the steam chest. Steam is admitted between these dummies from the centre of the turbine. The inner labyrinthic packings receive the full steam pressure, the pressure gradually decreasing from the centre until it finally drops to that of the condenser outside of the outermost labyrinth. Each rib of the fixed dummies has a small groove on its outer face, into which a folded strip of thin nickel is lightly driven.

These labyrinthic dummy packings form a very accurate method of balancing the axial thrust. Should the load increase in the turbine, the revolving labyrinthic face D approaches the fixed face E, thereby increasing the space between the nickel strips, and causing high-pressure steam to enter between E and D, forcing D in the opposite direction, and automatically closing the labyrinthic openings. A small dashpot is fixed to the end of each rotor shaft for the purpose of damping any oscillatory movement which would otherwise occur. The

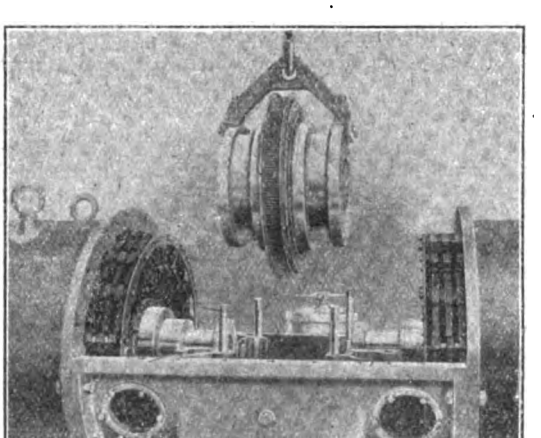

FIG. 8.—TURBINE, WITH STEAM CHESTS.

shaft packings F, fig. 4, which reduce shaft leakage to a minimum, are of nickel steel, designed to expand freely in all directions without distortion. Packing for a 1,500-B.H.P. turbine occupies a length of less than 3¼ in. of the shaft, but contains no fewer than 158 constricting surfaces. The actual leakage through these glands is less than 1 per cent. of the maximum output of the turbine, but this is not wasted, as a separate pipe leads it to the feed-water heater, where it is economically utilised.

L M, fig. 4, shows the overload by-pass, which introduces high-pressure steam direct into the outer blade rings through a series of 60 holes drilled circumferentially in the supporting disk.

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The shaft bearings of the turbine are provided with delicate methods of adjustment by four adjusting screws fitted with hemispherical heads (fig. 9). Each adjusting screw is provided with a pair of locking washers on which are 12 and 11 holes respectively, thus giving 132 different positions for each turn of the adjusting screw, corresponding to a thread with a very fine pitch. An eccentric ball admits of axial adjustment by turning its corresponding screw.

All bearings are automatically lubricated by oil under forced pressure. It is impossible to start the turbine unless the bearings are lubricated at their normal oil pressure, as should for any reason the oil supply fail, the turbine will automatically shut down.

The oil pump is of the ordinary geared type, driven directly by the governor spindle, and maintains a pressure of 35 lb. per sq. in., which is lowered to about 15 lb. for the bearing lubrication by means of a reducing valve. The throttle valve is normally pressed to its seat by means of a powerful spiral spring acting vertically downward. On the lower side of the valve spindle is attached a double-beat piston. The oil pressure acts on the bottom side of this piston, and consequently has to work against the spiral spring in order to open the throttle valve. Thus any variation in oil pressure varies the position of the throttle valve, which, through a floating lever and side shaft, maintains a constant relationship between the position of the stop valve and that of the governor, fig. 9, which is of the Chorlton Medlock type.

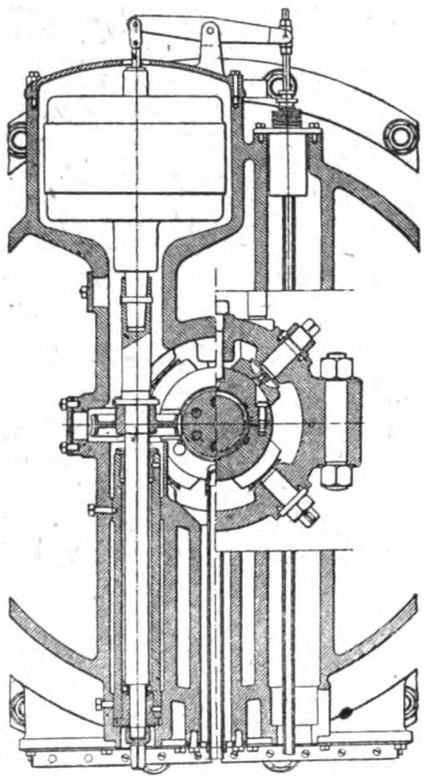

Fig. 9.—Section of Governor and Shaft Bearing.

An emergency release device is supplied by a steel cable which, so long as it is in tension, holds shut an oil relief-valve in the relay controlling the stop-valve; in the event of the turbine attaining an excessive speed or the bearings becoming unduly heated, the cable slackens, thus releasing a lever at the side of the stop-valve; this releases the oil pressure, the tension spring operates, and the turbine stops.

To start the turbine, the handle at the top is unscrewed a couple of turns, so as to admit sufficient steam to raise the disk valve from its seat, allowing steam to leak past the double-beat piston-valve, which is quite sufficient to warm up the turbine in a few minutes. A few strokes of the hand pump raise the oil pressure sufficiently to lift the piston on the valve spindle against the downward pressure of its spring, so that the turbine starts, and when once it has attained its maximum speed the regulation becomes automatic.

The generators are of very substantial construction, the whole machine forming a rigid cylindrical structure, which is adequately supported on the condenser inlet, thus forming a direct path without the necessity of intermediate joints. As the turbine casing is itself part of the condenser chamber, it requires no external lagging.

A ventilating fan attached to the rotor of each generator draws in air through a special inlet and propels it through slots in the stator, and through the air-gap between stator and rotor, to an outlet, whence it can be conveniently led through ducts to the forced-draught preheater in the boiler, dispensing with a separate fan engine. Fig. 7 illustrates the 1,500-B.H.P. turbine, the steam chests being removed, coupled to one rotor.

The relative lightness of the rotating parts of the Ljungström turbine, coupled with their mechanical construction, should dispel any criticism respecting the overhang. In the case of the 1,500-B.H.P. machine, the weight of each revolving part, that is, turbine rings, supporting disk, and attached labyrinthic packing, is only 265 lb. and 303 lb. respectively, while the maximum overhang to the outside of the bearing is 10½ in.

Fig. 8 shows the 1,500-B.H.P. turbine complete with its steam chests being lifted out of the casing, and separated from its generator rotors. The total weight of turbine and steam chests is about 1,300 lb. The complete turbine can be removed for inspection, and opened up in two hours. The overall diameter is 29 in. and overall length across the steam chests 27½ in.

No insulating jackets need be removed to make bolts and nuts accessible. The internal parts of the turbine are made accessible by lifting off the upper part of the turbine casing. The couplings between the generator shafts and the turbine wheels are then unscrewed, and a clamp is applied to the steam chests. By the aid of this clamp the whole turbine and its steam chests are lifted together.

Fig. 6 shows a longitudinal half cross-section of the largest Ljungström turbine actually completed, the maximum output being 10,000 B.H.P., and speed 3,000 R.P.M. The diameter of the outer blade-ring is 34 in. The width of the outer rings necessary to give the required blade area is here obtained by building up a series of six independent blade rings, thus giving a sufficient stiffness to the drum as a whole. Each ring is connected with its neighbour through an expansion ring dovetailed and rolled together.

(To be concluded.)

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Lightning Arresters.

A recent list issued by the British Thomson-Houston Co., Ltd., Rugby, describes the type M form D_2 lightning arrester for direct-current circuits. It consists of a single spark gap with a non-inductive resistance in series constituting the discharge path to earth: the spark gap is protected by a magnetic blow-out coil connected in parallel to part of the resistance, and should any current from the supply system follow the lightning discharge and tend to maintain the arc, a portion of such current will pass through the blow-out coil, producing a magnetic field tending to blow out the arc. The spark-gap terminals are threaded, allowing of adjustment; the box and cover are made of brown glazed porcelain, and the exterior view is shown in fig. 1.

Easy Clip Shade Carrier.

Messrs. Siemens Bros. Dynamo Works, Ltd., of 38, Upper Thames Street, E.C., have placed on the market a new shade-carrier of neat design, which simplifies shade fixing. This carrier is shown in figs. 2 and 3; it consists of two sets of claw grips, the inner ones to engage the screwed part of the lampholder and the outer ones to grip the shade. The clip is compressed by hand and forced into the top of the shade, where it holds in position; the shade and clip together are then forced over the lampholder, when the inner grips engage with the thread on the holder. The shade is removed by unscrewing, and it is not possible to remove it otherwise, as the grips act in opposite directions.

The clip renders the fixing of deep shades an easy matter, and when in position it presents but little difference in appearance from the ordinary shade ring.

Fig. 1.—B.T.H. Lightning Arrester.

Fig. 2.—Easy Clip Shade Carrier.

Fig. 3.—Easy Clip Shade Carrier in Position.

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Helsby Zinc Rods.

THE BRITISH INSURATED & HELSBY CABLES, LTD., of Prescot, have sent us particulars of their special zinc rods for Leclanché cells. The ordinary rods of uniform section are usually eaten away chiefly at a point one-third of their length from the bottom, and consequently much zinc is wasted, especially in the stump which remains at the top. The Helsby zincs are therefore made *thinner* at the top and thicker over the lower half of their length, so that the material is more efficiently used, and an equal life is attained at reduced cost.

HYDRO-ELECTRIC DEVELOPMENT IN AMERICA.

THE following notes are extracted from an address by Mr. Maurice Deutsch, delivered at the recent Pan-American Scientific Congress, and abstracted in *Power* :—

At present the total hydro-electric development of Niagara Falls is only 455,000 H.P. by five power companies. The average flow of the Niagara River is estimated at 222,400 cb. ft per second, or about 25,000,000 tons per hour. Considering the total fall in the river from half a mile above the Falls to the Pool below as being 216 ft., there is, theoretically, available a total of 5,700,000 H.P. Assuming a turbine efficiency of 87 per cent. (this has recently been carried to about 93 per cent.) and a generator efficiency of 92 per cent., the average available power would be about 4,500,000 H.P. This may be reduced by reason of friction losses, &c., to a net 4,300,000 H.P.

Three of the most interesting waterfalls in the world are to be found in South America—the Iguazu, Nacunday, and La Guayra. The Iguazu is probably the most important, its height and the volume of water being greater than those of Niagara Falls. It enters the upper Parana River about 1,500 miles from the Atlantic Coast, at the junction of Argentine, Brazil and Paraguay, and lies in the midst of a primeval forest. It is estimated that about 28,000,000 cb. ft. per minute bursts through a series of thickly wooded islands, and makes a clear leap at this point of 210 ft. into the gorge below.

About 200 ft. above the entrance of the Iguazu, on the Parana River, are the Falls of La Guayra, 310 ft. high, with an estimated flow of over 13,000,000 cb. ft. per minute. The physical conditions around this fall make it in every way a natural water power requiring only the installation of power-houses and penstocks. Although the journey from the Atlantic Coast to this falls takes about 12 days, the straight-line distance to the Atlantic Coast markets is not more than 400 miles. This entire country is wealthy in timber and other natural resources, awaiting only the assistance of capital for its exploitation..

In the United States the most remarkable development in recent years is that of the Big Creek, a tributary of the San Joaquin River, on one of the most inaccessible sites in the Sierra National Forest Reserve, 250 miles north-east of Los Angeles, California, and at an elevation of 7,000 ft. above sea level. The snow water from mountains 10,000 ft. high is stored and fed to two power plants, utilising in turn heads of nearly 2,000 ft. in horizontal distances of 2 miles to the first station, and 4 miles to the second. Power is transmitted 241 miles to Los Angeles at 150,000 volts, for industrial, lighting, and street-railway uses. The present plant has a capacity of about 80,000 H.P., but it is ultimately to be developed for 400,000 H.P.

The Coosa River project is the first of a number of hydro-electric developments by the Alabama Power Co. in Central Alabama, about 40 miles from Birmingham. The maximum distance of transmission is 150 miles. This company is largely financed by English capitalists. The present power house will provide for the installation of six 12,500-H.P. units operating under a 68-ft. head and at a voltage of 110,000. The ultimate capacity will be 400,000 H.P.

In power output, and especially in physical magnitude, by far the largest hydro-electric power plant in the world is that at Keokuk, Iowa, on the Mississippi River. The ultimate installation contemplates 30 turbines, each having a rated capacity of 10,000 H.P. at the normal head of 32 ft. At the maximum head of 39 ft. the output of each of these will be about 14,000 H.P., and at the minimum operating head of 20 ft., approximately, 6,000 H.P. The operating voltage is 110,000.

One of the largest water powers in the United States will be the Mount Shasta Power Co.'s development now in progress on the Pitt River, at the head of the Sacramento Valley. Its position will enable it to furnish power to the mining interests and mountain railroads of Northern California and to all towns and cities as far south as San Francisco and Oakland at a maximum transmission distance of 224 miles. Interesting features are the largest water-power tunnels in the world—16 × 19 ft. and 36 753 ft. long. The distance from the intake portal of the tunnel to the power house will be not quite 9 miles.

An important hydro-electric development in Brazil is the Pirahy plant of the Rio de Janeiro Light and Power Co., on the Lages River. The original plant had six vertical impulse wheels of 9,000 H.P. each, the maximum distance of transmission being 51 miles. As a result of the rapid growth of the cities served, the demand has exceeded the original capacity of 54,000 H.P. and the power house has been enlarged so as to make room for the two largest impulse turbines built to date, each capable of producing 20,000 H.P. at a speed of 300 R.P.M. under a net head of 900 ft.

In 1914 the Sao Paulo Electric Co. started its plant at Sao Paulo, Brazil. The present capacity is 40,000 H.P., and current is transmitted 56 miles at 88,000 volts, to Sorocaba and vicinity. Ultimately, it will have a capacity of 67,000 H.P. One of the units in this plant has a capacity of 14,500 H.P. under a head of 600 ft.

While formerly gravity waterwheels were used to a greater extent than reaction or impulse wheels, the practical water prime movers to-day have been reduced to two—the Francis turbine and the impulse wheel. These have been applied to a range of head from 6 to over 5,000 ft. With the marked advance in the workable speed of these machines, it is now possible to develop water power under heads heretofore considered impracticable. A single-runner high specific speed mixed-flow Francis wheel has recently shown an efficiency of 93·7 per cent.

The largest single units so far constructed are the 17,000-H.P. vertical Francis turbines installed at Tallulah Falls. These operate under a head of 600 ft. Manufacturers now declare that 40,000-H.P. units are quite practical if the demand arises.

Niagara Falls power is transmitted to Syracuse and to Oswego at 60,000 volts. The Southern Sierra Power Co. transmits power from Bishop, California, to San Bernardino, California, 238 miles, at 150,000 volts. The Province of Ontario has been delivering Niagara power 130 miles and has continued its line to Windsor, a distance of 235 miles, at 110,000 volts. Already improvements are at hand permitting a still larger transmission at a voltage of 150,000. The standard generating voltages are 2,200, 6,600 and 11,000, the choice being governed by the speed and capacity of the plant. Standard transmission voltages are 11,000, 33,000, 66,000, 110,000 and above, depending on the amount of power and distance transmitted.

A few years ago the greatest trouble was had with high-tension transformers, but American manufacturers have now entirely overcome this. In some of the biggest foreign plants the engineers have found it desirable to come to the American manufacturers for transformers even when the rest of their plant was of home manufacture.

Thirty-one plants operate at or above 100,000 volts. One-half of these are on the American continent and most of them in the United States; all but one are three-phase plants. About 40 per cent. of the total number are operated at 60 cycles, 30 per cent. at 50 cycles and the rest at other periodicities, mostly 25 cycles. There seems to be a strong tendency to use single-phase units in the transformers, although a few plants use the three-phase type.

Lamps by Post.—According to the *Central Station*, the Rochester Railway & Light Co., of N.Y., has for some months been using the U.S. mails for the delivery of incandescent lamps, and has found a reduction in cost over the old method of electric auto-delivery. Pre-cancelled stamps are used to avoid handling. During four months, 26,000 incandescent lamps—70 per cent. Mazda—have been delivered by parcel post and about 20 lamps were broken in the first month, owing to careless packing.

Colliery Worker Fined.—A rope lad at Manton Pit, Worksop, named Tom Brailsford (17), held up the mine for over half-an-hour by making an electrical connection with a piece of wire, which set the alarm bell ringing and stopped the haulage engine. At the Worksop Court, Mr. E. G. Warburton, who prosecuted the lad on behalf of the Wigan Coal & Iron Co., said his action had held up over 40 tons of coal, and stopped 80 men for the period named. Defendant's excuse was that he had headache and did not know what he was doing. It was shown that although only 17, defendant could earn over 35s. a week, and a fine of £2 was imposed.—*Sheffield Telegraph.*

Rheinfelden Power Transmission Works.—The report for 1915 of the Kraftubertragungs Werke, of Rheinfelden, on the Baden-Swiss frontier, is of interest, inasmuch as it would appear that nearly the whole of the undertaking situated on Swiss territory has been disposed of to the Canton of Aargau. A special law, which was passed by this State some time ago, ordained that the supply of electrical energy to the inhabitants must be vested in the State by the creation of a special department for this purpose, which was to be brought into operation on January 1st, 1916. The report of the Transmission Co. shows that an agreement was reached with the Canton during last year, whereby the State took over the former's contracts and concessions in Aargau which apply to the supply of energy in Switzerland, whilst on its part the company agreed to supply current to the Canton in bulk at a low price for a period of 20 years. In addition to the primary and secondary network of mains, the transfer to the State includes 26 transformer stations and apparatus, as well as the large direct-current converter station which was established for the town of Rheinfelden, together with a battery of accumulators. Most of the purchase price was paid last August, the balance becoming due early this year. The portion of the company's Swiss undertaking which has not been acquired by the State of Aargau, which served for supply in the district of Basle and to Laufenburg, has been disposed of in another manner. The company's accounts show net profits of £52,000 for 1915, as against £54,000 in 1914, and the dividend is 8 per cent., as in the previous year.

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INDIAN NOTES.

[From our Indian Correspondent.]

Mysore Electric Power Schemes.—The *Associated Press of India* reports that in view of the growing demand for electric power in Mysore, the chief electrical engineer, Mr. S. G. Forbes, has formulated two projects to supplement the present works at the Cauvery Falls. They are known as the Shishwa and the Kededatu Schemes, estimated to cost 67 lacs and 30 lacs respectively. Power from these would feed the existing transmission cables. Increased production up to 40,000 H.P. is provided for with a further possible increase up to 50,000 H.P. In discussing a paper on the subject before the Mysore Engineers' Conference, Mr. Forbes, besides forecasting a possible supply of 3,000 to 4,000 H.P. to Madras City, points out that the railway from Bangalore to Mysore can be electrified. He thinks the schedule of trains over this 87 miles' run could be so arranged that the consumption would be fairly uniform at an average of 1,000 H.P. throughout the day.

Amritzar City Lighting Scheme.—His Honour the Governor of the Punjab performed the opening ceremony of this electric power and lighting scheme on March 15th. Originally, this was intended to be a canal fall scheme, but subsequently it was decided to have it a self-contained one, using Diesel engines. The contracts were signed with Messrs. Siemens Bros. in September, 1914; considerable delays were caused by the war, and it is considered that excellent work has been done in finishing the principal contract even within eighteen months. The total capacity of the plant at present is 360 KW., consisting of three units of 120 KW. each, with room for extensions later. The Municipality has borrowed the capital, 4½ lacs of rupees, from Government at 4 per cent. interest. It is hoped that when the scheme is fully working, in addition to repaying the loan and its interest, the undertaking will pay a good dividend to the Municipality, and that at the end of 20 years the scheme will be the Municipality's own.

A great measure of popularity has already been attained, and if the demand goes on increasing at its present rate, it will soon be necessary to add more generators.

The scheme was initiated by Mr. Miller Brownlie, municipal engineer; the supervision and technical details were carried out by Mr. Greenwood, the electrical engineer, who has been mainly instrumental in bringing about a speedy completion of the useful project.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SWITZERLAND.—By a Decree of the Swiss Federal Council, the exportation has been prohibited as from March 8th of manganese, chrome, molybdenum, titanium, uranium, vanadium, and tungsten, in so far as exportation is not already prohibited.

NORWAY.—A Customs Circular (No. 9 of 1916) states that the prohibition of the exportation of zinc applies also to (1) zinc ashes, (2) zinc scoriae, (3) zinc powder, (4) "sinkgröt," and (5) hard zinc.

SPAIN.—A Royal Decree, dated March 18th, authorises the Government to permit the establishment, by Spanish companies constituted in conformity with the Commercial Code, and at such ports as may be convenient, of bonded commercial warehouses. Goods may not remain within these warehouses longer than four years, after which period they must be exported abroad or entered for consumption in Spain. Certain operations may be performed within these warehouses (under supervision), including all those (with certain specified exceptions) which increase the value of the warehoused goods without essentially altering their nature.

Goods which enter these warehouses are to be exempted from transport duties, port duties, &c., as also are foreign goods re-exported from warehouse. Spanish goods which are exported to foreign countries through these warehouses shall be liable to transport duties and port dues, and also to export duties if such duties are leviable on the class of merchandise concerned. Goods from these warehouses which are passed into Spain are to pay import, transport, and other duties as if they had been imported direct from abroad.

BRITISH DOMINIONS AND POSSESSIONS.—A Supplement to the *Board of Trade Journal* of April 13th contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported to various destinations from British India, Canada, New Zealand, South Africa, Egypt, Malta, Cyprus, Mauritius, Ceylon, Straits Settlements, Hong-Kong, Nigeria, Gold Coast, Jamaica, Barbados, Trinidad and Tobago, and British Guiana. The information in the present Supplement supersedes that given in the Supplement published on January 13th last. Copies of the Supplement may be obtained, at the price of 3d. per copy (post free 4d.), from the usual sale agents for Government publications.

PERU.—Two Laws have recently been promulgated establishing export duties on copper and other mineral products. The duties are payable in 90 days' bills on New York or, at the option of the shipper, in the equivalent thereof in bills on London. The duties may be paid in sterling when the sum payable does not exceed £40. Producers and exporters are required to declare the nature and grade of their products.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co. Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

5,582. "Foundation and floors for storage batteries and for vats and tanks containing acid or corrosive solutions." R. H. Bryans & J. S. Highfield. April 17th.

5,586. "Junction box." W. A. Sutton. April 17th.

5,596. "Intercommunication telephone systems." J. W. Dungey & C. B Kersting. April 17th.

5,606. "Electrical means for indicating or transmitting movements." H. R. Wright. April 17th.

5,613. "Dynamo-electric machines." British Thomson-Houston Co. (General Electric Co., U.S.A.). April 17th.

5,628. "Electrolytic method for removing oxide or rust from iron or steel." P. Marino. April 17th.

5,631. "Sound detection." R. F. Bossini & H. R. Wilding. April 17th.

5,634. "Sound detectors or transmitters." R. F. Bossini & H. R. Wilding. April 17th.

5,637. "Tablets for train signalling on single lines of railway worked on the electric-train tablet block system." E. Roberts. April 17th.

5,646. "Electric plug connectors." F. G. Baily. April 18th.

5,675. "Controlling systems for electric lighting." T. McLeod. April 18th.

5,682. "Electrolytic extraction of zinc." Metals Extraction Corporation and H. L. Sulman. April 18th.

5,750. "Electrolytic refining or extracting processes." United States Metals Refining Co. April 19th. (U.S.A., April 20th, 1915.)

5,769. "Mine, &c., signalling." Automatic Telephone Manufacturing Co. April 20th.

5,773. "Gas alarm and telegraph." J. M. Meadows. April 20th.

5,777. "Electrically-operated friction hoists." J. Scott. April 20th.

5,807. "Distance-operated mechanisms and signals connected to electric supply systems." H. E. Angold, W. Duddell, A. H. Dykes, H. W. Handcock & C. Oliver. April 20th.

5,834. "Preventing rapid exhaustion of primary batteries." T. McLeod. April 20th.

5,841. "Electrical systems for engines." C. F. Kettering. April 20th. (U.S.A., June 24th, 1915.)

5,842. "Dynamo-electric machines." British Thomson-Houston Co. and F. P. Whitaker. April 20th.

5,847. "Illuminated signs or electrographs." E. J. Kingsbury. April 20th.

5,858. "Electric fuses." A. F. Berry. April 20th.

5,859. "Electric heat radiators." A. F. Berry. April 20th.

5,860. "Electrical relays and their application." W. M. Mordey. April 20th.

PUBLISHED SPECIFICATIONS.

1915.

3,364. Manufacture of Electric Insulating Materials and the like. W. E. W. Richards. March 2nd.

5,007. Spring Arrangements, especially for use in Electric Making and Breaking Devices. Landis & Gyr Akt. Ges. March 31st. (April 2nd, 1914.)

5,079. Dynamo-electric Machines. R. Boin. April 1st.

5,088. Relays especially for Metering in Telephone Systems. E. Shibko. April 1st.

5,200. Electro-magnetically Operated Devices. E. T. R. Murray & G. F. Shotter. April 6th.

5,260. Dynamo-electric Machines. British Thomson-Houston Co., N. Shuttleworth & G. M. Brown. April 7th.

5,741. Devices for the Discharge of Electricity through a Vacuum, Gases, or Vapours. British Thomson-Houston Co. (General Electric Co., U.S.A.). April 16th.

8,028. Electrical Measuring Instruments. H. C. West. May 31st.

8,204. Electric Batteries. W. Hoppie. June 2nd.

9,003. Miners' Electric Safety Lamps. J. G. Patterson. June 18th.

9,706. Spring Return Mechanism for Electric Motor Controllers and for other purposes. Electric & Ordnance Accessories Co., N. G. Langrish and L. Hodgson. July 3rd.

9,903. Electrical Connections, particularly applicable to the Sparking Plugs of Internal-combustion Engines. J. A. Kennedy-McGregor. July 7th.

10,325. Electrically-driven Luggage Truck. J. E. Hamilton. July 15th.

10,422. Connection and Insulation of Taps on Electric Transformers and similar apparatus. J. Wood, H. G. Furlong & Ferranti, Ltd. July 17th.

10,518. Apparatus for Converting Electrical Currents. G. Giandinoto and S. Scuderi-Scuderi. July 20th. (July 21st, 1914.)

10,598. Rheostat Switches and the like. J. Roothaan & Ferranti, Ltd. July 21st.

15,761. Replenishing Electrolytic Cells. W. S. Smith. November 8th. (June 3rd, 1915.)

16,441. Apparatus for Transmitting Morse and like Code Signals. P. W. Steele. November 22nd.

17,455. Installations and Apparatus for use in Wireless Telegraphy and Telephony. E. Bellini. December 13th.

17,542. Projector Lamp for use with Incandescent Filaments. Robert Bosch (firm of). December 15th. (February 18th, 1915.)

17,551. Sound Transmitting Devices Employing a Diaphragm. F. Morano. December 15th. (Divided application on 82/15. January 2nd.)

17,713. Electrically-heated Stove or Open Fire. G. A. C. Thynne. December 18th.

1916.

2,266. Electrically-operated or Controlled Indicating Apparatus for use with Signalling Apparatus on Railways. J. P. O'Donnell. February 15th. (Patent No. 100,216.)

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THE

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VOL. LXXVIII. MAY 12, 1916. No. 2,007.

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ENGINEERING AND SCIENCE.

It is gratifying, especially to those who for years have advocated a closer alliance between science and industry, to observe that the tide of public opinion continues to set strongly in that direction, and that a flood of exhortation in the Press and on the platform is being poured forth by men who occupy foremost positions in the ranks of both these parties; we earnestly hope that the movement will not end in words, but will develop into vigorous and wholehearted action. The current month has already seen a conference held by the Society of Engineers to promote the application of scientific research to engineering needs, at which Prof. Fleming once more laid bare the deficiencies of our existing system—or lack of system—and pointed out the remedies; a meeting of the Iron and Steel Institute, at which Sir Wm. Beardmore dwelt upon the application of science to industry; a meeting of the Textile Institute, at which Dr. Garnett urged the need of reform in our educational methods in order to attain a higher standard of efficiency in industry and commerce; and a meeting of the Institute of Metals, at which Prof. Bragg showed how the properties of the Röntgen rays could be utilised in the study of the structure of metals. Here is activity, indeed.

Both Prof. Fleming and Dr. Garnett referred to the advantages derived by our enemies from their more practical system of education, as compared with our own, which is so largely devoted to cramming with knowledge (largely academic and remote from every-day life) instead of the development of the faculties of reasoning and observation.

The late Prof. Ayrton continually impressed upon his staff the principle that the purpose of a scientific training was to teach the students *to think;* for this purpose, a knowledge of fundamental principles was essential, but there was no need to memorise a mass of facts. In the same way, Prof. Fleming insists upon the importance of producing "men who can do new things, and not merely know about old ones." He draws attention again to the inadequacy of the instruction in the public schools, which results in the loss of valuable time at college which has to be spent in making up arrears; this is also referred to by Dr. Garnett, in connection with the education of the worker, and he points out that reform must commence in the training school, with the future teachers themselves. Years must necessarily elapse before the effects of such reform can become operative in the technical schools and colleges, and, consequently, it is imperatively necessary that this question should be taken up at the earliest possible moment. It is a matter of the utmost urgency.

The demand for compulsory attendance at secondary schools, while in harmony with the spirit of the times, would probably be superfluous if employers would recognise the value of the certificates obtained by evening-class students, which, as a rule, are brushed aside with the disdain that is born of ignorance; if superior attainments could be sure of a due reward, they would be voluntarily sought after.

Dr. Fleming laid great stress upon the importance of cultivating and encouraging originality of thought. Led by men who are deficient in scientific and engineering knowledge, we have been handicapped in the past; we need only cite the examples of the motor-car industry, the manufacture of air-

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craft, and the development of submersible ships. The theory of our political incompetents has been: "Let us wait and see what other nations are doing; when they have made this thing a success, at their own expense, we will reap the benefit of their experience." No more disastrous policy could be conceived; to follow in the steps of others is to commit industrial suicide, and we hope that not the least of the benefits to be derived from the war will be the abandonment of this theory for ever.

We have space only to refer to one other feature of Dr. Fleming's address—his contention that the Government ought not to appoint committees of experts, but should work through the medium of the technical and scientific associations which already exist. Is the Government policy wrong? Have not these societies existed for decades, without directly exerting any appreciable influence upon the course of industry and commerce—subjects which they regard with supercilious contempt? With few exceptions they are, as Dr. Fleming himself admits, mere paper-reading societies, distinguished mainly by their stilted ideas of propriety and their narrow-minded attitude towards mundane affairs. It is the *Committees*—such as the Engineering Standards Committee, the Electric Vehicle Committee, and a few others—and never the *Councils* that get things done that are worth doing.

Daylight "Saving."

Sir Henry Norman's resolution in favour of the adoption of the late Mr. Willett's scheme for "saving daylight" came before the House of Commons on Monday last, and was adopted with the minimum of opposition. The House of Commons has thrice rejected or dropped the measure, which was first introduced eight years ago, but it is now brought forward under most exceptional circumstances, for the patriotic purpose of economising coal, and though we regard it somewhat in the light of a wolf in sheep's clothing, we cannot but acknowledge the powerful aid with which it seeks adoption.

In our issue of April 28th, 1911, we set forth at some length the grounds for our opposition to the original proposal; in brief, these were as follows:—the Bill was *optional*, and its partial adoption would have resulted in chaos: a change of time on our part would have thrown our foreign communications by sea and by telegraph out of phase with the rest of the world, especially our European neighbours; tide tables and other standard publications prepared long in advance would have been thrown out of gear; the change was sought by men who thought they would derive advantage from it, but not by the vast bulk of the population; and there was grave doubt whether the alleged advantages would be realised.

The situation has changed, for the measure will now be made compulsory, thus avoiding confusion; we have no dealings with the Central Powers, Holland has already changed the time, and France, Denmark, Norway, and Sweden are likely to follow suit, so that the communication difficulty is largely removed; many of our works are in operation day and night, and will therefore be unaffected by the change; and the compelling argument advanced in favour of the change is national economy. Our case is, therefore, greatly weakened, but by no means destroyed.

To begin with, a new factor has come into existence in our favour: the Ministry of Munitions wants benzol and toluol, derived from the distillation of coal, agriculture wants sulphate of ammonia, the textile industry wants tar for dyes, and Diesel engine users want tar oil; we have, therefore, been urged to use gas freely—how does this square with the economy advocated by the Home Office, which has cordially welcomed the proposal? The Board of Trade is also pressing for a 10 per cent. reduction in the consumption of coal for lighting purposes, apart from the daylight saving scheme, and this, again, will hit the Munitions Department, which, on the other hand, is calling upon electricity works to increase their output for power supply. What does the Government really want?

It is curious to read in *The Times* that gas and electricity undertakings, which would be directly hit by the scheme, "*regard its adoption with equanimity.*" The reduction in street lighting and the general lighting restrictions "have already had their effect"—and what follows? Surely, it is obvious that if the suppliers of light are indifferent to the measure, because its effect has been anticipated by other causes, the economy of coal that is hoped for cannot be realised; the Bill is already discounted. As for the street lighting, that goes by the sun, if it is not in fact wholly cut off, and no economy will be effected there; there is little shop lighting to save, and therefore the bulk of the economy must come from domestic consumption. Now, as mentioned above, the Board of Trade is urging the public to reduce their lighting by 10 per cent.; it is important that this fact be kept in view, for it overlaps the daylight scheme, and in all probability the advocates of the latter will claim for it, unjustly, the whole of the joint economy, thus producing a false impression of its benefits.

It is well known that agriculture has no use for the measure; the workpeople must be guided by the sun. As for the many workers who have to rise at five, in order to start work at six o'clock, these will rise with the sun until the middle of July, but throughout August and September they will get up in the dark; during a great part of September they will have to work by artificial light for the first hour, thus losing at one end what is gained at the other. In many cases the change will have no effect at all upon the lighting hours until the middle of August.

We feel that, with other European countries, we are about to take part in the perpetration of a trick upon ourselves, a voluntary self-deception, which is revolting to our intelligence and a slur upon our moral strength. Let it be granted that in the summer months it is desirable to rise earlier—could not that end be attained by other means, less suggestive of the child's "make-believe"? We see one ray of sanity in the speech of Mr. Herbert Samuel on Monday last—he said the Government would not think of favouring the proposed change unless they had reason to believe that it would be advantageous for war purposes. It is consoling to know that the proposal is now put forward for adoption purely as a war measure, and not on its own merits.

Copper.

Developments in the position of copper have been of a rather startling character, as testified by the further huge rise recorded in prices within the last few weeks, and there is as yet no sign of a halt in the upward movement, for it is increasingly difficult to secure spot or near copper of almost any description, even at the extreme prices now current. Reports from across the Atlantic are as strong as ever, consumers in all directions being anxious to have deliveries against current contracts in order to keep pace with their heavy requirements. The uncertainty regarding the tension between the United States and the Central Powers, and the fears of Labour disturbances, do not appear to have had the least effect on the temper of the market. Speculation on this side remains absolutely barred by the Government prohibition, which is to be regretted, for it was undoubtedly speculation or the operations conducted by large dealers which were instrumental in keeping down the price of standard copper, prior to the enforcement of the new regulation, at a much heavier discount than at present is the case. In the middle of last month the price of standard copper was in the neighbourhood of £125, and has

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now reached about £140, while electrolytic, of which the bulk of the American output consists, has risen during the same period from about £137 to £150. The premium on spot and near copper for weeks past has been constantly on the increase, owing not only to the fact that American producers have very little actually available for sale to meet urgent needs, but also to the virtual extinction of the stocks in home warehouses. With America producing at the rate of about 80,000 tons a month, and consuming as much as 75 per cent. of that amount, or something like 60,000 tons a month, it is at once realised that the exportable surplus is comparatively small, in fact, rather inadequate, in order to cope with the huge European war requirements. Within the last few weeks the additional orders placed by the Allies are stated on pretty good authority to have been as much as 150,000 tons, or representing but little less than a two months' American production, this to say nothing of the orders given out by American consumers. The world's output in 1912 was, roughly, quite one million tons, to which the United States contributed about 70 per cent., or fully 700,000 tons. The world's output for the current year has been estimated by a fairly reliable authority as 1,202,000 tons, to which America will contribute about 79 per cent., or 936,000 tons. The present position is absolutely unique, both output and consumption being a long way in excess of all previous records, with unsold stocks practically non-existent and a rise in price not seen within living memory. The course of the market, of course, depends largely on the duration of the war, or developments in the political situation calculated to hasten the conclusion of peace. Anything happening in the latter respect would probably have an important bearing on the demand, but the speculative market having been killed by Government action, the tendency of warrant copper cannot be expected to be immediately very materially affected unless some selling pressure makes itself felt.

Commission Agents and Remuneration.

Most commercial men have received or have paid commissions in their time. Some business houses, indeed, appear to rely entirely upon the efforts of the "men on the road" to bring grist to the mill in the form of orders; but while this method of bringing buyer and seller together is well recognised, the principles by which the question "Has this commission been earned?" must be answered are not always clearly understood. A recent case in the King's Bench Division shows that the person employing an agent may be liable to pay commission although he derives no benefit for the services rendered. In that case by a contract between the plaintiffs and the defendants it was provided that if the plaintiffs procured for the defendants a contract to supply certain motor-lorries to the French Government, the defendants were to pay the plaintiffs a commission immediately after the defendants had received payment from the French Government. The lorries were to be supplied from Turin, the defendants not being the makers. The contract was procured by the plaintiffs for the defendants, but the latter were unable to get the lorries, and the French Government cancelled the contract and paid the defendants nothing. In an action to recover the commission, it was held that as the defendants had put themselves forward as being able to supply the lorries, the non-receipt of the money was caused by the default of the defendants, and the commission was payable.

The principle underlying this decision was that when it is a term that the commission is payable on the receipt of the money by the other party, it is payable even though the money is not received if the non-receipt is caused by the default of the person employing the commission agent. It is to be observed that the application of this principle will not be avoided merely by inserting in the agreement a term to the effect that commission will only be payable "on orders accepted." A man may very well accept an order, only to find, on trying to carry it out, that it is commercially impossible to do so. For instance, suppose an agent has obtained an order for certain electrical machines, and the order has been accepted by the firm employing him. Subsequently it is found that to carry it out will involve such an expenditure on capital account that there will be a loss. If, in these circumstances, the firm decline to go on with the business, they will be liable to pay the commission due to the agent. The difficulty can be got over in one of three ways: (a) by the exercise of great care in the acceptance of an order; (b) by strictly limiting the classes of goods or orders which the agent may obtain; or (c) by drawing the commission note in such a way as to prevent the agent making any claim unless the order is not only accepted but carried out. We have heard recently of a case in which a firm engaged before the war in the manufacture of electrical fittings and apparatus had a claim made against them by an agent who had secured an order for munitions from the War Office. The firm accepted the order, only to find that with the plant at their disposal it could not be carried out except at a serious loss. Eventually, owing to delay, the War Office authorities cancelled the order. The claim of the agent was eventually compromised; but it is plain that the firm were in danger of having to pay the commission. These notes may suggest to those engaged in the electrical industry the advisability of revising or paying rather more attention to the terms of commission notes.

Water for Turbines.

A case which decided a point of interest to all those who use water for driving turbines was reported in our issue for April 28th. The action was brought by one James against the Bedwellty Urban District Council for a declaration that the defendants were liable to pay and make good to him the amount of the damage caused to him by nuisance arising from the pollution of the River Rhymney by sewage matter, which clogged the vanes of his turbine. Mr. Justice Astbury came to the conclusion that, while the clogging was partly due to grit and coal dust in the water, it was largely and mainly caused by sewage matter which could only have been kept out by the plaintiff enlarging his screens at very considerable expense; he awarded the plaintiff £150 damages and the costs of the action. This case is an illustration of the fact that a riparian owner has a right to have the water flowing past his land pure and unpolluted. In the days of the old watermill a little pollution by sewage would possibly have made no substantial difference to the working of the mill, but with a turbine it is otherwise; any impurities in the water appear to have a deleterious effect. While it is possible that a turbine would stand a certain amount of impure water at intervals, the constant flow of sticky matter would tend to clog, or of fluidy matter would gradually wear away, the blades of a turbine. It is important to notice that the right of a riparian owner to have his water unpolluted is an absolute right; so that it would be no answer to an action for the authority running sewage into the river to say: "You knew the sewage was there when you installed your turbine," unless, indeed, a right to pollute has been acquired by Act of Parliament, or by prescription; that is to say, by uninterrupted user for a period of years.

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SURFACE MINING ELECTRICAL PLANT.

There is practically no class of machinery employed in connection with mining work which has not been adapted for electric driving, the size of plant ranging from the small ventilating fan to the largest main winder equipment.

The advantageous use of electricity in underground mines is fully appreciated by all engineers, but its possibilities for shallow and surface mining work have not been developed in the same degree as for underground work. With surface mining, the area and position of operations may be altered within very short periods, depending upon the locality and conditions of working.

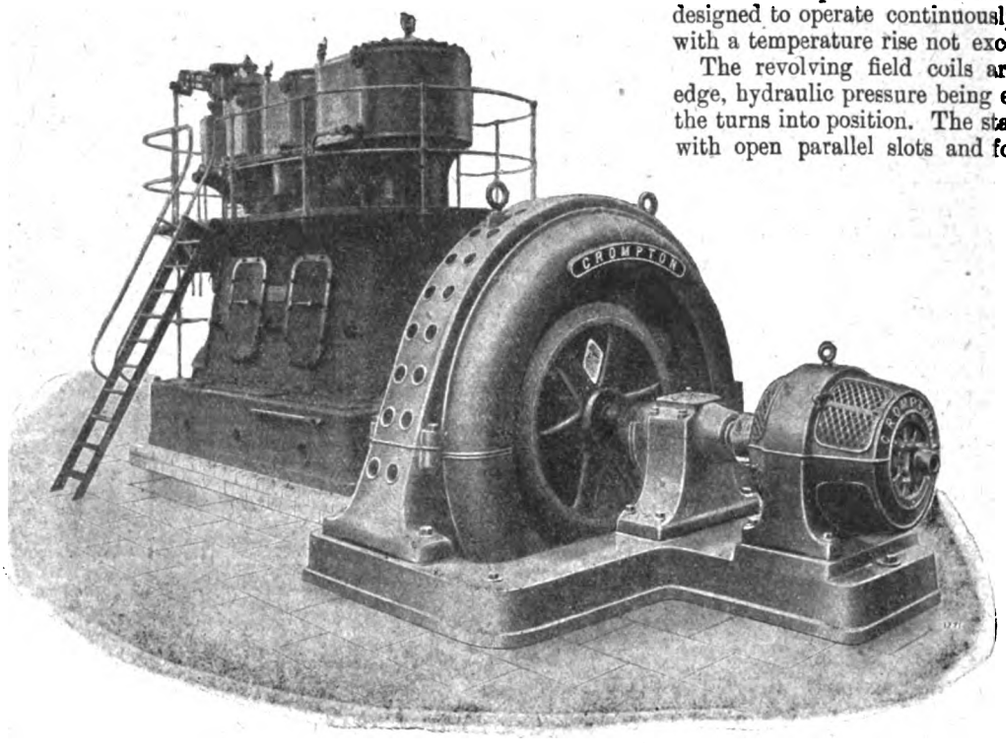

Fig. 1.—600-kw. Steam Alternator.

For various reasons, such as the difficulty of illumination and supervision of native labour, night working has not been adopted by many of the principal mining companies owning surface workings in different parts of the world.

The following illustrations of plant supplied by Messrs. Crompton & Co., Ltd., of London and Chelmsford, will, therefore, be of interest in showing the possibility of continuing the operations day and night, even when the workings are extended over considerable areas.

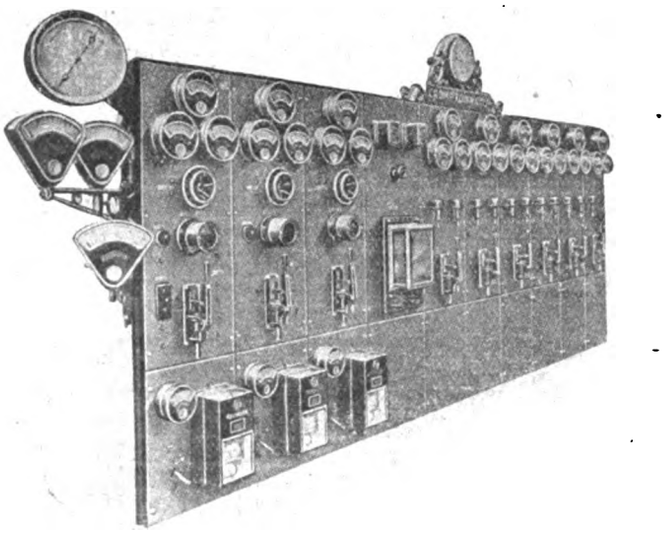

Fig. 2.—Main Switchboard.

Two well-known mining companies some time ago decided to adopt electric driving throughout their surface mines. The material in the workings was principally washed from the cliffs and headings by hydraulic pressure, and it was necessary that the electrical equipment should permit of the maximum output being obtained throughout the 24 hours.

In view of the extended nature of the workings and the necessity of carefully supervising native labour, the illumination at night was carried out principally by searchlight projectors, each fitted with lenses giving a widely diverging beam of light.

The electrical installation consists of three steam alternators, each having a normal three-phase output of 600 kw. at 550 volts, 50 cycles, with a 0·8 power factor; a view of one of these sets is shown in fig. 1. The alternators are of Messrs. Crompton & Co.'s standard construction, and are designed to operate continuously at their full rated output with a temperature rise not exceeding 70° F.

The revolving field coils are of copper strip wound on edge, hydraulic pressure being employed in winding to force the turns into position. The stationary armature is provided with open parallel slots and former wound coils, the latter being dried in a vacuum and impregnated under a pressure of about 50 to 60 lb. per sq. in., with special insulating and waterproof varnish, without breaking the vacuum. The armature and field coils of the exciters are treated in a similar manner.

In fig. 2 is shown the main switchboard, designed to control three alternators and feeder circuits. The alternators are paralleled by means of a synchronoscope mounted on a swing bracket at one end of the board. The alternators are protected by circuit-breakers with no-volt and reverse-current trips, as well as overload trips on the circuit-breakers on the feeder panels. A complete installation of lightning arresters is also provided.

All the feeders are of bare copper, carried overhead on porcelain insulators fixed to cross arms attached to wooden poles.

As most of the mining machinery is adjacent to the generating station, a pressure of 550 volts was adopted, but for the outlying district static transformers mounted on the transmission poles increase the pressure to 2,000 volts.

A general view is shown in fig. 4 of the hydraulic plant in operation, washing soil from the cliffs so as to expose the metallic strata and ore, thereby facilitating the collection of the ore.

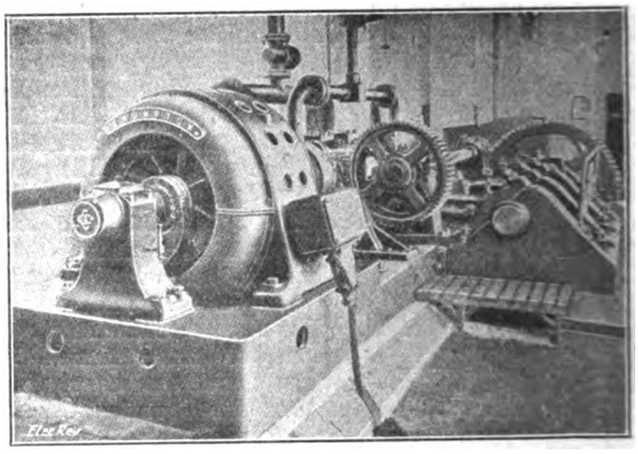

Fig. 3.—Three-phase Motor driving Hydraulic Pump.

In fig. 3 is shown a high-pressure three-throw ram pump driven by a "Crompton" three-phase induction motor, which supplies water power to various nozzles for washing the cliffs. The rotor is of the slip-ring type, and is fitted

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with brush-lifting and short-circuiting gear, which eliminates all friction losses of the brushes and rings, as well as the losses in the rotor leads, after the machine has attained full speed.

No special mention is necessary in connection with the motors driving the usual mining machinery, such as main and tail haulages, auxiliary pumps, concentration plant, crushers, puddlers, agitators, &c.

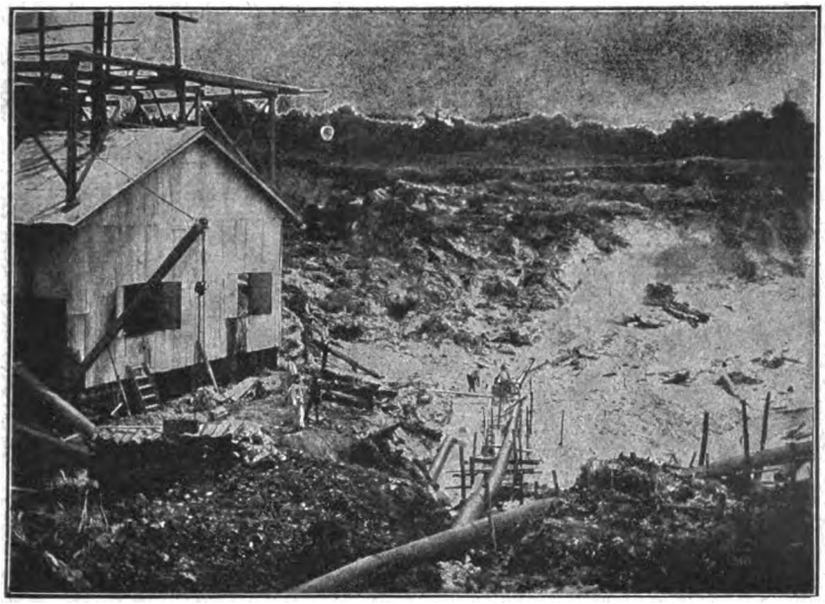

FIG. 4.—HYDRAULIC MINING PLANT IN OPERATION.

To ensure the maximum efficiency of the illuminating plant for night operations, it was necessary to employ searchlight projectors working with continuous current obtained from rotary converters, one of which is illustrated in fig. 5. These rotary converters are self-starting from the three-phase side, the pressure being reduced by static transformers to about 65 or 70 volts, in order to obtain approximately 100 volts on the D.C. side.

The switchgear mounted on the side of the rotary is for starting purposes, and also for reversing the field windings, so as to ensure the correct polarity being obtained on the D.C. side when starting up.

For this class of work the converting plant should be designed with a view to portability.

The continuous current from the rotaries supplies various 36-in. searchlight projectors. One of the projectors is illustrated in fig. 6, and is designed for controlling the training and elevating motions by hand, through gearing, or electrically from a distance, the motors for the two motions being fitted in the base of the projector. The projector lamps operate automatically, and run with a small steadying resistance in each lamp circuit.

The projectors have parabolic glass mirrors and dispersion lenses mounted in special frames, which can be rapidly attached to the front of the projector, either by hooks or hinges, and which give a beam of light diverging either vertically or horizontally, as desired.

It is possible that considerable economy in operation might be obtained by electrically controlling a number of projectors from a distance, by a single operator situated at a central position in full view of the operations, or in communication with the workings by telephone.

The disposition and number of projectors employed would naturally influence the D.C. voltage and type of converting plant. It is quite probable that the most satisfactory arrangement would be to provide a motor-generator with each projector, consisting of a three-phase induction motor operating direct from the overhead lines, and coupled to a D.C. generator and small exciter so as to obtain a drooping voltage characteristic. This would enable the projector to operate automatically, thereby avoiding the necessity of a steadying resistance in the lamp circuit.

In fig. 7 a view is given of one of the workings taken at night. The workmen can be clearly discerned conveying the ore in trucks from the workings to the haulage gear station.

A general view of the mining area and generating station, &c., is shown in fig. 8. This view was also taken at night under ordinary working conditions, and clearly shows the arc lamps on the main road from the mine buildings to the principal workings.

There are numerous instances of surface mines extending over considerable areas, which are often of a temporary nature, and where it is not practicable or convenient to erect overhead lines for a power supply for night operations. In these circumstances, the many advantages of a portable projector equipment cannot be over-estimated. It consists

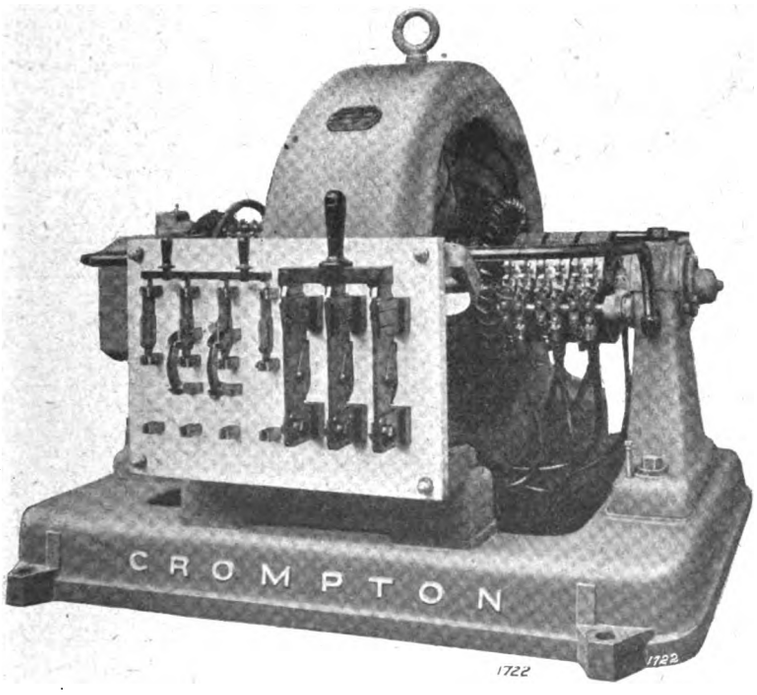

FIG. 5.—ROTARY CONVERTER WITH STARTING GEAR.

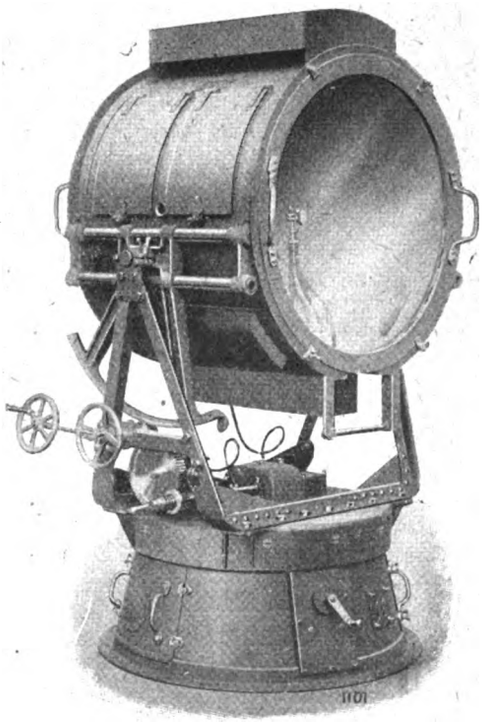

FIG. 6.—MOTOR-CONTROLLED 36-IN. PROJECTOR.

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of a petrol-driven chassis, the engine being arranged to drive the car or the generator for supplying the projector, when stationary. The projector burns with a normal current of 120 amperes at about 65 volts at the arc, and has a mirror of 36-in. diameter. It is shown mounted on a light trolley, so as to be capable of being easily moved in any direction. The supply cable from the chassis equipment to the projector is carried on a drum at the rear of the car.

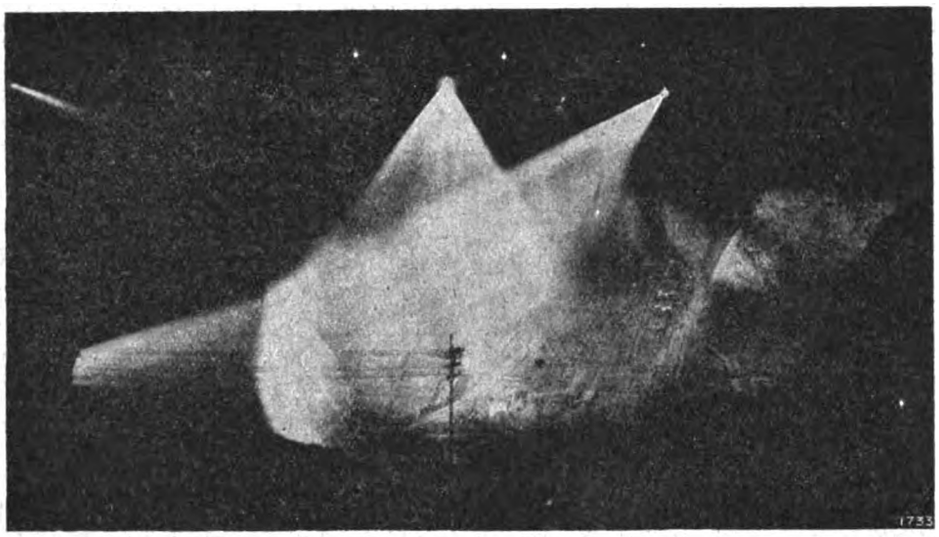

FIG. 7.—VIEW OF ONE OF THE WORKINGS AT NIGHT.

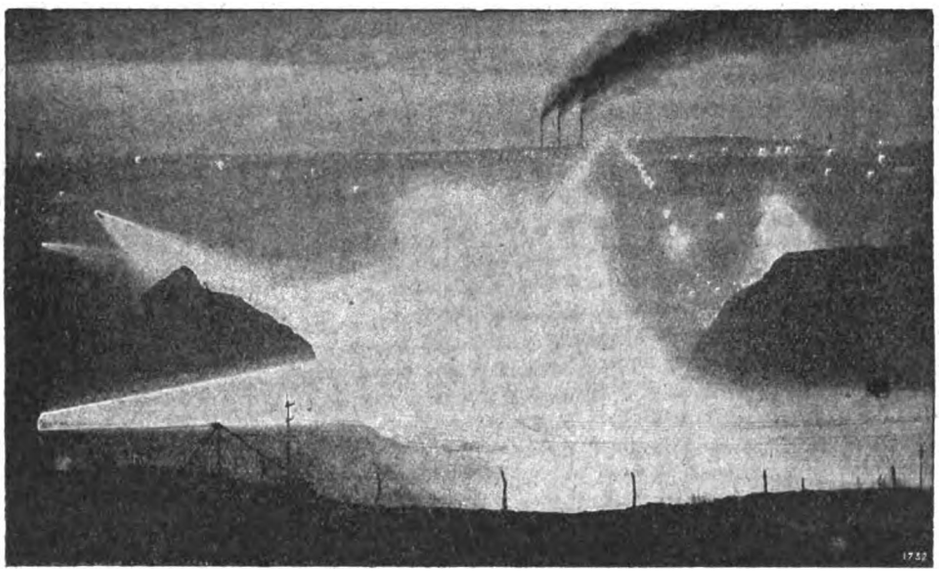

FIG. 8.—GENERAL VIEW OF THE MINE AREA AT NIGHT.

A similar equipment could also be usefully employed with other classes of outdoor work at night, such as the illumination of docks, shipyards, and all kinds of erection and excavation work, where the conditions of working require a high degree of illumination.

ENGINEERING AND SCIENTIFIC RESEARCH.

By J. A. FLEMING, F.R.S.

(*Abstract of paper read before the* SOCIETY OF ENGINEERS (INC.), *May 1st*, 1916.)

THERE seems to be a very complete agreement that one result of the great war in which we are engaged will be to render absolutely necessary certain reforms in our national systems of education, and especially in the attention given to scientific knowledge. An important step was taken by the Government through the Board of Education last July in the establishment of a Committee of the Privy Council and the appointment of an Advisory Council to deal with the question of scientific and industrial research as described in a scheme outlined in a White Paper.

Since any such Government control over scientific research is bound to have a great influence in time on the direction of scientific work and its applications, it appears most desirable to gather views upon this scheme, even after its inception, from those who are concerned with one of the most scientific of these industries, viz., engineering in all its branches.

Important industries have died out or never thriven in this country in consequence of our neglect of scientific education and research. We cannot undo the effect of this neglect by a wave of the wand; reforms to be useful must be very deep and very thorough, and begin at the top and at the bottom in our systems of national education.

It is unquestionable that the success of the Germans in the commercial field is in part due to their system of national education, which prepares every man for some vocation and does it thoroughly. We are by no means desirous of copying it in its entirety, as it possesses grave defects on its ethical side and in its extreme cultivation of materialism in its worst aspects; nevertheless, we can usefully draw some lessons from it.

Our own educational systems are too bookish, too much devoted to the cultivation of memory and words, and not sufficiently leavened by a real knowledge of the facts of nature and power to draw true inferences from observations. One barrier in the way of our industrial progress has been the imperfect scientific training of foremen, managers and young heads of departments in many engineering works. The young men who are brought in to fill directing positions have generally received the usual public or middle-class school education, with its entirely insufficient attention to scientific subjects. Even when this has been supplemented by a course at a technical college, the time at the latter has been so much taken up with learning things which ought to have been learnt at school that the opportunity of acquiring advanced scientific knowledge or real power of independent investigation has been very much curtailed. Hence, when once immersed in business it has been impossible for them to keep up with scientific advances, and they can at most copy what they see others do. We have to produce more men who can do new things, and not merely know about old ones.

Until this state of affairs is remedied it is perfectly futile for Great Britain to hope to gain pre-eminence over Germany in scientific industries. The advantages which we have in greater originality of mind and better workmanship are neutralised to a large extent by the want of a sufficiently thorough and broad scientific education to enable us to see the practical value of, and work out exhaustively, and especially with reference to trade purposes, the openings given by scientific discoveries. It is the want of this sufficiently thorough scientific education which accounts for the limited faith of many employers and capitalists in scientific research, and also for the inability of the practical worker to take advantage of, or see the meaning of, facts which present themselves to him in his every-day work.

One of the educational reforms which seems most necessary is the compulsory attendance of lads after leaving the board school at a technical continuation school. Assuming he leaves at 14 or 15 and is taken on at an engineering works, it should not be optional whether he attends a continuation technical school. He should be compelled to do it until he is 17 or 18 years old, as in Germany. This continued education should not be merely a handicraft training, but should be a careful instruction by practical engineers in mechanical drawing, graphics, mechanics, physics, chemistry, metallurgy, electrotechnics, and machine construction. The attendance should not be allowed to become irregular, and the certificates of proficiency should have an immediate effect on the lad's prospects of advancement.

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In the case of young men of higher social rank who have been to public schools, the practical experience in the shops and drawing office should not be deferred entirely until after the college course. The school education should have provided them with a thorough grounding in the elements of chemistry, physics, and mathematics, pure and applied, and a speaking acquaintance with at least one modern language. One year at a university or technical college should then prepare them to take advantage of some shop experience, and after that they should return to the college for a year or, perhaps, two for the advanced laboratory and designs work.

The degree or diploma examinations should be made to depend more than at present on the results of practical laboratory and drawing-office work. My experience is that students who come straight from school to college for three years without break are less serious workers than those who have had some experience in an engineer's shop and then returned to the college.

In order to compress into this time the necessary training, our methods and means of instruction must be much improved. It is essential now for every engineer to have a good working acquaintance with certain branches of mathematics. If he has no knowledge whatever of the calculus or trigonometry he finds it impossible to read many original papers in the technical journals. In teaching electrotechnics to young engineers, I find I have to give much time to imparting elementary mathematical knowledge which ought to have been gained elsewhere. It should, however, be taught by engineers to engineers.

The great thing to guard against on the part of the student is premature specialisation. He should broaden as much as possible his knowledge of the principles of chemistry, mechanics, physics, mathematics, and metallurgy, and he will then be able, later on, to build up on this foundation. Unless he does lay this foundation he will not be able to follow or assist in improvements. As an illustration of this, we may take subjects such as telephony or wireless telegraphy. It is impossible now for anyone to make any really important addition to these subjects who has not a very competent knowledge of physics and some parts of mathematics. The easier problems are worked out and the design of telephonic systems or radiotelegraphic stations has become a matter in which advanced scientific knowledge is an important factor. Then, again, to make any advance in metallurgy requires a very intimate acquaintance with the chemistry of metals. A lucky accident might give a clue to an improvement, but an observer not sufficiently acquainted with modern chemical principles could not take advantage of it or follow it up.

In the third and fourth year the student will, of course, have given time to learning as much as possible of the methods of testing—both mechanical and electrical—required in engineering work, the especial object of which is to enable him to deal with the kind of problems which will present themselves in practice.

It is of extreme importance that he should acquire sympathy with and confidence in scientific research to give the data for engineering work.

We then turn to the subject which it is our purpose more particularly to discuss, viz., the relation of scientific research to engineering practice.

There are first the laboratory researches, which aim at determining various physical constants of the materials used in engineering which are requisite to give data for design. This knowledge can never be made too accurate or too complete; but the moment one goes to any of the well-known pocket-books or tables of engineering data it is astonishing to find the wide gaps in our knowledge. Hence, we require abundant provision for re-determining these values for particular samples of new materials to be used in bulk for various purposes.

In the second place, there are those researches which aid engineering by providing new methods of examination and test of materials or structures. An an instance of this, consider the invaluable aid rendered by what is now called metallography, or the study of the internal structure of metals and alloys by the aid of the microscope. Every engineering student is now familiar with the processes applied and with the immensely important knowledge that has been gathered as to the composition of steels and other alloys by this method.

The great development of pyrometry and high temperature thermometry by the invention and improvement of the thermo-junction and radiation pyrometer and the electrical resistance thermometer have provided the engineer with implements of great accuracy for the measurement of high temperatures and made it, in fact, an exact science.

The improvement in the means of testing the mechanical or elastic properties of engineering materials by testing machines is another instance of the same class of research. Of late years, the appliances for testing the mechanical properties of materials under repeated stresses, vibrations or blows have become important in giving the dynamic as contrasted with the static stress properties.

In the third place, we have a type of research which calls for special aptitude and insight, viz., those which lead to the discovery of some new process, material, or machine.

An excellent example of this is the discovery which rendered the production of metallic aluminium in bulk a commercial possibility; further examples of the same important class of researches are given in the production of the various alloy steels with extremely valuable properties.

This originative power is partly due to natural gifts, partly to effective training, and partly to the possession of sufficient appliances and means.

Originality stimulates originality; a really great investigator not only discovers himself, but imparts something of his powers to his associates. Hence we require to establish and strengthen those research institutions such as the Cavendish Laboratory, Cambridge, or the Royal Institution, London, where notable scientific investigators have established schools of research and imparted some of their great powers to students and colleagues.

In providing a large mass of accurate scientific data for use in engineering, the National Physical Laboratory has given most valuable service for the last twenty years. Nevertheless, there are matters requiring assistance for which even its present resources are insufficient.

In Germany much of the technical research work is carried out by private associations of the trades concerned. In Great Britain manufacturers in the same trade are far too prone to regard one another as rivals, whereas in the future they will have to stand shoulder to shoulder much more against their common and German antagonists, who will be united against them. In many matters it would pay British firms in the same business to promote scientific research in common on certain problems of manufacture, subscribing together the funds to undertake it either at a National Technical Laboratory or at some Technical College or University which may be provided with the proper equipment. Such information when obtained would then only be communicated to the members of the association or union.

The same principle of common action might be brought to bear upon the collection of information as to what is being done in certain branches of manufacture; the establishment, in fact, of an information bureau common to certain firms or manufacturers. Trade associations such as the British Electrical & Allied Manufacturers' Association are doing and could extend this work with great effect.

As a rule, British technical firms do not expend anything like the same labour or money over their intelligence departments as German firms. The latter gather in from all countries every scrap of information which can assist them, both from scientific and technical papers and patent specifications. The first direction in which our advances should be made is in improving the means for obtaining this early information on possible improvements and advances.

Many important problems which need attention are very large ones and will require the assistance of many experienced men. Such problems are the conservation and more economical use of our national coal supply, the universal adoption of gas or of electric heating in place of the wasteful combustion of raw coal in domestic fireplaces, and the electrical transmission of power from coalfields to great cities. Hence, it is to be hoped that the principal engineering institutions will unite in a strong request to the Government, if they have not already done so, to place representative engineers upon the Advisory Council, and also that in the disbursement of funds allocated to the assistance of industrial research, these institutions, as bodies, shall be to a considerable extent the avenues through which it is dispensed.

The present policy of the Government and of the Board of Education seems to be the creation of fresh committees and boards, whilst setting on one side the existing learned and technical institutions, which include in their membership all those who have special knowledge and eminence in their various subjects.

Mr. Runciman has recently appointed certain committees to report on measures to safeguard the commercial interests of the iron, steel and engineering trades, and on shipping and shipbuilding. The Advisory Council for Scientific and Industrial Research is also appointing standing committees to deal with mining and metallurgy, and an engineering committee is promised as well. Furthermore, the Royal Society recently called a conference of about 25 of the chief scientific and technical societies, and it was decided to form a board to advise the Government on any branch of scientific inquiry which may be brought before it. The result of all this must be to diminish rather than increase the very organisation and co-ordination required.

The existing scientific and professional societies, if properly organised, would supply all that is required. These engineering institutions and societies should take a leading part in guiding the fortunes of the industries they represent, and not be reduced to the level of mere paper-reading or discussion societies.

At present, the Government prefer to ignore the existing societies and create fresh bodies of their own selection. The result will be to weaken these existing institutions and societies.

It is essential to guard against the bureaucratisation of science, and the safest and most simple method of avoiding this would be to make the great technical and professional institutions the means of advising upon the most important steps to be taken in aiding technology.

We have first to create a great change in the attitude of the public mind towards scientific knowledge and research and develop the conviction that until it is regarded as a most serious pursuit we shall fail to make any firm advances towards victory in industrial war.

No one who has studied German methods can fail to admit they have realised fully in commercial matters the truth that union is strength. Our ideal has been largely individualism

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and competition, theirs has been organisation and co-operation. The German commercial system is essentially militant in nature and organisation. It is all part and parcel of the plan to achieve world conquest at any cost and by every means. Our post-war policy cannot, therefore, be simply defensive. No tariff wall can be built so high, no boycott of German goods so thorough, as to defend our position in the absence of a positive and vigorous policy of attack. Hence, the first condition of success must be association and combination, and the second the scientific method in all things.

The first principle of scientific investigation is to collect the facts and to draw deductions only by the light of full knowledge. The inference is that our information about foreign markets must be greatly increased. This means that our Consular reports must be improved, that foreign agencies must be staffed with men who have the necessary linguistic and scientific accomplishments, and that the study of foreign markets and of the nature of the foreign demand for goods shall be made a scientific study.

In the main, however, we have to rely on bringing to bear scientific knowledge of all kinds upon the manufacture and distribution of goods and obtaining foreign markets for the same.

The importance of a true education in science is that it leads to love of accuracy as to facts, loyalty to scientific truth, unwearying labour in obtaining it, and care in the inferences derived from it. We have to cut ourselves adrift from all the past, its easy, self-satisfied mediocrity, dislike of trouble, and contempt for knowledge.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electricity in War Areas.

My thanks are due to you for the copy of the ELECTRICAL REVIEW which reaches me here regularly. Even though one is not actually filling one's corner in the work at home, it is very gratifying to read of what others are doing, and of what is happening in the wide circles of electrical science and engineering.

Your correspondent's description of the utilisation of derelict machinery in the war area is very interesting. I have seen many instances where otherwise wasted energy could be made use of with advantage—ancient flour mills with overshot wheels offer very good scope in this direction. By the way, the condition of the wooden-teeth pinions in some of these old mills is really surprising—they have a wonderfully long life.

Perhaps it is not looking too far ahead when we express the hope that we shall soon see some examples of German engineering ingenuity "behind the line," an article on which appeared in the REVIEW some little time ago.

J. H. Pembrey,
A.S.C., M.T.

British Expeditionary Force, *April 30th*, 1916.

The I.E.E. Election.

I have just returned my ballot paper to the Secretary of the Institution of Electrical Engineers, and I regret to say that I consider myself justified in having erased the name of Mr. Sparks, who has apparently been nominated by the Council as President of the Institution for another year.

My action has been prompted through no hostile feeling on my part towards Mr. Sparks, because, as a matter of fact, I very much admire the way in which he has carried out his duties during the past year, but I entirely disagreed with the practice of electing presidents for two successive years. There are any number of eminent gentlemen who could quite well fill the position satisfactorily.

I believe there are any number of people who agree with the above sentiment, although they probably do not take the trouble to express their opinions in writing.

I am in entire agreement with the remarks regarding this matter which appear on p. 386 of your journal dated 7th ult.

I enclose my card, and sign myself

President for One Year Only.

May 3rd, 1916.

Justice for the Inventor.

Your leader, and the letter in the current issue of the REVIEW on the above subject, will certainly be appreciated by everyone interested, but more especially by those, like myself, who were just applying for a patent when the war started.

Briefly to state my own case: For some months before the commencement of the war I worked hard to perfect a device for which, at that time, there was a certain market; there were but a few days between the outbreak of hostilities and my application for the patent, and, hoping for the best, I paid the money, which I have since sorely needed.

The patent was granted, and I have since submitted the invention to certain people with a view to their adopting it; the opinions expressed regarding the merits of my invention were very pleasing, but there will be no market for it until we return to a state of peaceful industry. Three months from now, two years of the life of my patent will be gone, and as my invention is not of much use in connection with the manufacture of munitions, it is exactly in the position it was in when the patent was granted, and will probably remain so until a considerable time after peace is restored.

Nevertheless, if when the renewal fee is due I have had no return for my labours and initial outlay, and cannot afford the amount demanded, I lose everything. This is not very encouraging for British brains to help to capture the trade previously held by the enemy. It could hurt nobody, and would be only justice to the patentees, if patents which were shown to be adversely affected by the war were granted an extension of life, or, rather, a "stay of progression," equal to the duration of the war—by which I mean that the renewal fees and the ultimate expiration of the patent should be deferred to the extent of that period; but it must be free, or in many cases, like my own, it would be useless.

Invention is the seed of industry; therefore, if those who cultivate it are discouraged, there will be a scarcity of the seed.

G. W. W.

The Electric Cooker in India.

While agreeing generally with Mr. C. S. Jeffrey's article under this head, may I say that servants are not quite so impossible as he would make them. When I was transferred from Calcutta to Simla my servants aggregated 85 years' service, several having been with me over 15 years, while other long-timers died in my service earlier. Also, the fetish of charcoal for the kitchen is easily overcome. My cooks have always used coke except for pastry making. I have found the electric kettle and iron invaluable, but they *must* have an earth wire, for the reason given by Mr. Jeffrey.

J. W. Meares.

Clive Hall, Shrewsbury, *May 7th*, 1916.

INDIAN NOTES.

[FROM OUR SPECIAL CORRESPONDENT.]

No report has yet been made public as to what took place at the meeting of Government electrical officials in Calcutta last cold weather. Their deliberations lasted over a week, and they are said to have worked very hard: the only tangible result up to now seems to be that a very good photographic group was taken—copies of which adorn their office walls in each presidency.

Mr. J. W. Meares, the electrical adviser to Government, has gone home on furlough, and his work is being done by Mr. C. C. Eastgate, who is Government electrical inspector to the Punjab. Mr. Tufnell, the electrical inspector to the United Provinces, has joined the Army, and his work is being done by Mr. Bell, who is municipal electrical engineer to Mussoorie Municipality. Mr. Warren ably assists Mr. Bell as assistant electrical inspector. Mr. R. J. Browne, electrical inspector to Bengal, Assam, and the new Province of Behar and Orissa, has gone home on sick leave. His duties are now divided between Mr. A. N. McIntyre, who takes over sole charge of Behar and Orissa Province, and Mr. A. K. Taylor, who is acting as electrical inspector in Bengal.

Lucknow.—The work of building and equipping the new power-house is making progress. This is in the hands of Messrs. Crompton & Co., who have now accumulated a rare experience in town lighting in India. No certain date is yet given for actual supply of current; but, judging by the multiplicity of electrical contractors now opened up in Lucknow, wiring work should be brisk—and inexpensive. The great ambition of the average Indian electrical engineer—be he the result of a technical college or, as more often is the case, the result of a few months' so-called apprenticeship with a European contractor firm—is to start on his own, open up a business with a high-sounding name, and get a few jobs, mostly from among relatives, and then, in most cases, go "phut," as the saying is, either from want of capital or, which is generally the case, from want of experience. Allahabad, which, as well as its sister city Lucknow, is going to have an electrical supply shortly, is also a happy hunting ground for the small one-horse contractor. This city is also being equipped by Messrs. Crompton & Co., and a good return

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should be shown after a few years' working. In Indian cities like Lucknow and Allahabad, a certain revenue can be always counted on from large Government offices and buildings—a revenue almost large enough to pay interest on capital and establishment charges annually. The surplus may fairly be counted upon as profits. The hot-weather load, with its innumerable fans, is, of course, a feature of Indian electric supply.

It is surprising with what regularity machinery and electrical accessories are still imported to India, in spite of the immense shipping difficulties. Of course, the delays are considerable; but with a little patience the goods get here some time. Shortages are, perhaps, noticeable now in electrical accessories, particularly rubber and flexible wire, especially the latter.

Japanese electrical goods are making great headway, especially insulators, lampholders, flexible wire, and so on. The material is passable, though not up to English standard; insulators particularly are below the mark, their finish, instead of being white or creamy, is of a grey-bluish tint, due probably to the glaze. The adaptable Japanese will shortly, however, better this, and given another year of present conditions he will have a very firm grip on the Indian electrical market for light material.

WAR ITEMS.

Exemption Applications.—On the application of Mr. Dashwood, electrical engineer, the Canterbury Tribunal has granted another month's exemption to a wireman.

At the Newcastle Tribunal, an electrical engineer appealed on the ground that he supported his parents, and that his occupation was a reserved occupation. It transpired that his parents were not wholly dependent upon him, and that his occupation was with a cinematograph company. When told that he must serve, he asked whether he could go into a munition factory, and was told that he must fight.

At the Brighton Tribunal a lecturer in physics and electricity at the Brighton Technical College appealed for exemption on the ground of the importance of his work. The Brighton Education Committee also appealed for him on the ground that the work he is engaged in is of more national importance than his services in the Army would be. Six months' conditional exemption was granted.

At the Southport Tribunal a firm of electrical engineers asked for the absolute exemption of a branch manager on the ground that they were engaged in the supervision and carrying out of important Government sub-contracts and other jobs of national importance. He was 35 years of age, and the only eligible single man in their employ. The Tribunal said that it was not prepared to deal with the application; it would simply mark the man as at present holding a badge.

Before the Rawmarsh Tribunal, on May 5th, five employés—four connected with the generating station, and the other a motor-man—were appealed for by the Mexborough and Swinton Tramways Co. Mr. Priestley said that two of the men were switchboard attendants, and, in reply to the military representative, stated that there was not a girl on a switchboard in any generating station in the country. The military representative said he knew of cases of girls attending switchboards in important places, such as large theatres. If they could do that they could, with a little training, do the work of these men. The Chairman said he did not think girls could do the work of the generating station. A member suggested that older men could be obtained, and Mr. Priestley replied that there were great difficulties in the way of getting other men; considerable training would be required. The Tribunal granted exemption to each man until the end of June, the military representative in the meantime to ascertain whether the men were legally exempted under the heading of "Public Utility Service."

Before the Cornwall Appeal Court, Mr. John Jewell, of Redruth, appealed for exemption for his son, Mr. Wm. Jewell, electrical engineer, who was in charge of an electrical plant at a tin works. The Local Tribunal had granted two months' exemption. The Court considered that another man at the works could carry out the duties, and the appeal was dismissed.

At Nuneaton, exemption was appealed for on behalf of Mr. A. N. Lilley, aged 18, a pupil in the electrical engineering department of the Corporation. It was stated that the indentures expired on October 30th, and at the end of that period he would be put in the Officers' Training Corps or under the Admiralty. Exemption was allowed to the end of May only.

At Glossop, the Urban Electric Supply Co. appealed for a motor-man, but the request was refused on the ground that he was not in the position he held on August 15th, 1915.

At Dover, on May 3rd, exemption was applied for by the Corporation for Mr. Goodwin, traffic clerk on the tramway staff. It was stated that he was the only clerk left. A member asked if a woman could not do the work, and a negative reply was given. Exemption was allowed for two weeks from May 29th for a substitute to be found.

The Whitehaven Tribunal have granted exemption until June 20th to the son of a principal of a local firm of electrical engineers, and engaged in the business, which caters for firms who are on war work. It was stated that the only male left was a Belgian, and that the places of men who had left had been filled by women.

At Gloucester, the Corporation appealed for a motor-man engaged on the tramways. Mr. Corson, for the Council, said the time was quickly approaching at which the employment of women as drivers must be settled; it was a question whether women should be employed in such a capacity. As the service was still normal, it was contended by the military that it might with advantage be curtailed, and a number of men thus released. The appeal was put back to ascertain what arrangements could be made for releasing a portion of 13 attested motor-men who remained in the service.

Before the Gloucestershire Appeal Court, the Bourton-on-the-Water Electricity Co. applied for exemption for their assistant electrical engineer, on the ground that he was in a certified occupation—public utility service. It was explained that the installation supplied 1,463 lights, while the company ran a motor pump at the local hospital. The assistant engineer was the sole man in charge of the Bourton installation, his chief was stationed at Burford, and if he went his place could not be filled, and the town would be left without artificial light. The Tribunal granted exemption until Michaelmas.

The Herts County Tribunal has dismissed an appeal for further exemption for G. E. Way, electrician at the Berkhampstead Picture Palace, for whom a substitute had not been found.

At Oxfordshire Appeal Court, the military appealed against exemption granted by the Local Tribunal to Raglan D. Price, of the Oxford Electric Tramways staff, on the ground that he was not in a certified occupation. It was contended that Price only did the work of a mechanic. Mr. A. A. Tyler, manager of the tramways, said that Price examined the engines and fittings of 'buses, which were at the disposal of the military for the wounded free of cost. He was a fitter and did fitter's work. The appeal was dismissed, but the exemption was varied, and granted until November 2nd.

At Horsham, on Monday, a private estate electrician claimed exemption on the ground that he was indispensable, but he was allowed only a month's postponement.

At Bath, on Monday, the military appealed against exemption granted to Mr. W. J. Fussell (23), engaged with Messrs. Kendall, electrical fitters, and said that the man was employed in a private concern and should be released for service, while the age for men in this occupation to be regarded as reserved men had been raised to 30. The appeal was allowed, and exemption cancelled.

At the Stockton-on-Tees Tribunal, exemption was sought for 16 drivers employed by the Imperial Tramways Co., Ltd., on their Middlesbrough, Stockton and Thornaby system. It was stated that 115 men had been released by the company and provision made for their dependents. Since the last appeal to the tramway employés, a representative of the Ministry of Munitions had visited the company's premises, and, after investigation, admitted that the absolute limit had been reached so far as the release of men was concerned. The Chairman said the Tribunal was of the opinion that the number of drivers could be reduced, and that the single men should be spared. Mr. F. Freshwater, manager, replied that for every three men they took away, it would mean the taking off of a tramcar. Conditional exemption was granted in regard to nine drivers who are over 25 years of age, but the remaining seven were dismissed.

Russian Pressspahn.—A writer in a Russian semi-official journal, complaining of the want of tone in Russian industry, observes that the production of insulators in the country might be extensively developed, including special cardboard. Until the war opened, this cardboard—pressspahn—was imported from abroad, "that is Germany." When the war started, it was found that pressspahn could not be had at any price. But after inquiries, pressspahn was found within the boundaries of Russia itself. It appears that in Russia the manufacture of pressspahn and fibre has existed for a long time, but electrical industrialists were quite unacquainted with the fact. There were factories making pressspahn and fibre, using the pressspahn for binding copybooks and block notes, and they sold the fibre for the manufacture of peaks for caps and for cartridges. But pressspahn and fibre for electrical insulators were ordered from abroad. "These examples are extracted from the latest publications by the industrialists themselves. They are astonished by the fact, and are endeavouring to throw the blame on third parties."

Lighting Prosecution.—The manager of a large Middlesbrough drapery and furnishing establishment, when charged on May 2nd with having failed to observe the lighting regulations, pleaded that it was the fault of an electrician who had been doing work on the premises, and had tapped the wrong main. Instead of tapping one of the mains through the shop, he tapped a main controlling the lights in the whole of the windows. A junior switched up the lights in mistake.—Fined £2.

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Johannesburg and Trade After the War.—According to the "South African Mining Journal," the Executive of the Johannesburg Chamber of Commerce has submitted a series of recommendations on post-war trade. They urge co-operation between the Imperial Government and the Dominions so as to make the Empire self-supporting; that the Imperial and Dominion Governments should be urged to encourage, for a period of years, the continuance by subsidy or otherwise of new and "key" industries established within the Empire prior to or since the commencement of the war, or which may hereafter be established; that the assistance of the Imperial and Dominion Governments in the organisation of industries is essential to a more complete development of the Empire's resources with a view to ensuring that each industry shall be enabled to obtain all its requirements from sources within the Empire itself; that steps be taken to prevent dumping and under-valuation of all foreign goods imported into British markets after the war, and certificates of origin should be required to be signed by British Consular agents; that the British Consular service should be strengthened by the appointment of men qualified to safeguard and promote the interests of British trade; and that it is of the highest importance that various Governments of the Empire should take steps for the development of technical institutions and scientific research, and their adaptation to industrial and commercial ends. They further urge that the Union Customs tariff should be amended in order to provide for preferential trading between all parts of the Empire; reciprocal arrangements with foreign countries, excepting present enemy countries (against whose produce and manufactures a prohibitive tariff should be enforced), and a special tariff on a prohibitive scale against the products and manufactures of present enemy countries; differential charges against enemy shipping; the prohibition of the entry of enemy trading journals, catalogues, and price lists; that no trading licences be issued to enemy subjects or to agents of enemy firms; that no foreign patents be allowed to be held in South Africa unless they are worked or the articles so patented are made in the British Empire; and that Government departments, municipalities and other bodies administering public funds should be required to confine purchases to products and manufactures of British firms whenever articles required are obtainable within the Empire.

Trading with the Enemy.—In the Cape Town House of Assembly, on April 26th, according to a Reuter dispatch in the "Times," the debate on the Enemy Trading Bill was resumed. Mr. Burton declared that the Government were determined to pass the measure during the present Session. General Botha described the measure as a deplorable necessity, but nevertheless a necessity, for the protection of the inhabitants of South Africa. He quoted a German Act of Parliament dealing with British interests in Germany, adding that if Germany at the end of the war refused to return the goods of British subjects, South Africa would be in a position to adopt a similar attitude towards German goods.

In the "London Gazette" for May 9th there appear new schedules of persons or bodies with whom trading is prohibited in the following countries, and alterations in previous lists:—Denmark, Greece, Japan, Norway, Philippine Islands, Portugal, Sweden, Brazil, Netherlands East Indies. A number of well-known electrical names appear in the lists.

Scarcity of Metals in Austria.—Reuter's correspondent at Zurich reports that lead and tin are now required very badly for military purposes in Austria, and new decrees have been issued for their requisitioning. Manufacturers and merchants are required to give up 80 per cent. of their stocks of lead and tin goods, including plumbing materials, baths and boilers. Type founders, printers and newspapers are also required to give up 20 per cent. of their type. If such reports as these regarding German and Austrian metal supplies be correct, it is not easy to reconcile them with reports of a coming big after-the-war dump of manufactured goods—and any rate, in the metal-using trades.

Municipal Corporations and Enemy Contracts.—Hackney B.C. is recommended by its General Purposes and Establishment Committee to support the Manchester Corporation in adopting similar standing orders with regard to contracts with foreign manufacturers, viz.:—That in future no contract shall be entered into with any person of German or Austrian nationality, or with any firm or company whose subscribed capital (whether by way of shares or otherwise) is held or controlled to the extent of one-third or upwards by persons of German or Austrian nationality.

Bacup Town Council last week adopted new standing orders to the effect that no contract be entered into with any person of German or Austrian nationality, nor with any firm or company whose subscribed capital was held or controlled to the extent of one-third or upward by persons of German or Austrian nationality.

An Australian Board of Trade.—In a discussion by the Melbourne Chamber of Commerce as to how to remove German trade influence, one member suggested the creation of an Australian Board of Trade.—"Times."

The Paris Conference.—The Parliamentary correspondent of the "Daily Telegraph" says that the Economic Conference of the Allied Powers in Paris has been fixed to commence on Monday, June 5th.

To be Wound Up.—The following further companies have been ordered to be wound up:—

Coutinho, Caro & Co., 134, Fenchurch Street, E.C., metal merchants. Controller: N. W. Wild, 22-28, Broad Street Avenue, E.C.

Wolf Safety Lamp Co., Boston Street, Sheffield, engineers and lamp manufacturers. Controller: T. G. Shuttleworth, Sheffield.

E. M. Brinckman & Co., 99, Redcross Street, London, S.E., merchants (electric lamps, batteries and gas mantles). Controller: K. C. Fox, 45, London Wall, E.C.

Enemy Firms in Hong-Kong.—The "Board of Trade Journal" for May 4th contains a list of enemy firms in Hong-Kong under liquidation, to some of whom British firms, obviously under misapprehension, continue to send advertising literature, trade papers, &c. The following appear in the list:—Arnold Karberg & Co.; Bume & Reif; Carlowitz & Co.; Siemssen & Co., Garrels, Borner & Co.

Artificial Limbs for Returned Soldiers.—Following the example adopted in Germany, an exhibition is about to be opened in Petrograd of artificial limbs specially designed to enable wounded soldiers to follow industrial employment when they return to civil life.

LEGAL.

Hands *v.* J. Davis & Co.

An application was made to Mr. Justice Astbury, in the Chancery Division on May 5th, to enter judgment for the plaintiff in the action by Albert Hands against J. Davis & Co. (Southampton), Ltd., electrical engineers, of Bedford Place, Southampton, the defendants having entered no defence. The action asked for a declaration that the plaintiff was entitled to a charge on the company's assets to secure the payment of debentures.

His Lordship entered judgment as asked.

Charge of Bribery.

At Leeds City Court, last week, Thomas William West (37) a War Office viewer, of London, was remanded for a week on a charge of attempting to obtain a bribe from Mr. A. S. Taylor, of Armley, works manager of the Cremer Lamp & Engineering Co.

Mr. E. O. Simpson, for the War Office, said the defendant was a viewer, or inspector, in the Ordnance Department at Woolwich, and it was alleged that whilst visiting the Cremer Co.'s works at Leeds to inspect some lamps that were being made under contract, he offered to pass the lamps if he were given £5 half of which he would share with Mr. Taylor. There was another charge of falsifying accounts respecting the time spent in Leeds, which might be preferred against him.

The defendant pleaded "Not guilty," and said that after inspecting lamps Mr. Taylor took him to lunch, saying the "guv'nor" would pay, and it was suggested to him that he should stay the week-end and inspect some more lamps. He stated that he had not enough money with him, and, he alleged, Mr. Taylor said: "I could do with making a bit," and added that he would get £5 and they could go halves.

Ilkley U.D.C. *v.* Evans.

Before the Otley Bench, on May 5th, Edgar W. C. Evans, electrician, Bradford, was summoned for fraudulently diverting electricity at Ilkley on February 10th.

It was stated on behalf of the Ilkley Council that the defendant was manager for Messrs. Christopher Pratt & Sons, Ltd., of Bradford, who electrically wired a number of premises at Ilkley. Amongst these was a shop, into which was put an electric motor. It was later found that two lights had been connected with the power meter, and thus the consumer was able to obtain electricity for lighting at the power rate.

Mr. Sidney H. Bill, electrical engineer for the Ilkley Council, admitted in cross-examination that in Bradford and Leeds it was the custom to have two or more lights from the power meter, but this did not prevail at Ilkley. It was contended for the defence that the defendant had been accustomed at Bradford to connect one or two lights with the power meter.

Without asking the defence to call witnesses, the Bench dismissed the case, and ordered each side to pay their own costs.—*Leeds Mercury.*

Shrimpton and Another *v.* The Northern Light, Power, and Coal Co., Ltd., and Others.

This case came before the Court of Appeal on Friday, May 5th, upon the appeal of the plaintiffs from a judgment of Mr. Justice Peterson. The matter was referred to in our issue of December 24th, 1915.

At the conclusion of the arguments, their Lordships dismissed the appeal, with costs.

The Accuracy of Electric Meters.

At Morpeth County Court on 8th inst., the Northern Counties Electricity Supply Co. sued Andrew Foster, a local tradesman, for £1 15s. 4d. for energy supplied.

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Mr. P. Corder, who represented the plaintiffs, said it was a question of the accuracy of the meter.

The Defendant said he had refused to pay, because while he was using nine lights before the war, and had only used two since, the cost had been very much larger. He produced accounts in support of this statement. The meter had been changed three times.

One of the company's testers said the tendency of the meters was to go slower in use, rather than faster.

Mr. Biblis, one of the company's electrical engineers, said the last meter had been tested and found to be quite accurate.

Judgment was entered for plaintiffs, with costs.

"Z" Electric Lamp Manufacturing Co., Ltd., *v.* W. Denton, Ltd.

In the King's Bench Division on Tuesday, May 9th, this case was in the list to be mentioned before Mr. Justice Rowlatt.

Mr. Whateley was for the plaintiffs and Mr. Morle for the defendants.

It was stated that the defendants now submitted to an order for the payment of a sum of £32 4s. 6d., and High Court costs.

Adams Manufacturing Co., Ltd., *v.* Broadbent.

In the City of London Court, on May 5th and 8th, before his Honour Judge Rentoul, K.C, an action, which had been instituted in the High Court of Justice, was brought by the Adams Manufacturing Co., Ltd., Bedford, against Mr. Frank Broadbent, electrical engineer, London, to recover £71 for electrical switches supplied.

Mr. C. P. Blackwell appeared for the plaintiffs, and Mr. Fortune for the defendant.

Mr. Blackwell said that the claim was really reduced to £43 by payment. It was brought in the name of the Adams Manufacturing Co. by Mr. Hardy, who was appointed the receiver and manager for debenture-holders by an order of the Court on April 11th, 1913. Various contracts had been sanctioned by the Court. The claim was for electrical switches sold by Mr. Hardy after his appointment. The company ceased to be able to carry on business on the appointment of Mr. Hardy. Defendant had admitted that except as to £20 the rest of the claim was admitted, but he said that the claim had been assigned by the plaintiffs to the Igranic Electrical Co., Ltd. In fact, it was intended to assign the debt due to the plaintiffs to the Igranic Co., but it was never done. Defendant had not paid the Igranic Co. or the plaintiffs. Defendant had said that he granted to the plaintiffs full and exclusive licence and authority to manufacture and sell electric switches under letters patent, or any improvement or modification thereof. Plaintiffs agreed to pay defendant a royalty of 5s. on the price of every switch so manufactured. The agreement did not in truth confer on the plaintiffs any right to sell or manufacture in respect of any improvement or modification. There were several patents concerned; one had lapsed by effluxion of time because the defendant had not paid the necessary fees.

Mr. Fortune said that Mr. Hardy had gone, so far as the receiver was concerned, and the company were the real plaintiffs.

Mr. J. Morley, plaintiffs' solicitor, said that Hardy sold the business of the Adams Manufacturing Co. and the assets for £15,000 to the Igranic Co.

Mr. Fortune said that the wrong plaintiff was suing. The Igranic Co. had been using the defendant's patents for making electric switches on which defendant was entitled to royalties.

Mr. Blackwell said that the patents were not valid, and plaintiffs had been making the switches without licences, as they did not consider they were necessary.

When the hearing was resumed on Monday, the Judge said that the receiver and manager appeared to have sold the plaintiffs' business to Bacon, and Bacon sold to the Igranic Electric Co.

Mr. Blackwell: He did not sell this debt—that is the point.

Mr Fortune: They have given us notice of assignment of this debt to the Igranic Co., and the choice in action is in the Igranic Co. The sale was to take place on April 11th, 1913, The whole business passed to Bacon on that day. Hardy had no interest in the business; he was going to be indemnified as regards any outgoings. The claim is for electrical goods sold after April 11th. Hardy had it in trust for Bacon. Hardy could only sue as Bacon's agent.

Mr. Blackwell: Yes; but although the debt might become vested in Bacon, and that was contemplated, I say that it never has become vested in Bacon, although he can direct ultimately what shall be done.

Judge Rentoul was sure that neither side wanted to get a judgment that they could not hold when the other side went to the place which dealt only with points of law and had no conscience—the Divisional Court.

Mr. Fortune: They have treated everything as assigned to the Igranic Co. until they come to this action. We claimed this money we are now counter-claiming. The Igranic Co. have taken a part of the debt, and we are not claiming that.

Judge Rentoul said he could only consider the legal documents. No matter how many people had acted in the matter in another way, that could not affect him. If he could settle the case altogether—if there were no appeal—he might possibly look at what he thought roughly was the justice of the case, that did not enter into the matter at all.

Mr. Fortune: No. I am entitled to say: "I have a counter-claim against your principal, because you were only trustee or agent, and you have no interest in the action you are bringing; you are only a cloak for a principal." Leaving out the question whether the new patents are new patents or modifications, this action is by the receiver. I claim my minimum royalties on the 1906 patent so long as he has been receiver and manager.

Judge Rentoul: The first point is who is the right plaintiff and, as far as I can see, the plaintiff is the right man; the right to sue was never in the Igranic Co. There must be judgment for the plaintiffs on the claim. Now about the counter-claim.

Mr. Fortune said that must be regarded as another action in which the receiver was acting in the name of the Adams Co. The receiver had sold certain goods during the time of his receivership, and during that receivership there was a contract going on between the company and the defendant whereby the company were manufacturing under those licences. The receiver took no steps to terminate the licences; they went on for the life of the patent, subject to the company giving three months' notice.

Mr. Blackwell did not agree.

Mr. Fortune said the Receiver did not do that, and he sent out a notice wherein he said he was going to carry on the company as usual.

Mr. Blackwell added that the company went into liquidation on April 22nd, 1913. The company's business came to an end, except for the purpose of realising the assets of the company for the debenture holders. There was no contract continuing. There was no grant of improvements or modifications to the company.

Mr. Fortune: The company were manufacturing with a view to selling to the Igranic Co.

Mr. Blackwell: Not after the liquidation.

Mr. Fortune: Oh, yes.

Mr. Blackwell thought that if agreements which were made covered the new patents which were entered into, inasmuch as the company, during the time of the Receiver, did manufacture and sell on plaintiff's evidence under the new patents, the defendant might, be able to maintain a counter-claim against the plaintiffs.

Mr. Fortune said that Hardy could have repudiated the licence, but he sat on it, and therefore he had to pay the dead royalties, even if he never manufactured at all under it. He did not mind whether Hardy was acting for the Adams Manufacturing Co., or for Bacon, or for the Igranic Co. Defendant was entitled to £50 a year for 15 months, or £62 10s. from April 11th, 1913, to September, 1914.

Mr. Blackwell replied that the receiver and manager was neither a successor nor the assignee of any contract with the company. He did not come within the words of the contract at all.

Judge Rentoul: Could he repudiate it?

Mr. Blackwell: Yes, in the sense that he could say "I am not going to express my willingness to take over the contract;" but he is under no obligation to repudiate, because it is not a contract which is binding upon him. It is a breach of contract on the part of the company in not carrying out the agreement. They had failed by selling and manufacturing or by omitting to pay the dead royalty. Mr. Blackwell added that every one thought the Igranic Co. would take over the patents, but they did not do so.

Judge Rentoul gave judgment for the plaintiffs on the claim for £43 and costs, and for defendant on the counter-claim for £62 and costs.

BUSINESS NOTES.

Catalogues and Lists. — British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park, Manchester. — A number of new publications giving descriptive particulars and illustrations, and, in most cases, prices, of a variety of electrical manufactures, as follows:—

No. A56/A1.—Type EA oil-immersed auto-starters for squirrel-cage motors.
No. A56/B1.—Type MF rotor starters for A.C. slip-ring motors.
No. A56/C1.—Type D starters for D.C. motors.
Nos. L858/2-1 and L858/2-3.—A.C. single-phase watt-hour meters, type N.
No. L858/2-4.—Performance curves, and diagrams of connections, of type N single-phase watt-hour meters.
No. 312/3.—Horn type switch fuses.
No. 47/3.—Brake solenoids for single-phase connections.
No. 47/4.—Brake solenoids for three-phase circuits.
No. 322/2A.—Knife switches for low and medium-pressure switches, type B.
No. 7,703/1.—Westinghouse motor applications: Notes on the electrification of a modern flour mill.

Messrs. Simplex Conduits, Ltd., Garrison Lane, Birmingham. —List No. 627, illustrating and giving prices of several designs of inspection lamps for shells and other articles such as casks, carboys, &c., where interiors can only be inspected through small apertures. The largest design shown is for the inspection of the interior of hogsheads, and it is fitted with a spigot for removing stray corks. The smallest lamp shown is designed for the inspection of 18-pounder shells or other small work. Some of the lamps are fitted with small switches in the handles; some are without switches, whilst one specially robust type for munitions work is fitted with a standard tumbler switch in a convenient position near the handle. All the fittings are sent out complete with lamps and flexible, with earth-wire connected.

Messrs. Meldrums, Ltd., Timperley, Manchester. — 20-page illustrated catalogue of the Meldrum forced-draught furnace, with a host of extracts from tributes paid thereto by users in all departments of industry.

For Sale.—The Postmaster-General has for disposal, and is open to receive offers for, a quantity of surplus stores. The Corporation of Accrington Electrical Engineering Department invites tenders for one 175-kw., 460-D.C., direct-coupled generating set, and three 56-kw., 230-volt, D.C. Willans-Johnson & Phillips sets. Particulars are given in our advertisement pages to-day.

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Temperature Measurement.—During the past month the CAMBRIDGE SCIENTIFIC INSTRUMENT CO. have received contracts for temperature measuring instruments for various Home Government departments, also for the Victorian Government Railways, the Small Arms Factory—Lithgow, Australasia, and the Russian Government Supply Committee.

Australian Imports.—We have received from the Australian Association of British Manufacturers and their Representatives at Melbourne a copy of their statistical statement of competitive imports into the Commonwealth of Australia for the 12 months ended June 30th, 1915. The statement has been compiled differently from those previously issued, as it is considered that it will be of more value to give the totals and values of goods imported into the Commonwealth under preferential and non-preferential tariff rates, than to show the percentages of imports into each separate State from the United Kingdom. Further, as imports from Germany have now disappeared, figures are shown for imports from British Dominions and Possessions and the United States of America, as well as the United Kingdom.

The United Kingdom share of the Commonwealth imports of competitive manufactured merchandise (1914-15) was 64·9 per cent. We make the following extracts :—

IMPORTS FROM ALL COUNTRIES (1914-15).

CLASS.	Total.	Preference.	Non-Pref.
Metals—Manufactured	£9,441,123	£9,422,708	£18,415
,, Machinery	3,806,100	3,806,100	—
,, Miscellaneous manufactured	2,886,608	2,886,593	15
,, Bars, rods, blooms	933,594	933,594	—
,, Pig and ingot	258,167	241,555	16,612
India-rubber, and manufactures of ..	481,811	481,811	—
Instruments, scientific, surgical, &c.	543,463	388,384	155,079

ANALYSIS OF IMPORTS, 1914-15.

CLASS.	UNITED KINGDOM.						BRITISH DOMINIONS & POSSESSIONS.						UNITED STATES.					
	Total.		Preference.		Non-Pref.		Total.		Preference.		Non-Pref.		Total.		Preference.		Non-Pref.	
	£	%	£	%	£	%	£	%	£	%	£	%	£	%	£	%	£	%
Metals—Manufactured	6,789,184	71·9	6,787,503	72·0	1,681	8·8	306,224	3·2	306,224	3·2	—	—	1,717,099	18·1	1,710,204	18·1	6,895	36·4
,, Machinery	1,988,409	52·2	1,988,409	52·2	—	—	122,279	3·2	122,279	3·2	—	—	1,446,744	37·9	1,446,744	37·9	—	—
,, Miscellaneous manufactured ..	1,691,967	58·6	1,691,957	58·6	—	—	241,147	8·3	241,147	8·3	—	—	715,639	24·7	715,624	24·7	15	—
,, Bars, rods, blooms	728,672	78·0	728,672	78·0	—	—	4,693	·5	4,693	·5	—	—	115,887	12·4	115,887	12·4	—	—
,, Pig and ingot	162,176	62·8	152,357	68·0	9,819	59·1	59,013	22·8	58,150	24·0	863	5·1	25,830	10·0	21,074	8·7	4,756	28·6
India-rubber—and Manufactures of	214,929	44·6	214,929	44·6	—	—	86,703	7·6	86,703	7·6	—	—	118,669	24·6	118,669	24·6	—	—
Instruments—Scientific, surgical, &c. ..	257,061	47·2	182,994	47·1	74,067	47·7	8,610	·6	8,021	·7	589	·3	220,813	40·6	156,739	40·3	64,074	41·3

A copy of the annual report of the Association for 1915 is also before us. It shows that the number of members has increased by 35 to 270, of whom 134 are British manufacturers and 136 representatives of British manufacturers. The principal subject referred to is that of the Federal Income-Tax, a new tax to be imposed in addition to those previously in existence.

"The Federal Act imposes a tax on persons selling goods in Australia on account of persons not resident in Australia, or on account of companies not registered in Australia, and lays down that the principal shall be deemed to have derived from such sales a taxable income of 5 per cent. upon the price at which the goods were sold. The person selling the goods is made personally liable for the payment of the tax if he disposes of or parts with any fund or money out of which the tax could legally be paid. An amending Bill was later introduced which provided that goods shall be deemed to be sold in Australia on account of a person not resident in Australia or of a company not registered in Australia if any person in Australia receives a commission in respect of the sale of the goods or is paid a salary for obtaining orders for, or for influencing the sale of, the goods. During the passage of this amending Bill through the House, your Executive Council waited on the Secretary to the Prime Minister as a deputation, and protested against the unfairness of these provisions, pointing out that the British manufacturer who is sufficiently progressive to have an agent or representative in Australia who employs labour, pays taxes and generally contributes to the welfare of the country, would have to pay this tax on all business done by or influenced through his agent or representative, while the British manufacturer who is content to merely sell to some London merchant or to people in Australia by means of distributing catalogues through the post, would entirely escape taxation, and would thereby obtain a trade advantage over his more progressive competitor. Further, the fact that British Manufacturers require every assistance at the present time was accentuated, and that they already have to pay very heavy British Income-Tax on the profit on all goods manufactured at their works, whether sold at home or exported overseas. . . . The Prime Minister insisted that as the whole purpose of the Act is to obtain revenue, he could not agree to sacrifice that which would be levied under the provisions to which exception was taken, but after a lengthy debate he finally agreed to an amendment which exempts the agent from personal liability in respect of business done before June 30th, 1915, and also confines such personal liability to tax in respect of goods sold by the agent. The Prime Minister further undertook that the subject would be brought up by the Government for further consideration before the provisions as to the personal liability of agents come into operation, so that the matter will be discussed again by the House when the rates for next year are fixed probably about April or May, 1916."

The Executive Council of the Association have again placed their views before the Federal Government in writing, and have lodged an application for a date to be appointed for a deputation of members of the Association to wait on the Treasurer.

The Executive Council have on several occasions had before them suggestions that some steps should be taken to prevent enemy countries regaining trade which they have lost on account of the war, but as this is a matter so much bound up with questions of tariff, national treaties and future, discussion of terms of peace, they have found it difficult to formulate any definite proposals. The following resolution was unanimously adopted and copies have been forwarded to the Prime Minister, the Attorney-General and the Minister of Trade and Customs, and also published in the Press :—

That the Executive Council of the Australian Association of British Manufacturers and their representatives, bearing in mind the fact that countries at present at war with the British Empire are certain to make strenuous efforts to recapture trade which they have lost during the war, wish to impress on the Government of the Commonwealth of Australia the necessity of taking such steps as will absolutely prevent the importation of German and Austrian goods after the declaration of peace.

The Association has strongly urged the necessity of the British Government and British financiers, stipulating in regard to all future loans granted to, or underwritten for, Colonial Governments, that all money loaned must be spent within the Empire, and not, as has so frequently been done in the past, paid away to foreign firms.

The policy of the Association in endeavouring to obtain preferential treatment for goods of British manufacture has been persistently pushed on every possible occasion. The Cabinet of the New South Wales Government has decided that a 10 per cent. preference shall be extended to goods or material of local, British or Empire manufacture as against those of other countries. It was also decided that such margin of preference shall be inclusive of any preferential Customs duty that may obtain in the case of the particular material affected. All Government departments and corporate bodies operating under the ægis of the Government have been asked to give effect to this policy forthwith.

Electrical Trade in the Caucasus.—H.M. Consul at Batoum says that the electrical trade is a branch of British industry that might very profitably be developed in the Caucasus. Until the outbreak of war, and for some time after, the electrical engineering appliances and materials required locally came principally from Germany. If the intention to capture German trade under this head is to be realised, British manufacturers should take advantage of the present opportunity to prepare for the competition that will exist after the war. The needs of the Caucasus in all manner of electrical appliances from the smallest to the largest are indeed very great, and when normal conditions are resumed there is no reason whatsoever why British sources of supply should not be preferred to those of Germany. The quality of the articles produced in the United Kingdom is admitted in the Caucasus to be superior to that of German-made goods, but the question of price will have to be studied closely together with that of the terms of payment. In March this year most supplies were almost exhausted. The Consul says that if we are to successfully compete with German firms our manufacturers should enter the field now, if only for the purpose of making preliminary arrangements. Our travellers should speak Russian, and carry Russian price lists, with prices worked out in roubles at the current rate of exchange. Manufacturers of other countries are very alert just now in the Russian markets.

Trade with Serbia.—Dr. Svotosar Groich, speaking on Anglo-Serbian economic and political relations, at the London Chamber of Commerce, said that by freeing herself from the control of the Central Powers, Serbia would have to solve a very important and difficult economic problem, and she hoped and expected that England would give her adequate assistance in this work. British commercial influence in Serbia had hitherto been far too inadequate. The radical changes of conditions after the war, and the acquisition of direct commercial communication by sea, would enable England to occupy the predominant position hitherto held by the Central Powers in Serbia. To encourage Anglo-Serbian trade, it was necessary to organise a few Anglo-Serbian commercial and industrial syndicates of well-known and experienced business men of both nations.—*Times*.

Dissolutions and Liquidations.—BERNERS ELECTRIC CO., electrical engineers and contractors, 55, Berners Street, London, W.—Messrs. C. J. Heffer & F. E. Bayley, have dissolved partnership. Debts will be attended to by the Berners Electric Co.

CEDES ELECTRIC TRACTION, LTD., London.—First meetings of creditors and contributories, May 19th, at Carey Street, W.C.

M. & G. TRUCK AND ENGINEERING CO., LTD.—This Company is winding up voluntarily with Mr. C. Cooper, 30, Moorgate Street, E.C., as liquidator. A meeting of creditors is called for May 17th, at 14, Old Jewry Chambers, E.C.

ARDWICK ELECTRIC REGULATOR CO., LTD.—A meeting is called for June 9th, at 67, Princess Street, Manchester, to hear an account of the winding up from the liquidator, Mr. J. W. Shepherd.

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Bankruptcy Proceedings.—W. C. WILD, electrical engineer, Halifax.—Trustee (Mr. W. Durrance), released May 5th.

Trade Announcement.—Owing to increasing searchlight work and lamp-lowering gear business the LONDON ELECTRIC FIRM, of Croydon, require additional space, and they are building a new works at Brighton Road, Croydon.

Electrical Imports to the Argentine Republic.—According to a recent official return, the imports of electrical goods into the Argentine Republic, during last year, only attained a value of £751,000, as contrasted with £1,405,000 in 1914.

Book Notices.—*The Exporter's Handbook and Glossary.* By F. M. Dudeney. London: Sir Isaac Pitman & Sons. 5s. net.—The author had begun his work before the outbreak of war, and he has adhered to his original plan of preparing a permanent handbook to the export trade, resisting the temptation to point the commercial lessons of the war, about which so many other authorities are writing and speaking to-day. The book is intended to give an exposition of the principles and methods of export business which will assist British manufacturers and merchants who determine to secure a larger share of the world's trade. It consists of some 40 chapters, a glossary of abbreviations and terms used in export trade, and inset there are many useful specimen shipping documents, such as advice notes, bills of exchange, bills of lading, Consular invoices for different countries, Customs specifications, certificates of origin, a marine insurance policy, and so forth. It is an instructive and educative work throughout, and should be valuable to exporting firms and their employés, especially at a time when it is recognised that there is room for improvement in the commercial training of the younger generation who will have to play a large part in the maintenance and extension of our Colonial and foreign trade after the war. Among the matters dealt with in the course of its 40 chapters are:—The advantages and general principles of export trade; the indent; types of overseas importers; the native importer; the merchant shipper; the export agent; manufacturers' oversea representatives; travelling representatives; export advertising; a summary of methods to be followed in order to secure export trade. The author proceeds in the second part to discuss and describe such matters as financial machinery, bills of exchange, credits and terms of payment, and in Section 3 he tells how to quote to oversea buyers, how to prepare export catalogues, emphasises the wisdom of giving metric equivalents in all quotations, classifies the weights and measures systems of different countries, and handles such points as sampling, packing, marking, and methods of shipment. In the fourth section the subjects covered include freight, bills of lading, demurrage, marine insurance, Consular invoices and certificates of origin, Customs requirements, consignors' and consignees' liability, &c. In several places the author refers to the important part which must be played in certain markets by the technical representative who is able to supplement the efforts of the commercial or sales representative, especially in connection with mining and electrical machinery and other engineering classes of exports. He appreciates the importance of adequately compensating the right man, a direction in which British manufacturers have, unfortunately, played too often into the hands of the Germans in past days. One of the most interesting chapters in the book, so far as we are concerned, is that in which emphasis is laid upon the great part which must be contributed by reputable export trade journals. The author says that the solid basis of any general export advertising campaign must be the specialised export trade journal—systematically reaching oversea buyers who can be got at in no other way. He remarks that there are comparatively few, even of these, which can honestly claim effectually to fulfil their purpose, but those which really do offer sound value for the advertiser's money, are undoubtedly among the most potent levers available for creating and extending export connections. He proceeds to remark that figures of circulation are not to be regarded as the gauge of value in regard to the more respectable export publications. These often refuse to divulge such figures, knowing that the true test is quality rather than quantity, "which latter any mushroom print can guarantee, and even provide, without the advertiser being one jot the better for it." "The only circulation worth considering is that which covers the *bonâ fide* wholesale importers in a given market or markets." Elsewhere, in discussing the want of co-operation between commerce and finance in pursuit of export business, he advocates an adaptation of our present system to the needs of the times. There is a chapter on "How the Government Helps Manufacturers in which the part played by the Board of Trade in placing export trade information at traders' disposal is more fairly dealt with than is sometimes the case. From the foregoing summary of the contents it will be observed how complete a work on the subject Mr. Dudeney has set himself to produce. He has brought together a vast amount of most useful information in a very well-arranged form, and the book deserves, and, no doubt, will have, a ready sale among the commercial community.

"*Proceedings* of the Physical Society." Vol. XXVIII, Part 3. April 15th, 1916. London: *Electrician* Printing and Publishing Co., Ltd. Price 4s. net.

Telegraph and Telephone Journal. Vol. II, No. 20. May, 1916. London; G P.O. North, the Editing Committee. Price 3d.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXV, No. 4. April, 1916. New York; The Institute. Price $1.

"Science Abstracts." A. and B. Vol. XIX, Part 4. April 25th, 1916. London: E & F. N. Spon, Ltd. Price 1s. 6d. each net.

"Mechanical Engineers' Pocket Book." By W. Kent. London: Chapman & Hall. Price 21s. net.

"Anglo-Russian Trade: Exposure of the Russian Chamber of Commerce in London." London: *Daily Chronicle* Office. Price 6d.

The French Exporter is a new monthly journal for the "defence and the expansion of French interests." It will appear separately in the English and French languages. A number of interesting illustrated articles on such matters as the Lyons Fair, the Economic Conference, French automobile and carriage trade, &c., appear in the April number, a copy of which is before us. Price 1 fr. per copy; published at 24, Boulevard des Italiens, Paris.

International Company Law.—According to the *Manchester Guardian*, Sir John S. Randles, M.P., chairman of the Commercial Committee of the House of Commons, moved at the Congress, in Paris, of the Commercial Committees of the Allies' Parliaments: "That a reform of company law amongst the Allied nations is very desirable, with a view to enable business men of the Allied countries to buy and sell more freely." Money, said Sir John, lacked nationality; it went where it could find a congenial and profitable field. While money, however, was cosmopolitan, national boundaries remained, and a company was often under two jurisdictions, with an inevitable conflict of laws. The moment was ripe for the enunciation of an agreement upon leading principles of joint-stock company law such as could be accepted by virtually all European nations, and would be of incalculable convenience to all who were engaged in company enterprise, in addition to affording an inestimable stimulus to the investment of further active funds in this form of enterprise.

LIGHTING AND POWER NOTES.

Accrington.—YEAR'S WORKING.—There was a loss of £3,410 on the working of the Council's electricity undertaking during the past year, as against £3,670 in the previous year. The income was £35,247, and the expenditure £38,657.

The Tramways and Electricity Committee has decided to enter into a five years' agreement for an additional supply of current to the Calico Printers' Association.

Australia.—HYDRO-ELECTRIC SCHEMES.—A series of proposals for the generation of electric power by the utilisation of waterfalls in various parts of New South Wales is to be submitted by the Government to the Public Works Committee. The principal proposal is in connection with the overflow from the Burrinjuck dam, and would cost about £100,000; it would provide power and light in many towns and districts.

The Upper Clarence River would provide a hydro-electric scheme at a cost of £25,000.

The schemes have been tentatively recommended by engineers as the result of inquiries set on foot by the Government about 18 months ago.

The Sydney City Council, on May 1st, commenced the supply of electricity to Lane Cove (North Sydney) Municipal Council.

Additional plant is being installed in the rolling mill of the steel works of the Broken Hill Proprietary Co., Ltd., at Newcastle, N.S.W., and, in order to supply the necessary power, a further 1,000-KW. set is being added to the electrical generating plant.

Belfast.—YEAR'S WORKING.—For the year ended March 31st the net profit on the Corporation electricity undertaking—according to the *Northern Whig*—was £17,000, this being a record. The highest previous surplus was £13,175. The total receipts were, roughly, £115,000, and the expenditure amounted to £68,579. The output sold for lighting and power, exclusive of tramways supply, was 9,149,000 units, as against 8,193,000 units in the previous year; the tramways supply was 3½ per cent. less than in 1914-15. The excellent result is attributed to the growing power supply, coupled with the recent increase in price.

Blackpool.—ANNUAL ESTIMATES.—The electricity department's estimated income for the present year is £46,200, and the expenditure £26,925. Gross profit is estimated at £19,275, but capital charges will absorb £17,275, leaving an estimated surplus of £2,000, as compared with a surplus for the year just closed of £2,478. The estimated receipts are up by nearly £2,000. During the last three years there have been 1,028 new consumers.

Bootle.—PRICE INCREASE.—As from June 30th next, 12½ per cent. is to be added to the charges for electricity for lighting, power, and other purposes, except in cases where special agreements limiting the charges for electricity exist.

Bo'ness.—LOAN SANCTION.—The T.C. has been notified by the Secretary for Scotland that he is prepared to sanction the borrowing of an additional sum of £12,000 for the extension of the electricity undertaking, subject to the condition that one-twentieth of any sums borrowed under the sanction is paid off, or set aside, to a sinking fund annually. The Council has approved of the terms of the letter, and has agreed to ask the National Electrical Construction Co. to submit the particulars of the modified scheme, with estimates, for the acceptance of the Council.

Bury.—YEAR'S WORKING.—The profit for the past year on the Corporation electricity undertaking was £2,003, £1,000 of which is to go to the relief of the rates, and the balance to the reserve fund.

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Carnarvon.—Loan Sanction.—The T.C. has received the sanction of the L.G.B. to the borrowing of £2,680 for additional plant at the electricity works.

Chile.—A decree has been issued granting permission to Don Horacio Urrutia Gundian to install electric light and power systems in the towns of Illapel, Salamanca, and Vicuna.—*Board of Trade Journal.*

Continental.—Switzerland.—An influential Swiss electrical concern is the Columbus Electrical Society, formed some years ago at Glarus. It is associated with the Brown-Boveri group and possesses 75 per cent. of the capital of the Italo-Argentine Electrical Co., of Buenos Aires, which enjoys a concession similar to that of the Deutsche Ubersee Elektricitäts Gesellschaft, and has secured a number of private, municipal and State contracts. The Italo-Argentine Co. holds the majority of the shares in the electrical companies in the Argentine cities of Dolores, Courientes, and Pergamino.

Cumberland.—The C.C. has granted the Cumberland Waste Heat Owners' Co. permission to cross the Whitehaven, Egremont, and Cleaton Moor, and Egremont Main roads with electric cables, provided they are placed underground. Objection was taken to overhead lines on the ground of danger to the public in rough weather.

Dartford.—Increased Assessment.—The Assessment Committee has increased the assessment of the electricity undertaking from £450, rateable value, to £1,700, and the refuse destructor from £166 to £300. Notice of objection has been lodged.

Greenock.—Plant Inauguration.—Last week, a new 5,000-kw. Westinghouse-Rateau turbine set was started up at the Dellingburn power station, this being a duplicate of the one installed two years ago. The alternator is of the totally enclosed self-ventilated type with compensating windings. In the course of some remarks at the inauguration ceremony the convener mentioned that the output of the works in 1913-14 was 11,000,000 units, while it was expected that the present financial year would show an output of considerably over 20,000,000 units.

Horwich.—The U.D.C. has consented to the Bolton T.C. supplying energy to a consumer in the urban area, on condition that other applicants will be supplied.

Hove.—War Bonuses.—As a result of a petition from the employés of the Corporation electricity department, it has been decided to grant various members of the staff an extra war bonus of 3s., in addition to the present bonus of 2s. per week.—*Sussex Daily News.*

India.—All-Electric Colliery.—The Burelia Colliery of Messrs. Bird & Co. is the only entirely electrical colliery in India. Two groups of two shafts have been sunk, the power being supplied from a station at the Chichuria pits equipped with two 300-h.p. Belliss-Siemens generating sets. Four similar electric winding engines are installed, each driven by a 25-h.p., 500-r.p.m. motor, and having a capacity of 200 tons in eight hours, using single 15 cwt. tub cages. One pump is installed at each dip shaft with a capacity of 6,000 gallons an hour against a head of 320 ft. Four additional three-throw dip pumps on trolleys are also in use. Two Turbon fans are to be installed, one at Chichuria and one at Dahooka.

A ropeway in two sections is provided, to connect the two collieries with the screens, and this is driven by a 60-h.p. motor.

Llanfyllin.—Mr. R. A. Jones, who has completed an E.L. installation for the town, has offered to undertake the public lighting at £2 per lamp per annum. This, compared with the present cost of gas lighting, will ensure an annual saving of £30. The T.C. has decided to consider the matter at a special meeting.

London.—Hammersmith.—The Electricity Committee recommends the Council to conclude an agreement with the Osram-Robertson Lamp Works, Ltd., for a supply of electricity to Brook Green Works for a period of four years from April 1st, 1916, and afterwards, subject to determination by six months' notice, at 8d. per unit. The minimum guaranteed payment to be £5,000 per annum, representing 1,500,000 units.

Fulham.—Owing to the difficulty of obtaining adequate supplies of water from the river for condensing purposes in connection with the Council's electricity undertaking, owing to low tides and other causes, the Electricity Committee recommends that the circulating water pipes be extended further into the river, at an estimated cost of £1,500. The work can only be carried out during the summer.

Battersea.—Owing to the increase in the demand for electricity in the Nine Elms and Church Road districts, the Electricity Committee recommends the adoption of the scheme of the electrical engineer providing for a sub-station at Nine Elms, with a rotary converter, which, with mains, will cost £3,723; also for additional transformer and switchgear in the New Road sub-station, at a cost of £875, and an additional feeder cable at a cost of £780.

On Wednesday, last week, an inquiry, lasting six hours, was held into the application of the Charing Cross Electricity Co. to be allowed to increase its statutory charges during the war. The City Corporation, the L.C.C., the Port of London Authority, and about 30 private consumers appeared to oppose the application.—*City Press.*

Bethnal Green.—The B.C. has given notice to the Stepney B.C. of the commencement shortly of the supply of electricity in Bethnal Green.

Middlesbrough.—Bulk Supply.—The Cleveland and Durham County Electric Power Co. has approached the Corporation with a view to advancing the price of energy temporarily by 15 per cent., as from January 1st, 1916, until six months after the termination of the war. The matter has been left with a Sub-Committee pending a proposed meeting of the principal consumers of the Power Co.

Middleton.—Price Increase.—The charge for electricity for lighting has been increased by ½d. per unit, and for power purposes by 12½ per cent.

Newcastle-under-Lyme.—Price Increase.—Owing to the high price of fuel, the T.C. has increased the tariff for general electrical lighting by 5 per cent.; for power, by 16⅔d. per cent; cinemas, increase of 10 per cent. on lighting, and of 20 per cent. on power; North Staffs. Railway Co., increase of 20 per cent. on power; Messrs. Hammond's mills, increase of 10 per cent. on power.

Rochdale.—Proposed Loan.—The Gas and Electricity Committee has recommended that application be made to the L.G.B. for sanction to borrow £60,900 for extensions to buildings and plant at the electricity works. The T.C. has decided to call a special meeting to discuss the matter.

Salford.—Bulk Supply.—The Council last week adopted a recommendation of the Electricity Committee varying a resolution of February last relative to the supply of electricity in bulk, by agreeing not to require the Lancashire Electric Power Co. to supply a demand of over 2,000 kw. unless the company has the necessary plant available, and subject to reasonable notice being given by the Corporation.

South Africa.—The Boksburg T.C. has had under consideration an offer from the Victoria Falls Power Co. to supply the town with electricity under a 15 years' contract. Apparently the town has spent £13,000 on electric plant and buildings, and, if the offer is accepted, it will be necessary to dispose of the plant at an estimated loss of £4,300; it will also be necessary to spend £500 in connection with the proposed supply; assuming that the proposed supply costs an average of 1·25d. per unit, the addition of financial charges on the amounts above mentioned would bring the cost to 1·43d. per unit.

South Lancashire.—A correspondent informs us that the completion of the equipment of the Hulton Colliery Co.'s new pits at Huyton is being hindered by the difficulty in obtaining delivery of the equipment for the electric winders which are to be installed.

Torquay.—The Corporation Electric Light Committee has deferred consideration of the proposed increase in the price of current to the Tramway Co. until the expiration of the company's year of account in August next.

Walkden.—A new generating station has been completed at Lord Ellesmere's Mosley Common Collieries, in which exhaust steam turbine and air-compressing plant is installed: generating stations have also been erected at the Bridgewater and Ashton Field collieries.

Warrington.—Loan Sanction.—The L.G.B. has sanctioned the borrowing of £9,536 for extra boilers at the electricity works, and has authorised the work to be put in hand.

Wigan.—Proposed Extensions.—The T.C. has adopted a scheme of electrical extensions based on the recommendation of Mr. H. Dickinson, city electrical engineer of Liverpool. Application is to be made to the L.G.B. for sanction to the borrowing of £53,920 in connection with the proposal, which involves the installation of new boilers, turbine plant, &c.

Wolverhampton.—Loan Sanctions.—The L.G.B. has sanctioned the borrowing by the Corporation of £4,000 for the laying of mains and £2,000 for sub-station equipment in connection with the electricity undertaking. The Electricity Committee has entered into an agreement to supply the works of Arcorundum Abrasives, Ltd.

TRAMWAY and RAILWAY NOTES.

Accrington.—The last year's accounts of the Corporation tramways show total receipts amounting to £29,393, compared with £27,850, and working expenses amounting to £19,498, against £16,438 in the previous year. The passengers carried totalled 4,841,334; the traffic revenue per car-mile was 12·86d., and the working expenses 8·67d.

Bacup.—Representatives of the Bacup Tramways Committee and the Rawtenstall Corporation are to meet to discuss questions relating to tramway stages and fares, upon the suggestion of the Rawtenstall Corporation.

The Corporation has approved draft tramway rules and regulations, as amended by the L G B

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Belfast.—Year's Working.—At the quarterly meeting of the Corporation the annual statement of the tramway accounts, the details of which were given in these notes last week, was approved of after much criticism. Councillor Duff said that he did not think that a surplus of £5,000, was enough when other systems gave from £50,000 to £70,000.

Birkenhead. — Female Labour. — Some criticism having been made recently regarding the work of the women car conductors, Mr. Halsall (chairman of the Tramways Committee), made a statement at a meeting of the T.C., on May 3rd, to the effect that the women were doing their duty very satisfactorily. Inspectors had been specially employed checking the women conductors' pay-sheets on the routes during the hours of the heaviest traffic, and it was found that very few fares had been missed on the cars. The management were satisfied with the work of the conductors.

Blackpool.—The Easter traffic returns on the Corporation tramways were remarkable. They were only £100 short of an absolute record, being £3,380, as compared with £3,480 in 1914, which was £800 better than any preceding year in the history of the department.

A statement has been prepared showing estimated receipts on the tramways for next year of £76,000, and expenditure amounting to £46,200, leaving a gross profit of £29,800. Capital charges will absorb £19,800, leaving an estimated surplus of £10,000. For the year just closed the estimated surplus was only £2,500, but the actual surplus was £16,500.

Bolton.—Electric Vehicles.—The T.C. has agreed to a recommendation of the Electricity Committee that an electric charging station for battery vehicles be installed at Spa Road works; also that the attention of the various Committees of the Corporation using vehicles be drawn to the enormous advantages to be gained by substituting electric vehicles for other types, and that a deputation from the Electricity Committee confer with those Committees on the subject.

Bradford.—Electric Vehicles.—The Electricity Committee proposes to purchase an electric battery vehicle for conveying coal from the railway yards to the electricity works, and ashes from the works to available tips. The authorities will be able to compare the advantages of this vehicle with the railless trolley 10-ton conveyance which the tramway department has put on the streets to help local industries to overcome transit difficulties.

The *Sheffield Independent* states that the new vehicle on the railless trolley system, which is to inaugurate a service of goods haulage on the tramways made its appearance on Monday last; it took a 2-ton load to Wibsey, running at the speed of an ordinary tramcar when in touch with the overhead wires, and at the same time accumulating power for use when leaving the tramway routes. It will be regularly used for the purpose of conveying wool from railway depôts to the various warehouses in the city, and will greatly ease the strain caused by the shortage of ordinary cartage facilities.

Dublin.—Gangs of men are making good the damage caused by the rebel outbreak of Easter week. The damage done to the tramway system appears to have been exaggerated, as by the end of last week the power station and the distributing stations were virtually working as usual. Some damage was done to the rolling stock, as some of the cars were seized by the rebels to form parts of street barricades. The electric lighting, &c., in Sackville Street is, of course, badly damaged owing to the havoc wrought by the rebels, fires, and the artillery bombardment.

The Dublin and Lucan Electric Railway, notwithstanding the danger prevalent in the neighbourhood of Conyngham Road, was able to maintain a complete service of cars. The manager reports that during one period, hundreds of bullets passed over the company's buildings, though no material damage was done.

Gateshead-on-Tyne.—The question of paving in connection with the tramway doubling on the Bensham route is being discussed by the T.C. and the Tramway Co., the latter disagreeing with the Council's requirement that it shall pave margins at the road side.

Glasgow.—The receipts from the Corporation tramways last week totalled £23,152, which is the highest amount yet received during a normal week.

The Sub-Committee on Tramways Finance has agreed to recommend that the depreciation for the current year be at the same rates as for the preceding 12 months.

The Tramways Committee has decided to recommend that the works and properties of the department be insured against aircraft risks.

Halifax.—The Tramways and Electricity Committee has been authorised by the Council to carry out extensions at the Skircoat depôt, at an estimated cost of £2,700.

Nottingham.—The Corporation tramways, gas, and electricity undertakings have contributed £60,350 this year to the relief of rates, as compared with £71,000 last year.

Salford.—Year's Working.—At a meeting of the T.C. last week, Ald. Linsley, chairman of the Tramways Committee, said the Committee had a net balance of £18,000 on the year's working of the tramways, and it was proposed to borrow £4,000 from the reserve fund in order to contribute £22,000 to the relief of the rates.

Stretford.—The U.D.C. is applying to the B. of T. for an extension of time for the completion of the construction of lines authorised by the Stretford Light Railways Order, 1906, and the West Manchester (New Lines, &c.), Order, 1906.

Sheffield.—The Corporation tramway receipts during the Easter holidays totalled £11,439, an increase of nearly £3,000 as compared with the previous year.

U.S.A.—The Brooklyn Rapid Transit System has recently introduced an articulated car made up of two single-truck cars and a low floor vestibule for its street lines. This type of car is really of an experimental character, and data as to its working will be collected over a number of lines. The complete car is 62 ft. 10 in. overall, comprising the centre vestibule 13 ft. long, two car bodies each 20 ft. long, and two end platforms each 4 ft. 10 in. long. The car is fitted with a motor-driven coin register in the centre entrance vestibule, and the latter is provided with pneumatically-operated doors.

Chicago-Milwaukee Electrification.—The Chicago, Milwaukee and St. Paul Railway was expecting to inaugurate electrical operation on the second section of its electrified district about April 15th. The road has been operated electrically since last December between Three Forks and Deer Lodge, Mont., a distance of 115 miles, and the new electrified section comprises that part of the road between Harlowtown, Mont., and Three Forks, a distance of about 113 miles. This will make a continuous piece of electrified railroad for both heavy freight and passenger service for a total distance of some 228 miles.

The new electrical equipment having been in service throughout the winter months, Mr. C. A. Goodnow, assistant to the President, has authorised the statement that the results of the electrification have in every way exceeded their expectations. At times when the severe cold weather was seriously impeding operation by steam the electric locomotives were moving without any trouble. The new equipment has given satisfaction not only with respect to tonnage handled and the mileage made, but also with respect to regularity of operation and freedom from failures. One electric locomotive is taking the place of four steam engines and promises eventually, at full efficiency, to supplant even a larger proportion of steam locomotive power. Moreover, the electric locomotive handles its full tonnage at 15 to 16 miles per hour as against 8 or 9 miles per hour by steam. The mileage of the heavy trains drawn by electric locomotives is 200 in 24 hours, which compares with 114 miles by steam locomotives. On the 115 miles now operated electrically, 24 steam locomotives, Mallet and other heavy types, have been released already by the nine electric locomotives which are now in service, and the trains are moved more quickly and cheaply. The maximum loads will be 3,000 tons over the mountains, 3,450 tons between Deer Lodge and the mountains, and 4,500 tons between Bitter Root mountains and Deer Lodge. These trains will be handled with one engine except for short stretches where a helper will be used. A rough estimate is made at present that repair costs on the electric locomotives will amount to about one-half the expense of the steam locomotive. The regenerating braking feature is working as satisfactorily as are other features of the equipment. It is possible to dispense with the air brake entirely in ordinary operating, thus avoiding heating and possibly broken wheels, and the excessive wear of brake shoes, with a stopping of the freight trains every 10 or 12 miles to cool wheels.—*Railway Review.*

Wigan.—Year's Working.—There was a profit on the past year's working of the Corporation tramways of £663.

TELEGRAPH and TELEPHONE NOTES.

Dublin.—During the recent rising in Ireland, the rebels neglected to cut the Stock Exchange telephone wires; had that been done, Dublin would have been isolated and the troops at the Curragh would not have been warned in time. Fortunately, some of the military got to the Exchange on Easter Monday in time to protect it, arriving exactly three minutes before the rebels came to cut the connection.

Telephone for Forest Rangers.—A portable telephone, made of aluminium and weighing only 2·5 lb., the invention of a U.S. forest officer, R. B. Adams, will be part of the regular equipment of patrolmen in the U.S. National Forests during the coming season; it is regarded as a great improvement over the set formerly used, which weighed 10 lb. A field man equipped with this telephone, a few yards of light emergency wire, and a short piece of heavy wire to make the ground connection, can cut in anywhere along the 20,000 miles of Forest Service telephone lines and get in touch with the headquarters of a supervisor or district ranger.—*Electrical Review and Western Electrician.*

Trans-Atlantic Wireless Telegraphy. — Marconi's Wireless Telegraph Co., Ltd., announces the resumption of the deferred night and week-end letter services, which were suspended recently owing to the trouble in Ireland, and their traffic can now be expeditiously handled, as their land-line communication with the high-power trans-Atlantic wireless station in Ireland is restored.

Wireless Telephony.—Mr. Daniels, Secretary of the United States Navy, has communicated, by means of a wireless telephone, with the commander of a battleship off the coast. This is the first time communication by wireless telephone between ship and shore has been established.—*The Times.*

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Wireless on Aeroplanes.—According to the *Daily Express*, Mr. Marconi has succeeded in developing apparatus which makes it possible not only to transmit wireless messages, but also to receive them on aeroplanes, besides improving the reception on airships; he stated that the improvement would make wireless communication more efficient, and would make it more difficult for the enemy to intercept our messages. Hitherto it has not been possible to receive messages on aeroplanes, on account of the noise of the engines, but this difficulty has now been overcome. Mr. Marconi considered that the Allies were ahead of the enemy in science as applied to wireless work, but not in organisation. He stated also that wireless telephony from aircraft was already feasible, and that not too much importance should be attached to the German attempts to jam the wireless between our warships at sea.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—May 24th. N.S.W. Government Railways and Tramways. 16 600-volt D.C. motors for tramway stores, Randwick.*

June 20th. Sydney Municipal Council. Two-ton electric lorry. City Surveyor, Town Hall.

MELBOURNE.—May 31st. Victorian Government Railways. Transformers for five years. First order, 220 transformers in six months.*

June 14th. Victorian Railways. Electric lamps and lampholders for signal system.*

Belfast.—May 24th. Electricity Committee. Chain-grate mechanical stokers. See "Official Notices" to-day.

Canada.—May 15th. Ten knots of single-conductor submarine telegraph cable (107 lb. copper, and 150 lb. gutta-percha per knot) with iron wire sheathing, for Canadian Government Telegraph Service, Department of Public Works, Ottawa.*

Keighley.—May 22nd. Wiring of Fever Hospital and Sanatorium, Morton Banks. Specifications (10s.), Mr. H. Webber, Borough Electrical Engineer, Coney Lane.

Liverpool.—May 31st. Liverpool Overhead Railway. Twelve months' supply of electrical fittings. Particulars from General Manager, 31, James Street.

Manchester.—May 17th. Electricity Committee. Automatic coal-handling plant at Stuart Street station. See "Official Notices" May 5th.

Alternating-current or direct-current motors, 200 B.H.P. capacity, at Stuart Street station. Specifications (£1 1s.), Mr. F. E. Hughes, Secretary, Electricity Department.

New Zealand.—June 23rd. Oamaru Borough Council. Overhead mains and street-lighting equipment (Contract No. 2); power-station equipment (Pelton wheels, alternators, &c.) (Contract No. 3); service meters (Contract No. 4); line transformers and accessories (Contract No. 5).*

PAHIATUA.—July 10th. Borough Council. Overhead wires, poles, street lamps, gas engines, producers, dynamos, and auxiliary apparatus, accumulators. Specifications from Borough Offices or E. J. Fenn, Consulting Engineer, Auckland.*

Swindon.—May 30th. Corporation. Steam coal for the electricity works and waterworks respectively. See "Official Notices" to-day.

Wolverhampton.—May 19th. Corporation Electricity Department. Small coal. Mr. S. T. Allen, Chief Engineer and Manager, Commercial Road (returnable deposit of £1 1s.).

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Accrington.—Electricity Committee. Accepted tenders:

Water-cooling tower.—Lancashire Water Cooler Co.
2,000-KW. turbo-alternator, with condenser, &c.—B.T.H. Co., Ltd.
Boiler feed pumps.—J. P. Hall & Sons, Ltd.
Feed water heater.—Holden & Brooke, Ltd.
Modernising one set of mechanical stokers.—Bennis & Co., Ltd.

Canterbury.—T.C. Repairs to economiser: Green and Co., Ltd., £130.

Glasgow.—T.C. Tramways Committee. Recommended tenders:—

Points and crossings and special junction work.—Hadfields, Ltd.
Chilled-iron brake blocks (three months).—Miller & Co., Ltd.
Steel axles (six months).—Glasgow Railway Engineering Co., Ltd.
Steel tires (six months).—Brown Bayley's Steel Works, Ltd.
Fire-clay goods (12 months).—Glenboig Union Fire-clay Co., Ltd.; Douglas Fire-brick Co.; Speirs, Gibb & Co.

Keighley.—Corporation. Accepted tenders:—

Dorman, Long & Co.—Steel girders and steelwork for foundations for new 5,000-KW. turbo-alternator, £132.
H. V. Robinson, Ltd.—Foundations for 5,000-KW. turbo-alternator, £1,217.

Meter Contracts.—The following contracts have been placed with the Electrical Apparatus Co., Ltd.:—Burnham and District Electric Supply Co., electricity meters for one year; Malvern U.D.C., electricity meters for one year; Leyton U.D.C., electricity meters for one year.

Sunderland.—T.C. Tenders accepted on Wednesday:

J. W. & C. J. Phillips.—Four boiler-draught gauges.
E. Green & Son, Ltd.—C.I. damper.
General Electric Co., Ltd.—Six E.H.T. main boxes.

Wolverhampton.—Electricity Committee. Accepted tenders:—

J. E. Perry & Son.—To purchase and remove three Lancashire boilers, steel girder, and floorings, £655.
Strachan & Henshaw.—Installation of ash-handling plant, £515.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, May 12th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Papers on "The Latent Heats of Fusion of Metals and the Quantum Theory," by Mr. H. S. Allen; "Lenses for Light Distribution," by Mr. T. Smith; "The Choice of Glass for Cemented Objectives," by Mr. T. Smith.

Royal Institution of Great Britain.—Saturday, May 13th. At 3 p.m. At Albemarle Street, W. Lecture (II) on "X-rays and Crystals: First Results and their Applications," by Prof. W. H. Bragg, F.R.S.

Friday, May 19th. At 5.30 p.m. Lecture on "The Movements of the Earth's Pole," by Col. E. H. Hill, F.R.S.

University College, London.—Monday, May 15th. At 5.30 p.m. At Gower Street, W.C. Lecture on "The Manufacture of Nitrates from Air by Electric Power," by Mr. E. Kilburn Scott.

Tuesday, May 16th. At 5 p.m. Lecture on "The Rôle of Chemical Science in Civilisation," by Prof. F. G. Donnan, F.R.S.

Royal Society of Arts.—Monday, May 15th. At 4.30 p.m. At John Street, Adelphi, W.C. Cantor Lecture on "Vibrations, Waves and Resonance," by Mr. J. Erskine-Murray (Lecture III).

Institute of Engineers and Shipbuilders in Scotland.—Tuesday, May 16th. At 2.15 p.m. At the Royal Technical College, Glasgow. Address on "Engineering Industry in the Economic War," by Mr. T. C. Elder.

Chemical Society.—Thursday, May 18th. At 8.30 p.m. At Burlington House, Piccadilly, W. Lecture by Prof. F. Gowland Hopkins.

Institution of Mechanical Engineers.—Friday, May 19th. At 6 p.m. At Great George Street, S.W. Paper on "Spur-Gearing," by Mr. D. Adamson.

NOTES.

Electrical Methods in Surgical Advance.—At the Royal Institution on Friday last, Sir James Mackenzie Davidson delivered a lecture on "Electrical Methods in Surgical Advance." He said that the discovery of X-rays had revolutionised surgical diagnosis, but the shadow-picture produced by X-rays, however realistic it might appear, was not like an ordinary photograph from which the relative positions of objects could be inferred. To obviate this difficulty the stereoscopic method was largely used, but this, while invaluable in many respects, was not precise enough for exact localisation, and in order to arrive at the measurements required with mathematical accuracy, some system based on the principle of similar triangles was necessary. The lecturer gave a description of his own cross-thread localising method, and of a rapid procedure by which the measurements could be carried out with a small hand fluoroscope. Having ascertained the position of the foreign body, there were various electrical aids to the surgeon when he came to the question of its extraction. Of these, one of the most useful was the telephone attachment (already described in these columns); one terminal of the telephone being attached to the surgeon's instrument, and the other to a carbon plate placed on the patient's skin, a click was heard in the receiver when the electrical circuit was completed by contact with the foreign body. Another device was a telephone forceps with fluorescent screen attached, adapted by Dr. A. E. Barclay, of Manchester. Another instance of the adaptation of electrical methods to war surgery was Prof. Bergonié's electromagnet; this device, largely used in France, and of which the lecturer gave a demonstration, consisted of a large electromagnet excited with an alternating current. When the magnet was held over the suspected part, a vibratory motion was imparted to the projectile (if this were in the magnetic field), synchronising with the pulsing of the current. The surgeon felt the part, and became instantly aware of any vibration of the tissues, which indicated the presence of the metal. The point of maximum vibration having been selected, he made an incision at that point if convenient, and then the magnet was again used, and the incision deepened in accordance with the information it gave. It was stated that vibration was induced, not only in the ordinary magnetisable metals, but also in some of the non-magnetisable, including aluminium and copper.

A new Tungsten Arc Lamp.—At the meeting of the RÖNTGEN SOCIETY on May 2nd, Major Wilson, of the Canadian Medical Service, demonstrated a new enclosed tungsten arc lamp which he has devised for therapeutic purposes. He said that his idea originally was simply to produce a lamp capable of giving ultra-violet rays, but much more cheaply constructed than the ordinary large arc in use at some of the hospitals, and at the same time

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more effective than the ordinary Finsen-Reyn lamp, and costing less for running than the Simpson arc. For this purpose he had devised a lamp, one of the electrodes being of pure tungsten, while the other was of carbon cored with tungsten, the tungsten powder being made into a paste and forced into the central cavity of the ordinary carbon. When the arc was formed, the tungsten was reduced in the intense heat, and rays of very short wave-length were liberated. The spectroscopic results showed that it was possible to get down to a wave-length of 2,000 Angström units. Cerium and other materials were tried, but nothing gave so good a result as tungsten, nor was any arrangement so effective as the tungsten and the carbon cored with tungsten powder. There was no sputter, and the arc worked quite automatically, a good quartz compressor being effective for bringing the rays on to the part in the therapeutic treatment of wounds. The president (Mr. J. H. Gardiner) suggested that uranium might be tried in the place of tungsten, the uranium spectrum being remarkable for its great masses of fine lines, and approaching a continuous spectrum. Radiations higher than a wave-length of 2,000 units could be obtained with metallic uranium. At the same meeting Mr. H. E. Donnithorne read a paper on a new modification of the ionisation method of measuring X-rays, and complained of the inadequacy of the ordinary milliamperemeter, which utterly failed to measure the exact value of the current passed through the tube.

Newspaper Science.—In these days, when all the non-technical Press has awakened to the fact that the demands of the technical Press for the cultivation of science, reiterated continually during the past 20 years, are fully justified, we may perhaps be merciful and regard its errors with a lenient eye. Yet we cannot altogether ignore a blunder which is not only ridiculous but also utterly gratuitous, especially when it is found in the columns of the leading daily journal, which has been a prominent advocate of reform in the nation's attitude towards science. Referring to Sir J. Mackenzie Davidson's lecture at the Royal Institution on "Electrical Methods in Surgical Science," the *Times* of May 6th, states that the lecturer dwelt upon the utility of the *spectroscope* in localising bullets in the body. How the reporter managed to substitute "spectroscope" for "stereoscope" we cannot tell, but it is clear that neither he, nor the sub-editors, had any notion of the respective uses of the two instruments, which are about as much alike as a compound microscope and a pair of spectacles, and are employed for purposes differing as widely. The operating surgeon has no use for the spectroscope, but has used the stereoscope with radiograms for years, and no one who knew the A B C of the subject could possibly have confused the two instruments.

Economy in Use of Coal.—The following letter has been sent by the Board of Trade to gas and electric lighting undertakings:—

"I am directed by the Board of Trade to state that, as you will be aware, difficulties have been experienced for some time in securing adequate supplies of coal for manufacturers of munitions, and other consumers of national importance, owing to the decline in the output of coal from the mines and the increase in the demand for war purposes. The position has been met in the past to a large extent by the restriction of export, but coal which is now being exported goes largely to meet the urgent requirements of our Allies, or is valuable as a weapon in negotiating with neutral countries.

"The Board have observed with some concern the recent decline in coal exports, and in their opinion it has become necessary that special steps should be taken to maintain, and if possible to increase, the exportable surplus of coal, and that for this purpose everything possible should be done to encourage economy in the use of fuel at the present time. A copy of the notice which they recently issued, recommending a reduction in the consumption of domestic coal, is enclosed for your information. The question has been further considered by the Central Coal and Coke Supplies Committee, and they have recommended that a general policy of economy in lighting should be adopted, and that gas and electric lighting undertakings should be asked to do what they can to reduce consumption by a definite amount. The Board think there can be little doubt that there are many cases in which light is at present being used needlessly or wasted altogether. They have accordingly decided to request owners of gas and electric lighting undertakings that they should notify their consumers that the Government desires to see the consumption of coal for lighting purposes reduced by 10 per cent., and they should do all in their power by notices and inspection to see this recommendation carried out. The Board would suggest that inspectors should be sent round as often as possible to examine meters, and hand to consumers, where necessary, a notice reminding them of the recommendation, and calling attention to the fact that they have not yet carried it out. The Board would be glad to be informed of the steps taken."

The Electrical Wholesalers' Federation, Ltd.—The annual general meeting of this Federation took place on Wednesday, April 26th. The chairman, Mr. R. W. Smith, in presenting the report of the Committee and reviewing the work of the year, said that many questions affecting the wholesale electrical trade had arisen, which the E.W.F. had been able to negotiate successfully. He appealed for more support from *bonâ fide* wholesale firms, so that the Federation should be thoroughly representative. Wholesale electrical firms desirous of becoming members can obtain all information from the Secretary, Electrical Wholesalers' Federation, Ltd., Amberley House, Norfolk Street, W.C.

Foreign Trade.—THE APRIL FIGURES.—The following are the electrical and machinery figures given in the official returns for April:—

	Month of April.	*Inc. or dec.*	*Inc. or dec. to date compared with 1915.*
IMPORTS.			
Electrical goods and apparatus, excluding machinery and uninsulated wire... ...	£148,575	+ £58,432	+ £195,688
Machinery	637,917	− 239,889	− 13,998
EXPORTS.			
Electrical goods and apparatus, excluding machinery and uninsulated wire	273,274	+ 34,375	+ 220,386
Machinery	1,284,348	− 290,107	− 400,967

X-Rays and Crystal Structure.—On the occasion of the sixth annual May lecture of the Institute of Metals, delivered on May 4th, Prof. W. H. Bragg, F.R.S., gave an interesting account of the new method of applying the properties of X-rays to the study of crystal structure, including the structure of certain metals. The method, it was shown by the Professor, results in the determination of the exact relative positions of the atoms of which the crystal is composed. It is not successful in every case as yet because of the lack of practice and experience of the experimenters in the new field, and because some of the interpretations are not fully understood.

Silver and copper have been shown to possess a very simple structure, in which the atoms are arranged as in the piling of shot. Bismuth and antimony have a distorted arrangement; but these two, as well as zinc, have not been completely determined. A beginning had been made with iron; the war has, however, stopped all work of the kind on this metal.

This new field of research, according to Prof. Bragg, depends on the well-known principle that when a regular train of waves falls upon a surface separating two media, part is reflected and part goes on. If the part that goes on meets another separating surface, a second portion is reflected, and some of this emerges from the second medium in the same direction as the beam reflected from the first surface. It will happen in general that the two reflected beams are out of phase, and to that extent destroy one another. Whether they do so or not depends upon the relation between the wave-length, the angle of the inclination of the beam to the reflecting surfaces, and the distance between the surfaces. In this way are explained the colours of the soap film, of the thin layer of oil on the surface of a liquid, of steel when being tempered, and so on. It is an essential cause of this effect that the wave-length and the spacing are not very different in amount. The X-rays consist of waves which are something like ten thousand times shorter than the wave-length of light. The layers of atoms in the crystal provide suitably spaced reflecting surfaces, and it is found that when a pencil of X-rays of a definite wave-length is allowed to fall upon the face of the crystal, and the crystal is gradually turned round so as to alter the angle of incidence, the reflection of the beam, as a whole, is non-existent except when the angle is right. Then it flashes out strongly. When this angle is observed, the relation of the wave-length to the spacing is known.

The instrument used is called the X-ray spectrometer. It has no lenses, because X-rays cannot be refracted; and the rays are invisible, so that, in place of the telescope, there is a chamber containing gas, which is ionised by the X-rays. The resulting electrical effect is observed in an electroscope. The measurement of the result is quantitative, so that in this respect the new spectrometer has an advantage over the old. In this way, if we use always the same X-ray, we can compare the spacings between the layers parallel to one after another of the natural faces of the crystal; and in this way we arrive finally at the crystal structure.

Engineers' Wages at Birmingham.—The Birmingham branch of the A.S.E. has made application to the Engineering Employers' Federation for an increase upon the day rate of wages. The men have pointed out that in many instances unskilled workers engaged under the piecework system are receiving higher wages than skilled engineers, and, further, that the increases which have already been granted are not commensurate with the increased cost of living and the additional responsibility placed upon them in consequence of the introduction into factories of workers with no previous experience. The *Birmingham Daily Post* states that some of the employers have met the demand of the men, but as others have not, the question is now the subject of negotiation between the Employers' Federation and the engineers' society. The matter has also been laid before the Minister of Munitions.

Faraday House Awards.—The following awards have been made as the outcome of the recent scholarship examinations at Faraday House Electrical Engineering College:—

A Faraday Scholarship of 50 guineas per annum, tenable for two years in college and one year in works, to F. I. Ray, of Bournemouth School.

A Maxwell Scholarship of 50 guineas per annum, tenable for one year in college and one year in works, to C. F. Fowler, of Brighton Grammar School.

An Entrance Exhibition of 20 guineas per annum, tenable for two years, to W. Parr-Dudley, of Cranbrook School.

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Institution and Lecture Notes.—Belfast Association of Engineers.—The annual general meeting was held on April 27th, Mr. J. W. Kempster, D.L., presiding. In the course of his address the chairman said that in other centres the Engineering Associations were actively interesting themselves in the future, and the Manchester engineers had commenced an organisation by which they hoped to compete successfully with the foreigner when the war was over. Engineers needed to make up their minds whether collective effort on their part was desirable, and what it could effect; and if they thought it could do any good, they should throw in their lot with whatever organisation was formed to further the movement. They must not expect everything from the Government; the latter could only make use of the forces which were in existence.

Mr. Stanley Johnston moved:—"That this meeting of the Belfast Association of Engineers approves of the prompt organisation of the engineering industries within the British Empire, in co-operation with other industries, under State auspices, with the object of stimulating internal progress and of exerting collective influence and common action in the severely intense competition for trade in the markets of the world that, it is anticipated, will arise immediately upon the termination of the present war. That a copy of this resolution be sent to Mr. Edmund L. Hill, the honorary secretary of the Engineers' Club, Manchester, asking him to lay it before the Council for the Organisation of British Engineering Industries, assuring him of the co-operation of our Belfast Association of Engineers in the effort to organise the British engineering industry, and expressing the hope that the organisation may extend to all industries throughout the Empire, including those of Ireland." He said when the war broke out British engineering firms were unprepared; they were isolated from each other, and their own petty jealousies were keeping them apart. It was not until the Ministry of Munitions was established that there was any co-operation, and now they were all working as one great organisation, under one head. This moulding together of our great engineering industries had been one of the wonders of the Allies. Three thousand firms had been taken over and controlled by one department, and 13,000 firms, with almost 2,000,000 employés, were working on munitions. The great question to be faced now—not when the war was over—was: what had to be done to turn those 2,000,000 workers back to the ordinary commercial life that existed before the war? They were told that Germany was ready to dump on the United Kingdom, after the war, a greater quantity of goods than ever before. Were they going to sit down and wait for that event? This was the problem which had to be faced, and the sooner we had a Ministry of Commerce the better. The motion was unanimously passed.

Institution of Electrical Engineers.—A special general meeting of the Corporate Members will be held on May 25th, at 5 p.m., for the purpose of considering the following resolution:—

"That the following words be added to Article 41 of the Articles of Association, namely:—

'(*a*) On and after the 15th day of June, 1916, no person, whether a naturalised British subject or not, who is or shall be or has or shall have ever been a subject of a country or State, then or thereafter at war with His Majesty or his successors, shall be or continue to be or be eligible for election as a member of any class of the Institution, provided nevertheless that the above disability shall not apply to a person who having at any time been a subject of such a country or State as aforesaid shall have become and shall be a naturalised British subject and shall prove to the satisfaction of the Council that under the laws of such country or State he has ceased to be and is not a subject thereof.'"

Should the above resolution be passed by the requisite majority, a further special general meeting of the Corporate Members of the Institution will be held on June 15th, at 5.15 p.m., when the resolution will be submitted for confirmation as a special resolution.

At the meeting of the Yorkshire Local Section, on Wednesday last, a paper was read by Mr. G. Dearle on "The Economical Production of Power from Coke-oven Gas."

Electrical Association of Australia (Victorian Section).—At a meeting held on March 30th, Mr. F. A. McCarty delivered his presidential address.

Association of Supervising Electricians.—The meeting announced for May 16th will not take place, owing to Mr. F. C. Raphael having accepted a commission in the Royal Engineers. Other arrangements are being made, of which notice will be given.

The Textile Institute and Research.—The outstanding feature of the annual meeting of the Textile Institute, which was held in Manchester on Friday last, was the evidence of increasing recognition of the importance of research work. The annual report stated that in addition to a special investigation which was to be carried out at the Bradford Technical College, a special research in relation to the control of the electrification of textile fibres during processes of manufacture had been initiated. Dr. William Garnett (late educational adviser to the London County Council), in a paper on "Industry, Education, and Research," spoke of the need for breaking down the academic isolation of the schools and bringing them more closely into touch with the everyday life and experience of the children—a reform which must commence in the training colleges. His principal word to the manufacturers of the country was the need of confidence and combination for successful competition with Germany and America after the war. Individualism might serve very well in competition for home trade, where all were on an equal footing, but it could not compete with organised collectivism in foreign markets. If in one country all the manufacturers in a particular trade combined to carry out scientific research, and so to distribute manufactures that there was the minimum duplication of plant, and each works produced those goods which it could manufacture with the greatest economy, they need not add the assistance of the Diplomatic Corps to see sufficient reasons why the individual firms of another country should find it hard to compete. Dr. Garnett spoke hopefully of the possible work of the Advisory Council for Research, and stated that the Council had made a start on sound lines. After outlining the way in which the Textile Institute might further industrial research in the textile trades, he concluded with one "small piece of advice"—never to regard with complacency the loss of any branch of trade, however small or unremunerative. It was very easy to be too late in defensive action.

Mr. H. Lesser, President of the National Federation of Employés' Approved Societies, read a paper on "Employers and National Health Insurance," in which he described the formation and work and advantages of approved societies for the employés of one or more employers. Mr. Joseph Taylor, secretary of the British Thomson-Houston Employés' Friendly Society, Rugby, opened the discussion. He alluded to the closer relationships between employers and employed that were often made possible through the employés' friendly society, and remarked upon the willingness of the employers to give help in any way which was calculated to be mutually advantageous. His own society had well-equipped ambulance stations throughout the works, not only for dealing with accidents but for attending to, say, a man with a headache, who could be given a draught by qualified persons which would probably put him right and enable him to resume his work and prevent him losing time, while giving the employers the advantage of having his machine running, and not idle. Mr. Taylor strongly recommended textile manufacturers who had not their own friendly societies to start them without delay. Other speakers spoke appreciatively of the benefits of these societies, not only to the employés but to the employers as well.

Sir William Mather (President of the Institute), who has been indisposed recently, was not present at the meeting. He was re-elected President for a second year.

The Metric System.—*Apropos* of the recent references in our columns to the metric system, the following extract from the paper on "Education, Industry and Research," read by Dr. William Garnett before the Textile Institute in Manchester, last Friday, is interesting:—"There is one subject of instruction in the schools in respect of which the trade of the country is in a better position to form a judgment than any education authorities or bodies of teachers; I refer to the metric system. I am quite prepared to set aside for the present the question of decimal coinage, but all our children should be taught to think in terms of the metric system of weights and measures. I have recently been examining statistics respecting the food supply of this country and of Germany. I find that sometimes two Government departments adopt different units for their statistical returns. I find ounces, pounds, hundredweights, tons, quarts, gallons all used more or less indiscriminately in the books I have consulted, and then, as soon as physiological science is brought to bear on the statistics, grammes and litres, kilogrammes and metric tons, with the great and small calorie and the kilo-litre calorie for heat values, are introduced along with the ounces and pounds of the British statistics. But these difficulties are trivial as compared with the effects of an insular system of weights and measures on foreign countries which have adopted the metric system. . . . The metric system is slowly, but very slowly, gaining ground in this country. Metric screw threads have found their way into British tool making, and only a few days ago I was interested in finding a small boy in a veneer shop in Shoreditch quoting three-ply birch in millimetres of thickness. The average Briton, however, still refuses to read any article which is written in terms of the metric system, regarding it as outside his comprehension. . . . . For the purpose of foreign trade we are bound to learn a system which is almost universal among other civilised countries."

South African Electrical Trade.—The annual report of the Johannesburg Chamber of Commerce, in reviewing the trade of 1915, states that the electrical trade has suffered throughout the year, owing to shortage of stocks consequent upon the abnormal conditions prevailing in British manufacturing circles, and also the restriction of shipping facilities. The demand from the mines for electrical machinery and supplies has been substantially maintained, but there has been a reduced inquiry from the Government Department and electrical wiring contractors. Cost prices have increased considerably, and this fact, in conjunction with the increased rates of freight and insurance and shortage of stocks, has caused a substantial rise in selling prices. While the British firms have derived some benefit from the elimination of cheap German goods, there has been a considerable amount of competition from neutral countries. It seems evident that when the war is over and German goods are again available, British electrical industries will continue to be seriously affected, unless some preventive steps are taken. The prospects for the current year (1916) are not too encouraging.—*South African Mining Journal.*

Fatality.—Bradford.—An inquest was opened on Friday last week, and adjourned to Wednesday, in regard to the death of Alfred Dickenson (31), married, a switchboard man in the employ of the Corporation electricity department. It seemed that he was engaged in his employment at Thornbury sub-station, when he touched a live wire and died as a result of the shock.

Electric Vehicle Committee.—The Society of Motor Manufacturers and Traders, Ltd., has appointed Mr. T. C. Pullinger, of Arrol-Johnston, Ltd., to represent this society upon the Electric Vehicle Committee.

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Inquiries.—Makers of ferro-type sheet for telephone diaphragms are asked for.

Appointments Vacant.—Engineer-in-charge (40s. to 45s.), for the Borough of Bedford electricity department.

Volunteer Notes.—ENGINEERING INSTITUTIONS' V.E.C.—At the desire of General Sir O'Moore Creagh, the Corps has joined with the 4th Battalion Central London Regiment (Architects' Corps), under the command of Lieut-Col. C. B. Clay, V.D., to form the 1st London Engineer Volunteer Corps. The identity of the Corps will be preserved in the Engineering Institutions' Company, and the funds will also remain separate.

1ST LONDON ENGINEER VOLUNTEERS.—Orders for the week by Lieut.-Col. C. B. Clay, V.D., Commanding.

Friday, May 12th.—Technical, at 46, Regency Street, S.W. for Sections 3 and 4, No. 3 Company; Squad and Platoon Drill for Sections 1 and 2, No. 3 Company, at Chester House; Signalling Class and Recruits, No. 3 Company, at Chester House.

Saturday, May 13th.—Company Commander E. G. Fleming's Instruction Class, at Chester House, at 2.30.

Musketry.—See notice, Tables A and B, at Headquarters.

Sunday, May 14th.—Major-General Sir Francis Lloyd, K.C.B. (G.O.C. London District), will make an inspection of the Corps at work on the Sections of the South London Defences allotted to them. Every member should make special efforts to attend. Parade, Victoria Station (S.E. & C. Railway Booking Office), at 9 a.m., for special train. Uniform, haversacks and water-bottles. Mid-day rations to be carried. Railway vouchers will be provided.

Notice.—The Parade for Richmond Park, on Sunday, May 21st, is cancelled.

MACLEOD YEARSLEY, *Adjutant.*

May 8th, 1916.

3RD BATT. (OLD BOYS) CENTRAL LONDON VOLUNTEER REGIMENT.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, May 11th, 1916:—

Week-End Parades.—Saturday.—The Battalion will Parade at Baker Street Station, at 2.30 p.m., and proceed by train to Wembley Park for Battalion Drill.

Sunday.—The Battalion will Parade at 9.30 a.m., at Liverpool Street Station (Low Level entrance, G.E.R.), and proceed by train for Entrenching duties. Members will carry their own lunch, and the Quartermaster will make arrangements for light liquid refreshments. The Battalion will return to town about 6 p.m.

Musketry.—Inter-Battalion Cup Competition. Bisley Range will be open for shooting all day on Saturday next, the 13th inst., to those members whose names appeared in Monday's Orders.

Morning Train.—Members to report, in uniform, to Sergeant Burmester, at 9.20 a.m., Platform No. 6, Waterloo Station.

Afternoon Train.—Members to report to Platoon Commander M. H. Galsworthy, at 12.45 p.m., same platform.

A. G. JOINER, *Major and Adjutant*, O.B.C.

South African Agencies Wanted.—H.M. Trade Commissioner in South Africa (Mr. W. G. Wickham) reports that a firm in Johannesburg wishes to obtain agencies covering the Transvaal, Natal and Rhodesia, of United Kingdom manufacturers of H.T. oil-break switches and switchgear, motors, transformers, electricity meters of all descriptions, and electric mine-signalling apparatus (such as bells, pulls and pushes). The name and address of the firm can be ascertained on application to the Commercial Intelligence Branch of the Board of Trade in London. Reference number 161.

Electrical Operation of Panama Canal Locks.—At a meeting of the Western Society of Electrical Engineers, held in Chicago, it was stated in a paper entitled "The First Year's Operation of the Panama Canal Locks" by Messrs. F. C. Clark and R. H. Whitehead, respectively superintendent and assistant superintendant of lock operation, that in the first year 1,370 vessels were locked through the canal without any accident whatever. The control apparatus had given excellent results, and it was only by the use of such a control system that so large a system of locks could be operated properly. Both up and down lockages were made at about twice the speed that was anticipated. Both lock operators and canal pilots were given very careful training. The night illumination of the locks had proved entirely satisfactory, so that vessels could pass through the locks as freely at night as by day. Electric locomotives used in towing and guiding vessels through the locks were designed for a speed of two miles per hour; it was feared that this speed would be too high when it came to handling very large vessels, so a scheme by which the locomotive speed could be reduced to one mile an hour was developed through concatenation of the motors. It had been found, however, that practically all vessels could be manipulated at the speed of two miles an hour without danger or trouble. Bids were being sought on a number of additional towing locomotives, in which certain improvements were to be incorporated.—*Electrical Review and Western Electrician.*

Bequest.—*The Times* states that the late Mr. Thomas Taylor, of Blackpool, left £1,000 to the Corporation of Ashton, for scholarships in electrical science at the Reginbottom Technical Schools.

Substitute for Platinum Leading-in Wires.—A note in *La Revue Electrique* describes a substitute for platinum for the leading-in wires of glow lamps, invented by Mr. Byron E. Eldred. Two conditions must be satisfied to make a permanently sound joint between the wire and the glass: the metal must be "moistened" by the glass, to secure adhesion, and the glass and metal must have practically the same coefficient of expansion. Platinum fulfils both these conditions, but expands slightly more than glass, so that when the joint is cold, the wire contracts more than the glass, and thus the glass sheath, sticking to the wire, is in a state of tension. Obviously it would be preferable to use an alloy having a coefficient of expansion slightly less than that of glass, so that on cooling the glass would be compressed. This condition is fulfilled by certain nickel-iron alloys, which, however, do not possess to so high a degree as platinum the property of adhering to glass. To remove this objection, Mr. Eldred uses a nickel-steel wire coated with a layer of copper and a final layer of platinum, the thicknesses being so chosen that the joint coefficient of expansion is a little less than that of glass, while the coating of platinum ensures good adhesion. The layer of copper improves the conductivity of the wire—a matter of some importance when dealing with very fine wires—and regularises the expansion of the nickel-steel, which presents some perceptible irregularities between the temperature limits that the wire must endure.

Metallurgical Research.—On Monday last the Standing Committee on Metallurgy, appointed by the Advisory Council for Scientific and Industrial Research, held its first meeting, under the chairmanship of Sir Gerard Muntz, who is also chairman of the Section on the Metallurgy of Non-ferrous Metals, Sir Robt. Hadfield being chairman of the Section on the Metallurgy of Ferrous Metals. In the course of an opening statement to his Section, Sir Robt. Hadfield referred to the necessity of improvements in electrical pyrometers, electric furnace practice, and the electrical and magnetic properties of various alloys.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—The Reading Tramways Committee has recommended that the salary of the general manager and engineer be increased from £550 to £600 a year from April 1st, instead of January 1st next.

Aberdare U.D.C. has increased the salary of Mr. A. J. ABRAHAM, general manager of the electricity and tramways departments, by £50 per annum.

A Sydney newspaper states that the proposal of the Electric Lighting Committee to appoint Mr. P. T. DAVIES, of Montreal, to the position of deputy general manager of the electric light department, caused a long discussion in the City Council. As against the appointment of Mr. Davies, the claims of Mr. S. T. MALING, a Victorian, were urged by Ald. Farrell, who vigorously pleaded for the appointment of an Australian. Eventually an amendment approving of the appointment of Mr. Maling was carried.

The Wolverhampton Corporation is recommended to increase the salary of Mr. J. S. DUDLEY, maintenance engineer, from £160 to £170 a year, and that of Mr. J. WYATT, second clerk in the electricity department, from £114 to £125 per annum.

General.—SIR HIRAM MAXIM has accepted the invitation of the Aeronautical Institute of Great Britain to become its first president.

The Tonbridge U.D.C. has decided to grant £12 10s. per annum to the electrical engineer, Mr. M. P. PLUNKETT, for taking over the responsibility of the electrical plant at the sewage works.

The marriage took place at Southampton, on April 26th, of Mr. WM. BOWEN, A.M.I.E.E., of Leeds, to Miss Elsie Marion Winship.

Mr. G. G. HAZARD, London representative of Siemens Brothers Dynamo Works, Ltd., of Upper Thames Street, E.C., has been appointed to the A.S.C., M.T., as from May 8th.

Mr. R. C. HATTON, Southern sectional engineer of the Yorkshire Electric Power Co. (previously on the staff of the mains department of the County of London Electric Supply Co., Ltd.) was married on April 22nd.

Sir C. A. PARSONS, K.C.B., and Mr. CHAS. BRIGHT, F.R.S.E., are two of the members of the new committee which has been appointed to inquire into the administration and command of the Air Service.

London Gazette notice: Territorial Force. London Electrical Engineers. Second-Lieutenant (temporary Captain) A. R. Z. PORTER, from London Regiment, to be Lieutenant (temp.).

Roll of Honour.—Amongst the prisoners taken by the Turks at Kut-el-Amara on the surrender of the garrison is Mr. A. J. WALDRON, who was, before the war, on the staff of the Western Union Telegraph Co., at Penzance.

Flight Sub-Lieutenant WARNER H. POBERDY, formerly a student engineer with the British Thomson-Houston Co., Ltd., of Rugby, and who was later in Canada, has been invalided home to Rugby as the result of a serious aeroplane accident in Flanders.

Private CHAS. HAROLD DAVID, of the Canadian Regiment, who was on the staff of the Bell Telephone Co., of Toronto, until he joined the Expeditionary Force, has fallen in action in France.

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Private ALFRED WHITEHEAD, of the Royal Fusiliers, who, prior to his enlistment, was engaged at the British Westinghouse Works, Trafford Park, has been wounded, and his right leg has had to be amputated.

Lieutenant MULLINER, assistant borough electrical engineer at Eccles, is on sick furlough. He has been suffering from nervous breakdown, after service at the Front. He has now left the Hospital for Officers at Hampstead, and gone to his home at Malvern.

Mr. WM. HAMBLIN, formerly a fireman at the Barnsley power house of the Yorkshire Electric Power Co., who was in the K.O.Y.L.I., was killed in France in January.

Second-Lieutenant J. FISHER, of the North Staffordshire Regiment, to which he was commissioned from the Honourable Artillery Company, has died from the effects of gas received at the Front. He was formerly engaged at Siemens Brothers Dynamo Works, Stafford, and was 25 years of age.

Obituary.—LIEUT.-COL. ST. GEORGE R. S. CAULFIELD.—The *Morning Post* states that Lieut.-Col. St. George R. S. Caulfield, of the Royal Engineers, while playing golf at Leeds, died from heart failure. He was for a time Chief Instructor at the School of Submarine Mining and Electric Lighting.

Will.—According to the *Times*, the late Mr. HAROLD FARADAY, Hampstead, and Wardour Street, W., electrical engineer and manufacturer, left £29,495.

NEW COMPANIES REGISTERED.

K. E. Syndicate, Ltd. (143,777).—Registered May 5th by Kenneth Brown, Baker, Baker & Co., Lennox House, Norfolk Street, W.C. Capital £1,000 in £1 shares. Objects: To acquire certain options and rights in respect of two inventions, relating respectively to electric arc lamps and to improvements in direction indicators, to carry on the business of electricians, manufacturers of and dealers in electrical, geometrical, chemical, photographic, and scientific apparatus and materials, &c., and to adopt an agreement with G. A. Knapton and H. Justus Eck. The subscribers (with one share each) are: H. C. Leggatt, 36, St. Mary's Square, Kennington, S.E., solicitor's clerk; H. T. Page, 60, Ballance Road, Homerton, N.E., solicitor's clerk. Private company. The first directors (to number not less than two or more than four) are G. A. Knapton, H. Justus Eck, F. Rutherfoord Harris (chairman), and R. O. Graham, each of whom may retain office for five years. Solicitors: Kenneth Brown, Baker, Baker & Co.

Haddow & Co., Ltd. (9,579).—This company was registered in Edinburgh on April 28th, with a capital of £3,000 in £1 shares (500 pref.), to take over the business of electrical contractors carried on by Haddow and Co., at 107, Douglas Street and 192, West George Lane; and by A. Wylie & Co., 10, Wemyss Place, all in Glasgow. The subscribers (with one share each) are: A. F. Wylie, Calderwood Road, Glasgow; J. S. Hutchison, 107, Douglas Street, Glasgow. Private company. The number of directors is not to be less than two or more than five; the first are A. F. Wylie and J. S. Hutchison. Registered by J. Oswald & Son, Edinburgh.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Sun Electrical Co., Ltd.—A memorandum of satisfaction to the extent of £275 on April 28th, 1916, of debenture stock dated March 31st, 1912, securing £7,000, has been filed.

Productive Engineers, Ltd.—Issue on April 27th, 1916, of £600 debs., part of a series of which particulars have already been filed.

Burgess Hill & District Electric Supply Co., Ltd. (85,698).—Capital, £6,000 in £1 shares (3,000 pref.). Return dated March 10th, 1916. All shares taken up; £5,900 paid; £100 considered as paid. Mortgages and charges: £1,200.

Record Electrical Co., Ltd.—Particulars of £7,000 debs., created April 6th, 1916, filed pursuant to Section 93 (3), Companies (Consolidation) Act, 1908, the amount of the present issue being £6,000. Property charged: The company's undertaking and property, present and future. No trustees.

G. H. Turner & Co., Ltd.—Issue on April 14th, 1916, of £200 second debs., part of a series of which particulars have already been filed.

CITY NOTES.

West India and Panama Telegraph Co., Ltd.

For the last half of 1915 the amount to credit of revenue is £33,553, as compared with £49,935 in the corresponding half-year of 1914, and the expenses have been £22,987, against £31,251. Including the balance brought forward and interest on investments, there is available £14,649. The directors propose dividends for half-year to December, 1915, on the first preference shares at 6s. per share, and on the second preference shares at 6s. per share, carrying forward £2,880. The board have thought it well to recommend that the above balance be carried forward. The traffic receipts for the half-year show a falling-off of £16,529 as compared with those of the corresponding period of 1914, when an abnormal volume of traffic was carried. Beyond the reduced traffics the company also suffered from the hurricane referred to below. At the date of the last report it was not possible to gauge the effect of the severe hurricane that in August passed over the West Indies, extending from Cuba and Jamaica to Guadeloupe, to which disturbance the simultaneous interruption of their two main cables between Porto Rico and Jamaica is attributable. This interruption lasted for twelve days, and necessitated the use, at considerable cost, of alternative connecting lines for carrying the traffic during the emergency. It is many years since a similar disaster happened to these two cables. Consequent upon, and as a direct result of, war conditions, the working expenses, although on the whole less than those for the corresponding period, are above the average of the previous few years, and no immediate reduction can be hoped for. The value of cable used in repairs and renewals was particularly heavy during the half-year; and, in the opinion of the board, the amount properly chargeable on this account against reserve for depreciation is £5,451.—*Financier.*

Shanghai Electric Construction Co., Ltd.

For 1915 the profit is £31,084 (compared with £33,602 for 1914), plus £4,703 brought forward, making £35,787. There has been transferred to reserve for renewals account £10,000, and applied in reduction of the preliminary expenses account £2,000; a dividend of 7 per cent. for the year, less income-tax, requires £22,400, leaving £1,387 to be carried forward. The loss by exchange on subsidiary coinage in 1915 was £31,707, which was equal to 9.91 per cent. on the capital. Profits had been converted into sterling at an average rate of 1s. 9d. to the Mexican dollar, as against 1s. 9½d. for the preceding year. Since the close of the year the improvement in the rate of sterling exchange had been material, and there was a tendency towards improvement in regard to depreciation of subsidiary coinage, which was likely to be maintained while the price of copper retained its present high level. The effects of the war on general conditions in Shanghai, and on the company's traffic, were seriously felt during the first half of the year; gradual recovery had since taken place, and the traffics and net receipts for the current year were the best in the history of the company. Ten motor cars had been added to the rolling stock, making 90, and an application had been made to the Municipal Council for leave to introduce a further 15 trailers, making 70 in all. They also had seven railless cars. After the relaying of Fokien Road in cement concrete, the service of railless electric cars was resumed on July 6th, 1915, and had operated successfully ever since. These cars were extremely popular. Application had been made for sanction to a small extension of this route, for which the cars in stock were sufficient. Passengers carried 59,749,710, an increase of 4,102,472; passengers per car mile 17.86, as against 16.97 in 1914; gross receipts per car mile 8.46d., an increase of .08d.; average effective receipts per passenger .35d., as against .37d. in 1914. Annual meeting: May 19th.

British Ever-Ready Co., Ltd.

For the year ended March 31st, 1916, the profit, including the amount brought forward and after writing off depreciation and transferring £7,500 to general reserve, was £59,218. The preference dividend of 10 per cent. absorbs £8,500, 10 per cent. dividend for the year on the ordinary requires £11,500, and a bonus of 10 per cent. for the year (making a total of 20 per cent.) requires a further £11,500, leaving £27,718 to be carried forward. It is anticipated that the excess profits tax for 1914-15 and 1915-16 will absorb the greater part of this carry-forward. The increasing business of the company has necessitated acquiring additional factory accommodation. New premises will shortly be taken over at Clissold Park of approximately 20,000 superficial feet area, and it is hoped that this factory will be in full working order by the end of May, 1916. The business is a controlled establishment under the Ministry of Munitions. Annual meeting: June 1st.

Lisbon Electric Tramways, Ltd.

The result of operations during 1915, after deducting interest and amortisation due on the debentures of the Companhia Carris de Ferro de Lisboa, and after the payment of £25,570 for interest on and redemption of the debentures of this company, and also the payment of London office expenses and directors' remuneration, shows a net profit of £59,917, plus £2,883 brought forward. The usual 6 per cent. preference dividend has been paid, absorbing £25,533, and after paying 4½ per cent. net for the year on the ordinary shares, £8,736 is to be carried forward. In order to meet this year's contribution to depreciation reserve, £25,000 has been transferred to that account from the exchange reserve to represent this year's appropriation, it being considered that this sum would have been available out of profits for this purpose, had it not been for the heavy fall in the rate of exchange, and as the exchange reserve account was set aside for this purpose it now falls to be drawn upon. The tramways carried 67,101,249 passengers, earning Es.2,022,143 $93.5, as compared with 63,758,037 passengers, earning Es.1,938,210 $79.3 in 1914, but though the receipts and passengers continued to expand, there was a considerable addition to the expenditure consequent upon the abnormal high price of coal and other supplies, and of labour. The company also suffered from the heavy depreciation in the exchange, the average rate of which during the year has fallen from 43.43d. to 35.97d. The system was closed down for two days during May, 1915, owing to political disturbances; this was the only interruption. With the exception of one small incline, which it is hoped will be completed during 1916, the remainder of the Ascensores line have been electrified and re-opened to traffic during the past year. The directors express their appreciation of the services of the local board in Lisbon, of Mr. A. O. Kolkhorst, the general manager, and of the entire staff. Annual meeting: May 17th.

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Calcutta Tramways Co., Ltd.

SIR HENRY KIMBER presided at the annual meeting on May 4th. He said that the traffic receipts showed a falling off of only £1,313, and the working expenses were less by £2,683 than in 1914. During the first half of the year there was a drop of over £5,000 in traffic, as compared to pre-war takings, but in the second half there was an increase of upwards of £4,000. The principal portion of the new capital expenditure of £11,720 was due to the outlay on the completion of the new Dalhousie Square substation, and the major portion of the cost of the new A.C. set at the Nonapookur power station and the works in connection with its erection. With regard to the prospects for the current year, whilst the aggregate receipts up to now showed an increase of £4,721 over those for the same period last year, they must expect that, with the continuance of the war, the cost of all materials, freights, &c., would continue to advance, with the addition of increased import duties and income-tax to be levied in India. There had been a discussion going on in a great number of companies having their headquarters in England, and their works and businesses overseas, with a view to escaping double income-tax. The speaker referred to, and quoted from, a paper on the subject issued by the London Chamber of Commerce, giving the reasoning for and against double income-tax. The company now had a system of about 35 miles; their traffic receipts were 10.16d. per car mile, and the expenses 5.21d.

Indian Electric Supply and Traction Co., Ltd.

MR. J. G. B. STONE, presiding at the annual meeting on May 5th, said that the increase in the number of units sold was 598,928, or 25 per cent. and the net profit in Cawnpore increased by about 25 per cent. The actual price per unit was slightly lower, but this had been more than balanced by the lower cost of generation. The supply side of the business continued to expand, and there were new districts awaiting development as soon as general conditions allowed. They must for the time being refrain from undertaking new work, for even supposing they were able to raise the capital, there would be a difficulty in getting the Treasury to sanction its issue. They must also consider the enormous increase in the cost of copper, machinery, plant, and material, and the prohibitive rates for freight. In regard to the last of these, the increase was from 50 per cent. to 75 per cent. over pre-war rates, and, in addition, there were increased amounts to pay for insurance. The short length of tramway still yielded no profit, although it was a convenience to the Indian population. It was too short to become a paying concern on the very low fares it was necessary to charge to attract passengers, there being no European traffic, and at present there was no encouragement to extend the system. They had placed to general reserve £2,000, and to depreciation and renewals account £3,000; they had also written £500 off the expenses of the debenture issue. The position for the current year was satisfactory, as the profits showed an increase.

Canadian Westinghouse Co.—The annual report shows net earnings for the year 1915 amounting to $860,628; property and plant account takes $150,000, and $261,285 is carried forward. The total surplus of the company is now $1,823,775, and the total assets $8,330,757. Regarding business conditions, the annual report says:—"The industrial life of Canada during the year just closed experienced a remarkable recovery from the suspended activity of the preceding year. Many plants which had with difficulty kept together an irreducible minimum of their operating organisation found themselves early in 1915 strained to their utmost capacity under night and day operation. In addition, numerous new industries have been brought into being, the changed conditions in these respects being the direct result of large purchases in Canada by the British and Allied Governments of various supplies and munitions of war."

Anglo-Portuguese Telephone Co., Ltd.—The profit and loss account shows a gross revenue of £81,923, of which operating, management and general expenses absorbed £51,577, and royalties to the Portuguese Government £2,459, leaving a gross profit of £27,886. After payment of income-tax £1,349, and providing for debenture interest £1,937, and sinking fund £1,662, the amount available for disposal, including £5,471 brought forward, is £28,409. Of this amount £2,000 has been added to exchange fluctuation account, and £10,000 to the renewals fund. An interim dividend of 3 per cent. was paid, less income-tax, last November. The directors now recommend a further dividend of 5 per cent., less tax, making a total distribution of 8 per cent. for the year, leaving £4,409 to be carried forward.

Eastern Telegraph Co., Ltd.—A final dividend of £2 5s. per cent. is recommended on the ordinary stock, also a bonus of £2 per cent., both free of income-tax, making a total of 8 per cent. for the year 1915.

Bell's United Asbestos Co., Ltd.—For 1915 the total distribution on the ordinary shares has been 15 per cent., placing £15,000 to reserve, and carrying £7,942 forward.

Auckland Electric Tramways Co., Ltd.—An interim dividend of 7d. per share, less tax, on the ordinary shares is announced.

STOCKS AND SHARES.

TUESDAY EVENING.

Stock Exchange markets are somewhat under the influence of the new Military Service Bill. Members of the House, their staffs, and their clients are all affected, in a greater or less degree. There is, of course, no shirking of the responsibilities or of the sacrifices which are called for. But if all men up to the age of 41 are called up within any brief space of time, business must suffer from disorganisation; and it will be some little while before the machine of commerce gets into smooth running order again. The Daylight Saving Bill is vigorously discussed in the Stock Exchange, but has had no effect in the market for electric lighting shares. The encouraging Board of Trade figures for April are helping Home Railway stocks. In the telegraph section, there is more inquiry than hitherto for the issues of the Anglo-American companies. The Globe Telegraph & Trust has increased its dividend by 1 per cent.

The Electric Lighting market's prices are unchanged, despite the proposed introduction of the Daylight Saving Bill. The market views the measure with equanimity, and the proprietor of electric lighting shares need not be troubled by the recent newspaper outpourings with reference to the effect it is likely to have upon the companies.

The summer-time is obviously the lean one for Electric Supply concerns. In some cases, the undertakers reduce the price of their current, by way of inducement to users, and it is well-known that in pre-war days they earned comparatively little in the summer months. The Government's appeal to the public that they should economise in the matter of coal, gas, and electric light, may affect the first two items, but so far as the last is concerned the public have probably got down to something like bed-rock in their bills for light and power.

As it is not proposed that the Daylight Saving Bill should be in operation throughout the winter, when the demand for current is greatest, it is contended in the Stock Exchange that the Bill will have little effect upon the receipts of the companies. A few investors in these shares show signs of nervousness, due, probably, to a lack of appreciation of the actual position—moved thereto by the newspaper comments aforementioned. The great body of proprietors, however, is not at all likely to be disturbed by the latest developments; and a guess may be hazarded that neither the Daylight Saving Bill nor the Government appeal will affect the dividends of the industry to the extent of one per cent.

Underground Electric income bonds have started to recover, but Districts continue dull, and have slipped back to 18¾ on the offering of a little stock for deceased accounts. Central London assented ordinary keeps very steady. There is, however, a few hundred pounds of the Company's deferred ordinary offered at 65¼ or thereabouts, the return on which works out to 6 per cent. on the money, though the dividend on this, unlike the interest payments on Underground Electric income bonds, is paid less income-tax. The unassented deferred stock of the Central London Railway is changing hands at 25, some 40 points below that of the assented issue.

Anglo-American Telegraph preferred has risen to within a fraction of par, and the deferred stock braced up to 21¾. The Eastern group is steady, with a further rise in Globe Telegraph ordinary shares to 12, on the increase of 1 per cent. in the dividend to 7 per cent. Great Northerns are £1 up, but Indo-Europeans at 49 have lost an equal amount, though it may be doubted whether a buyer, even at 50, would find many Indo-Europeans available at that price. West India and Panama shares eased off to 1 1/16. Marconis are a slightly better market, the parent shares hardening to 2 3/16; but the subsidiaries are dullish at 14s. 9d. for Americans and 7s. 9d. for Canadian Marconi.

The telegraph manufacturing shares are strong. India-Rubbers at 10¼ have gained the fraction. Telegraph Constructions went up £1 to 36¼; while as regards Henleys and Callenders, there are very few shares about. British Insulated at 10¼ are a good market.

Edison & Swan fully-paid shares, after their remarkable jump of 12s. 6d. last week, have receded ¼ to 1¼, shares naturally being tempted out by the big advance. At the same time, the partly-paid eased off to 11s. 6d., this still leaving them 2s. 6d. higher than they were a fortnight ago. British Westinghouse preference continue to mend, and Electric Constructions at 16s. 6d. are better.

The rises in the chemical group have suffered something of a check, although the market in them generally is a firm one. Here, however, as in the rest of the Stock Exchange, business is handicapped for the time being by the various uncertainties that arise out of the Military Service Act, which have had the effect of removing buying orders. Babcock & Wilcox keep steady, the little disappointment in connection with the dividend being counterbalanced by the excellence of the report. Rubber shares are heavy and dull. All the sparkle has evaporated from the market for the moment. Unexpected

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restrictions laid upon the export of rubber to Russia, and the falling away in the demand from the United States, are put forward as being the two principal reasons for the way in which the wind has gone out of the sails of the market, leaving them flapping heavily and idly. The provinces have ceased their voracious rush for shares; and the disposition now is to wait and see what is going to happen next.

Brazilian Tractions lost the rise that they gained last week, New York coming in with shares to sell. Mexican utilities are generally better. The first mortgage bonds of both the Tramways and the Light & Power Companies have strengthened to 41, stock being wanted at that figure in each case. The rise in the price of silver has been well held; and notwithstanding the absence of definitely good news from Mexico, indirect evidences add point to the hope that the country may be settling down, after all.

Argentine Tramway shares, first and second preference, have drooped ½, there being some little pressure to sell them on the part of proprietors disappointed with the outlook for the Republic, which seems to be slower than Brazil in overcoming the difficulties that arose in connection with the war. British Columbia issues are firmer, and there has been a little inquiry for Bombay Electric preference shares. The Calcutta Electric Supply report shows the fine net profit of £163,000, an improvement of £22,500 over the previous year. The dividend on the ordinary shares is retained at 9 per cent., the price is firm at 6⅜, and the 5 per cent. preference are 4⅜ middle.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price May 9, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6¾	—	£7 8 2
Charing Cross Ordinary	5	5	8½	—	7 18 10
do. do. do. 4½ Pref.	4½	4½	8½	—	6 18 6
Chelsea	5	4	8½	—	6 8 1
City of London	9	8	11⅞	—	6 14 9
do. do. 6 per cent. Pref.	6	6	10½	—	5 14 8
County of London	7	7	12⅛	—	6 18 4
do. 6 per cent. Pref.	6	6	10⅛	—	5 14 3
Kensington Ordinary	9	7	5	—	7 0 0
London Electric	4	3	1⅛	—	7 6 4
do. do. 6 per cent. Pref.	6	6	4½	—	7 1 2
Metropolitan	3½	3	2⅝	—	6 6 4
do. 4½ per cent. Pref.	4½	4½	8	—	7 10 0
St. James' and Pall Mall	10	8	6	—	6 18 4
South London	5	5	2⅞	—	8 18 10
South Metropolitan Pref.	7	7	1 1/16	—	6 14 0
Westminster Ordinary	9	7	6	—	5 16 8
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	99½ xd	+1½	6 0 6
do. Def.	80/-	83/6	21½	+ ½	7 15 0
Chile Telephone	8	8	8½	—	6 8 0
Cuba Sub. Ord.	5	5	7½	—	6 13 4
Eastern Extension	7	8	14½	—	*3 12 4
Eastern Tel. Ord.	7	8	14¼	—	*5 11 1
Globe Tel. and T. Ord.	6	7	12	+ ½	*5 16 8
do. Pref.	6	6	10½	—	5 17 5
Great Northern Tel.	22	22	31⅛	+1	6 0 7
Indo-European	13	13	49	−1	6 12 8
Marconi	10	—	2 3/16	+ 1/16	4 11 4
New York Tel. 4½	4½	4½	100?	—	4 9 4
Oriental Telephone Ord.	10	10	14⅓ xd	—	5 10 4
United R. Plate Tel.	8	—	6	—	*6 13 4
West India and Pan.	1	—	1 1/16	— 1/16	9 6 1
Western Telegraph	7	8	14½	—	*5 12 4
Home Rails.					
Central London, Ord. Assented	4	4	67½	—	5 18 6
Metropolitan	1½	1	25¼	—	8 18 6
do. District	Nil	Nil	18¼	— ⅛	Nil
Underground Electric Ordinary	Nil	Nil	1⅛	—	Nil
do. do. "A"	Nil	Nil	5/6	—	Nil
do. do. Income	6	6	85½	+ ½	*7 0 4
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4⅞	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½	5½	8⅝	— ⅛	7 11 9
do. 2nd Pref.	5½	5½	3½	— ⅛	8 9 2
do. 5 Deb.	5	5	78	—	6 8 2
Brazil Tractions	4	4	55	−1½	7 5 6
Bombay Electric Pref.	6	6	10⅜	+ ⅛	5 15 8
British Columbia Elec. Rly. Pfce.	5	5	65	+2	9 1 8
do. do. Preferred	—	Nil	89	+2	Nil
do. do. Deferred	—	Nil	88	—	Nil
do. do. Deb.	4½	4½	62	—	6 17 1
Mexico Trams 5 per cent. Bonds	—	Nil	41	+1	Nil
do. 6 per cent. Bonds	—	Nil	35	+3	Nil
Mexican Light Common	Nil	Nil	20	—	Nil
do. Pref.	Nil	Nil	32	—	Nil
do. 1st Bonds	Nil	Nil	41	+2	—
Manufacturing Companies.	Dividend 1914.				
Babcock & Wilcox	14		23	—	5 9 1
British Aluminium Ord.	5		22/- xd	—	6 7 3
British Insulated Ord.	15		10½	—	7 2 10
British Westinghouse Pref.	7½		48/-	+ 6d.	6 19 6
Callenders	15		11½	—	6 10 5
do. 5 Pref.	5		4½	—	5 17 8
Castner-Kellner	20		8 3/16	—	6 1 3
Edison & Swan, £3 paid	Nil		11 6	— 6d.	Nil
do. do. fully paid	Nil		1½	— ⅛	Nil
do. do. 5 per cent. Deb.	5		57	—	8 15 8
Electric Construction	6		16/6	+ 6d.	7 5 5
Gen. Elec. Pref.	6		9⅜	—	6 4 8
Henley	20		14½	—	*6 18 0
do. 4½ Pref.	4½		4	—	5 12 6
India-Rubber	10		10½	+ ½	*9 15 2
Telegraph Con.	20		86½	+1	*6 18 0

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, May 10th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/8	..
a Ammoniac Sal	,,	£70	..
a Ammonia, Muriate (large crystal)	per ton	£54	..
a Bisulphide of Carbon	,,	£28	..
a Borax	,,	£28	..
a Copper Sulphate	,,	£53	£1 inc.
a Potash, Chlorate	per lb.	2/6	..
a ,, Perchlorate	,,	3/-	..
a Shellac	per cwt.	96/-	..
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	,,	£14	..
a ,, Lump	,,	£10	£1 inc.
a Soda, Chlorate	per lb.	1/4½	..
a ,, Crystals	per ton	120/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	1/5½ to 1/6	1/16d. inc.
c ,, Tubes (solid drawn)	,,	1/6½ to 1/6⅝	1d. inc.
c ,, Wire, basis	,,	1/5½ to 1/5¾	⅛d. inc.
c Copper Tubes (solid drawn)	,,	1/8⅜ to 1/9	1/16d. inc.
g ,, Bars (best selected)	per ton	£167	£15 inc.
g ,, Sheet	,,	£167	£18 inc.
g ,, Rod	,,	£167	£18 inc.
d ,, (Electrolytic) Bars	,,	£152	£11 inc.
d ,, ,, Sheets	,,	£170	£11 inc.
d ,, ,, Rods	,,	£159	£11 inc.
d ,, ,, H.C. Wire	per lb.	1/7	1/16d. inc.
f Ebonite Rod	,,	3/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/3	1d. inc.
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	2/10	1½d. dec.
i Iron Pig (Cleveland warrants)	per ton	95/-	..
l ,, Wire, galv. No. 8, P.O. qual.	,,	£36	£1 inc.
g Lead, English Pig	,,	£35 5	5/- dec.
g Mercury	per bot.	£16 12 6 to £16 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e ,, ,, ,, medium	,,	8/6 to 6/-	..
e ,, ,, ,, large	,,	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/8½	..
r Steel, Magnet, in bars	per ton	£35	..
g Tin, Block (English)	,,	£207 to £208	£3 inc.
n ,, Wire, Nos. 1 to 16	per lb.	3/-	1d. inc.

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Winnipeg Electric Railway Co.—The directors have decided to suspend dividend payments on the common stock for the present. The passing of the dividend, which came as a rather unpleasant surprise, follows successive cuts in the annual rate from 12 per cent. to 10 per cent. in March, 1915, and from 10 per cent. to 8 per cent. in January last. It is likely that earnings are in excess of the 8 per cent. requirements, but as earnings fell short of dividends by $85,388 in 1914, and by $388,898 in 1915, the company has probably extended itself financially, and will require some time to recuperate.—*Montreal Herald.*

Craigpark Electric Cable Co., Ltd.—For the year ended March 31st there was a net profit of £9,482 (after making provision for excess profits tax), which, with £1,147 brought forward, makes £10,629. The directors recommend placing to depreciation £2,500, to reserve £1,000, dividend on the ordinary shares at 6 per cent. for the year, leaving a balance of £2,028 to be carried forward (subject to payment of directors' fees). In spite of transport and labour difficulties and the high price of raw materials, the result of the year's trading has been good. The quantity of work on hand at the moment is satisfactory. The directors have made provision out of the profits for Excess Profits Tax. Annual meeting: To-day, at Glasgow.

Calgary Power Co.—The gross earnings in 1915 amounted to $289,613, an increase of $58,427. Net earnings, after deducting all operating and other expenses chargeable against revenue, amounted to $237,159, an increase of $56,952. Interest charges ($156,966) deducted leave $80,193, which has been transferred to surplus account.—*Financier.*

Capital Reduction.—*New Vanadium Alloys, Ltd.*—The reduction of capital from £25,000 to £1,875 has been confirmed by the Court.

Richard Johnson, Clapham & Morris, Ltd.—Out of the year's net profit of £32,215, 10 per cent. is paid on the ordinary shares and £20,000 is carried to reserve.

Brisbane Electric Tramways Investment Co., Ltd.—After paying a further dividend of 4 per cent., making 8 per cent. for the year, £34,292 is to be carried forward.

Merthyr Electric Traction & Lighting Co., Ltd.—After placing £1,000 to reserve and paying 7 per cent. on the ordinary shares, £906 is to be carried forward.

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FROM THE POWER-HOUSE WINDOW.

By "ROVER."

I believe it was Mark Twain who designed his house with the kitchen windows looking out into the street. He declared the kitchen to be the most important room in the house, and said further that his cook would work better with a cheerful view before her than if she had only other kitchen walls to look at. Perhaps Mark's philosophy does not apply to power houses, but I think I understand his cook's point of view.

My first station experience was in a Midland town. The windows were so high up that only the sky could be seen, but, Heaven be praised, there was a door which opened direct upon a lane, not a very respectable lane, but one in which human beings disported themselves. They looked in our open doorway, stared at our strange machinery, asked foolish questions, and somehow shortened our night hours. Across the lane was the back of a large hotel, with the "club-room" just opposite our door, and occasionally we would hear "A Jolly Good Fellow" sung with fervour or would listen, without invitation, at a "smoker"; but the hand of progress was against us. Our chairman reported "The extensions made necessary by the increasing demand on our plant have now been completed, and the two new big 200-kw. sets and switchboard have been installed in the new engine room." Good-bye to the door which opened into the lane!

Next, a seaside resort. The power house here was placed, not on the front, but some distance inland. On one side of us we had a mortuary, and on the other, a cemetery. In the summer the mortuary was fairly busy, as this particular resort was found very convenient for purposes of suicide by distressed Londoners.

I think my next point of view was even worse—a small town in Ireland. Here we had no outlook at all, but a high wall separated us from the public abattoir, and every day we heard the death cries of countless pigs. I do not think centuries in Ireland would accustom me to the last shrill agony of the pig.

From Ireland to America was a natural change—a power house, hydro-electric, with many windows, seven miles from a town, in the heart of the Ontario bush. The camp, containing about a dozen souls, stood at the crest of a hill in full view of the men on duty, but too far off for a man to be distinguished. We rarely saw a stranger from our many windows—nothing but trees, trees, trees, and but two varieties of trees, the pine and the birch. We felt almost grateful when the bush fires started to devour whole acres of the accursed trees, and for a day or two we watched the smoke with some satisfaction. Later on, when the camp was threatened with extinction, we changed our minds as to the usefulness of bush fires. At night, the power-house men had to watch the flames and give the alarm if the fire came too close, in which case all the residents of the camp were to take refuge in the power house—the only non-inflammable building. I remember my wife made a parcel consisting of all our jewellery and three cans of evaporated milk for the baby, and we considered ourselves prepared for the worst, which, luckily, never came. I do not hope to watch another bush fire from a power house window. As it was, our transmission lines were burnt down for half-a-mile.

At another plant, about 100 miles further north, I had a similar outlook of bush, but, although the nearest town was 20 miles away, we got more passers-by. This was in the gold district, and many prospectors were looking out for precious metal. They came in twos and threes by canoe, and were generally very uncommunicative as to the locality in which they expected to make their "lucky strike." They would discuss every other subject discussed by civilised or barbarian man. They were nearly all American, and all most interesting talkers, and I came to the conclusion that prospecting for gold greatly stimulates the imagination. Usually they came just before the mosquitoes made bush life unbearable, disappeared for three weeks or a month, and returned with depleted knapsacks. They gave us a cheerless recognition at the power-house door and hurried home.

The Indians had even less to say. At certain times of the year whole tribes move to other hunting grounds, and there would be a procession of canoes past our door. The men and boys were nearly all dressed in dungaree overalls, but the squaws and girls had a passion for vivid colours. They all handle a canoe perfectly, and to see them shooting a rapid is a sight worth while.

We used to catch some decent trout from our power house windows, and some monster pike, too. Sometimes we would see a bear, and more rarely a moose, although early one morning a big bull moose so far forgot himself as to swim across our tail-race. In winter, we had little but snow to see, but an occasional Indian dog team or a couple of Indian hunters on snow-shoes would break the monotony.

Back to a London central station in fog-time. Nothing outside to be seen—not even the other end of the engine room could be properly distinguished when the usual fog was in evidence.

Last of all sunny Spain—all, all too sunny. From our windows, a vista of bare red rock, but with one precious green spot where a Spaniard has, with infinite labour, made an orchard. Close to the orchard is a spring of drinking water, and from the power house can be seen Spanish girls, each bearing on her head the heavy "cantara" or water-bottle of precisely the same design as those used by the Mediterranean race of how many thousands of years ago.

THE LJUNGSTRÖM TURBINE AND ITS APPLICATION TO MARINE PROPULSION.

By ROLAND S. PORTHAM.

(*Abstract of paper read before the* Institution of Engineers and Shipbuilders in Scotland.)

(*Concluded from page* 522.)

Fig. 10 shows the outer blade-rings of the 10,000-b.h.p. machine, and the rigidity of the structure is clearly apparent. The cylindrical stress caused by the lineal velocity in the 10,000-b.h.p. size is moderate, and the factor of safety is ample. Fig. 11 illustrates the complete 10,000-b.h.p. turbo-alternator and condenser. The overall length is 24 ft., height from bottom floor, including condenser, 21 ft., and weight of turbo-alternator 60 tons.

The overhang of each generator frame is supported by a pair of steel ties, each connected to the foundation through a stiff spiral spring or buffer, which effectively prevents any tendency to hogging in the event of any difference of temperature between any portion of the casing.

My endeavour has been to show the symmetry and compactness of the design and the care taken to eliminate any traces of distortion due to temperature changes, so that the highest possible temperature of superheat can be used. The fact that the steam velocity is at its lowest when the temperature is greatest is in marked contrast to the ordinary type of turbine, either of the impulse or impulse reaction type, where maximum velocities and maximum temperatures are invariably associated.

The whole turbine has been so designed as to be manufactured in ordinary lathes, such as may be found in any modern engineering shop. The fitter is almost entirely replaced by the turner. The manufacture of the blade rings is ordinary repetition work, to which unskilled boy or girl labour can be trained in a few weeks. The completed machine has a factor of safety larger than in any other type of turbine. Blade stripping is unknown, due to the mechanical construction of the rings, the blades being firmly held at both ends.

Some Steam Trials of Ljungström Turbo-Alternators.

Date of test.	Normal max. output in kw.	Trial output in kw.	Steam per kw.-hour, lb.	Pressure on turbine inlet (absolute) lb. per sq. in.	Superheat, degrees Fah.	Vacuum per cent.	Thermodynamic efficiency compared with ideal engine, per cent.
1911	1,000	1,000·6	11·6	168	302	96	76
1914	1,000	990	12·7	160	150	94	77
1915	6,000	2,000	11·1	170	270	97	79
1916	3,000	2,700	11·15	160	280	88	87

Attention is called to the remarkably good results shown by the 3,000-kw. turbine at 90 per cent. full load. Reduced to marine conditions of 220 lb. boiler-gauge pressure per sq. in., vacuum 95 per cent., and 240 deg. F. superheat on the inlet valve, the steam consumption of the turbine would be 7.25 lb.

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per B.H.P. per hour, or 8 lb. per S.H.P. per hour, including generator and motor losses, but excluding condensing and propelling auxiliaries. With electrically-driven auxiliaries, and including excess steam tapped from the turbine at 30 lb. pressure for feed-heating purposes, this would represent a total propelling steam consumption of 9 lb. per S.H.P. per hour, equivalent with coal of 14,000 B.TH.U. and an actual evaporation of 10 lb. of steam per lb. of coal with 210 deg. F. feed temperature, to 0.9 lb. of coal per S.H.P.

It might be said that trial conditions of consumptions may not be maintained in practice, due to possible wear of the labyrinthic edges which vary from .004 in. to .01 in. in the different radii of the blade rings. It has been found, however, that there is no perceptible increase in consumption. Recent trials carried out with the 1,000-KW. set installed in 1913, at the North Metropolitan Power Station, Willesden, show no increase on the original consumptions after a period of two years' continuous operation for 18 hours a day.

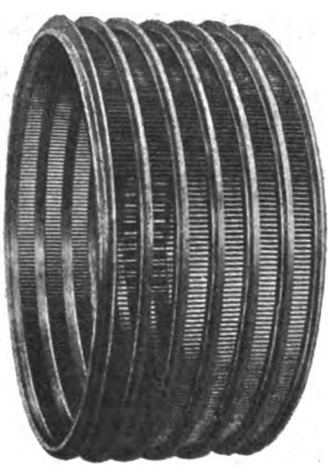

FIG. 10.—OUTER BLADE-RINGS OF 10,000-H.P. TURBINE.

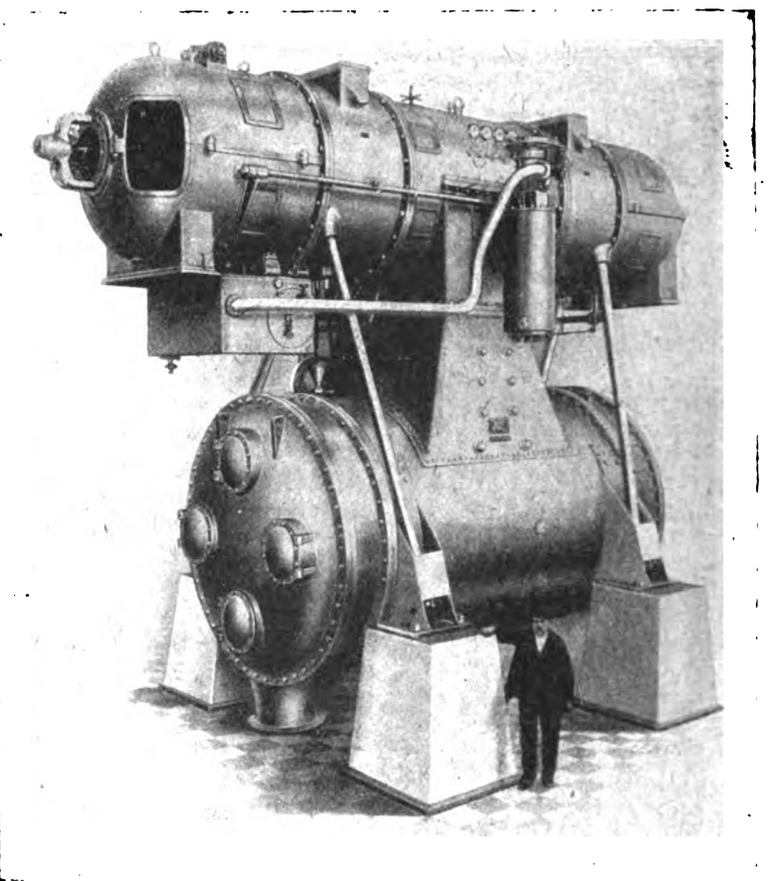

FIG. 11.—LJUNGSTROM 10,000-H.P. TURBO-ALTERNATOR AND CONDENSER.

Comparison of the *Mjölner* and the *Mimer* shows that—

1. There is a relative trial fuel economy of 42 per cent., and fuel economy in service of over 38 per cent. in favour of the former.

2. The machinery weight and space shows a relative reduction of about 25 per cent.

diminished fuel consumption, weight of propelling machinery, and, resultant increased cargo-carrying capacity should in normal times repay the additional cost of the installation in a period of under two years.

4. In respect of maintenance, the experience of sixteen months' running of the *Mjölner* has proved this to be extremely low. The cost of upkeep of the turbines, motors, and gearing has been practically nil.

5. During the period under review, the ship has not required to stop through any defect of the main propelling machinery; this is a pioneer installation, and the entire absence of breakdown must be considered a satisfactory feature.

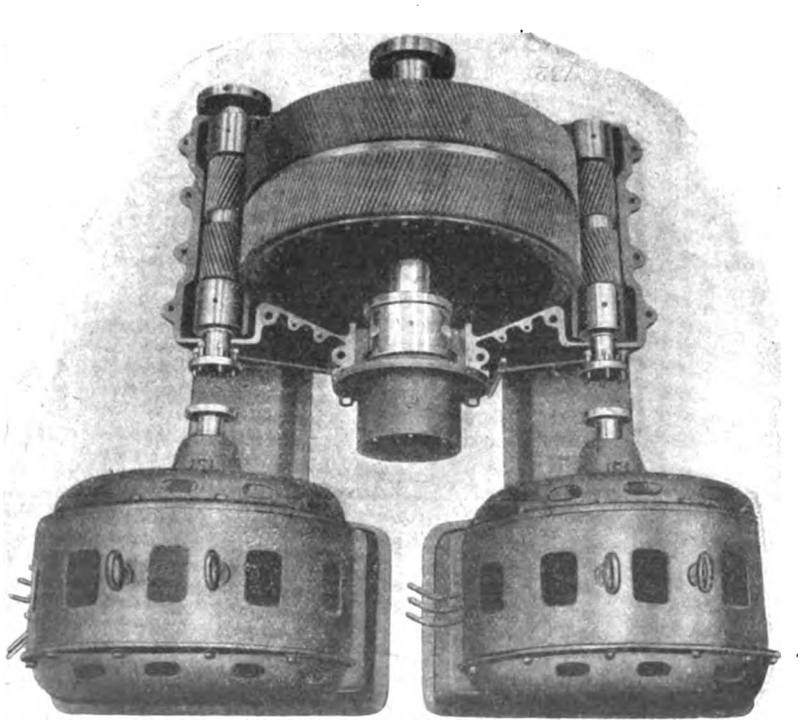

FIG. 12.—VIEW OF MOTORS AND GEARING.

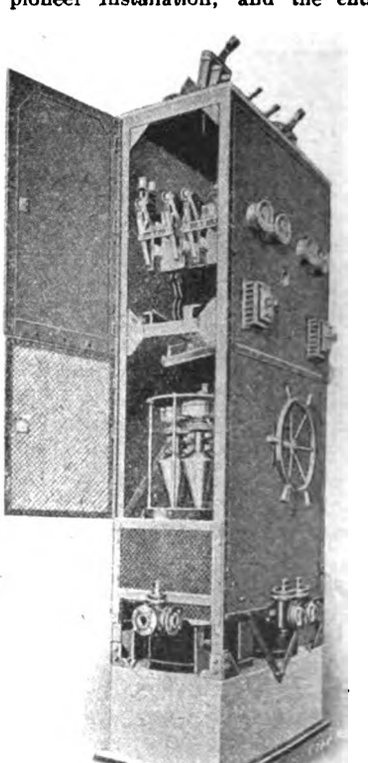

FIG. 13.—CONTROLLING GEAR.

3. As regards capital cost, if the propelling machinery in the electrical ship is more expensive for smaller powers than in the equivalent reciprocating ship, it will be found that the

As reversing is effected on the motors, an astern turbine is

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dispensed with. The prime mover runs under the best possible thermal conditions, which include as high a superheat as can be commercially obtained without unduly sacrificing the efficiency of the boilers. The gain in thermal efficiency due to such increased temperature eliminates the electrical conversion losses. Further, the Ljungström electrical method of propulsion, in conjunction with mechanically-geared motors, is a system which embodies the maximum degree of reduction between prime mover and propeller shaft, whilst the total weight of engine-room machinery is lower in the smaller powers and not greater, even in the larger powered merchant ships, than any form of mechanical reduction with the ordinary impulse or impulse-reaction turbine. The reduction in weight of boiler-room machinery is obviously in direct proportion to the steam consumption of the propelling plant.

To have at least two independent turbo-generators of equal power for each marine installation is advisable, not only in respect of the factor of safety through such duplications, but also in regard to the economy to be derived therefrom when running at reduced speeds. There is no necessity, however, in any class of merchant ship to increase the weight and expense

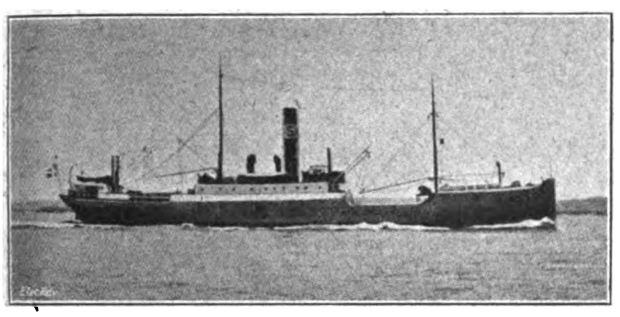

Fig. 14.—s.s. Mjolner.

of the motors by pole-changing devices. To run at half speed or about one-ninth power one of the two generator sets would run at half speed, absorbing about 25 per cent. of its normal full power. Between three-quarters and full speed, both sets are run in parallel at speeds corresponding to these two requirements, consequently the turbines run under at least as efficient conditions, and with the same elasticity, as in the case of ordinary geared turbines where the regulation is effected on the throttle or nozzles of the turbine.

The reversing switch and its resistances need only be used when manœuvring astern; the whole of the regulation from dead slow to full speed and *vice versa* can be effected on the turbine. The motor speed falls in direct proportion to the reduction of speed on the prime mover.

Twenty-one ships of an aggregate s.h.p. of 32,000 are at present under construction on the Ljungström turbo-electrical system, for British, Russian, Japanese, Swedish, Norwegian, and Danish owners. These vary from ocean-going vessels of 5,400 s.h.p. to river steamers of 550 s.h.p. They include one light-draught paddle steamer of 1,500 s.h.p., the power being transmitted from the turbo-alternator to two electric motors

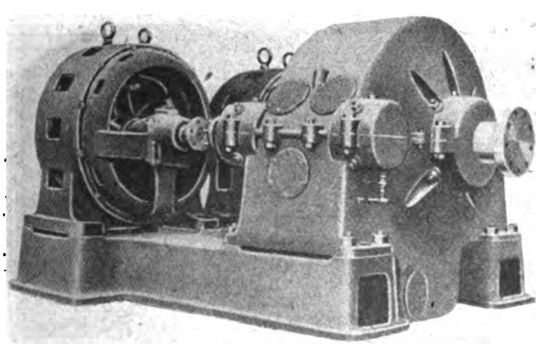

Fig. 15.—Motors and Gearing, Complete.

running at 450 r.p.m., each geared by single reduction to the corresponding paddle-wheel shaft, which runs at from 35 to 40 r.p.m.

In an appendix, a brief description is given of the Ljungström turbo-electrical propelling plant fitted in the *Mjölner*, and particulars are furnished of the comparative trials of the *Mjölner* with her sister ship *Mimer*, the latter possessing reciprocating engines.

These two ships, each of about 2,250 tons displacement, were ordered in 1913 for coasting trade, and delivered to their owners at the end of 1914. The following guarantee was given:—

On trial, the consumption per i.h.p. (equivalent) per hour of the electrically-propelled vessel should not exceed 70 per cent. of the consumption per i.h.p. per hour of the standard triple-expansion engine of the other vessel under equal conditions, excepting that the turbo-electrically driven vessel should have the benefit of the reduction in weight of machinery as regards draught.

The actual trial consumption showed that the *Mjölner* only consumed 58 per cent. of the fuel of her sister-ship. During a period of six months' service conditions, the owners have certified that the coal per ton mile consumed by the *Mjölner* was 62 per cent. of the coal consumed by her sister-ship for the same period.

The table below shows some of the trial results.

There are two turbo-generator sets in the *Mjölner* which run at 7,200 r.p.m., and supply three-phase alternating current at 500 volts, 120 cycles per second. The maximum load is approximately 400 kw. per generator unit—*i.e.*, 800 kw. for the complete installation. The over-all length of the turbo-alternator is 10 ft., the external turbine blade ring 15 in., and the weight of the turbo-alternator 7 tons.

The generating plant has been designed so as to avoid any possible trouble from salt or dust deposited on the generator stator or rotor. The generator rotor contains no air ducts. The stator air-ducts are straight, and, consequently, easily swept without removing or dismantling any other portion of the plant.

Mica only is used for the insulation of the rotor windings, which are consequently able to withstand a considerable amount of overload without injury.

The condensers, of a modified contraflo type, easily maintain a vacuum of 97 per cent. in service with a sea temperature of 65 deg. F. This high vacuum is in part due to the efficiency of the air-pump plant, and in part to the care which has been exercised in obtaining an air-tight condenser. No auxiliary engine exhausts are led into the main condensers, and where outlets are unavoidable water locks have been fitted to exclude the entry of outside air. An electrically-driven vertical centrifugal pump draws the condensate into the kinetic tank.

The condensate from the feed heaters is led to the main condensers through additional small heaters in series with the main feed-pipe.

	Mimer.	Mjölner.
Total boiler-heating surface	3,150 sq. ft.	2,140 sq. ft.
Weights: propelling machinery, tons ... Engine-room and tunnel ...	76	55
Boiler-room ...	110	81
Total ...	186	136
s.h.p.	730	843
Revs. per minute ...	86	89
Displacement... ...	1,698	1,648
Speed (knots) ...	11·3	11·7
Boiler pressure ...	180 lb.	220 lb.
Draught	Natural	Howden's ⅛ in. in ashpit.
Superheat	Nil	190° Fah.
Feed temperature ...	180° Fah.	230° Fah.
Vacuum (bar. 30 in.)...	26½ in.	29 in.
Coal consumption per day of 24 hours ...	13·1 tons	9·4 tons
Per s.h.p. per hour ...	1·798 lb.	1·036 lb.
Calorific value of coal	13,498 b.th.u.	13,485 b.th.u.
Moisture, per cent. ...	4·1	2·2
Ash, per cent. ...	3·6	5·0

The circulating pumps are three in number, each electrically driven by direct-coupled motors running at a speed of 3,600 r.p.m. The current is supplied from the main generators. The air-pump system is of the kinetic type.

One electrically-driven rotary multi-stage feed-pump is supplied for each generator unit, each capable of feeding both boilers under full power. The power taken by the feed pump is less than 1 per cent. of the total shaft horse-power. The pumps deliver the water to the boilers through feed heaters of the inverted-condenser type.

The propelling motors are of the standard three-phase induction type with slip-rings, and run at 120 periods, 900 r.p.m. and 500 volts. They are connected with the driving pinions by means of slipping clutches of a novel design, which are constructed to prevent breakage of propeller blades or shaft in the event of the propeller fouling block ice or any similar obstacle.

The gearing is of the helical type. The pinions are of chrome nickel steel, and the wheel of forged carbon steel. The shafts carrying the pinions run in fixed bearings of the same type as the rotor bearings; they are designed for minute adjustment, with great rigidity. Fig. 12 shows the two pinions, wheel, and one-half of the gear case, which is fitted to a box section bedplate on which the two motors are supported.

Owing to the motors and gearing, fig. 15, being on a common bedplate, the plant as a whole is self-contained, and all adjustments can be made at the works of the manufacturer. The lubrication of the gearing is effected by a separate oil-pump delivering the oil to the bearings and to the teeth under pressure. The gearing runs perfectly cool. The speed of the teeth is low, about 27 ft. per sec.

A Michel thrust bearing is mounted on the forward side of the gear casing.

Manœuvring is effected by the hand wheel shown on the switch-box illustrated in fig. 13. If the hand wheel is moved from the central stop or mid-position in one direction, the propeller turns in a similar direction, its speed corresponding

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to the angle through which the wheel has been turned. About 120 deg. represents full power ahead, and 120 deg. in the other direction represents full power astern.

Regulation of the speed of the motors when reversing is effected by inserting in series with the rotors of the motors resistances of the liquid type. These resistances consist of two sets of cones, of which the lower ones are stationary and filled with a saline solution, whilst the upper cones are mounted on vertical spindles which can be raised or lowered into the lower cones by the hand wheel, thereby inserting a greater or lesser resistance in the circuit. In mid or stop position, the upper cones are lifted entirely out of the liquid and lower cones; thereby the circuit is broken and the motors come to rest. At full speed the two cones come nearly into contact, the resistances being simultaneously cut out through a short-circuiting switch.

Reversal is effected with the wheel in mid or stop position —that is, when the rotor is open-circuited—and is accomplished by a change-over switch which reverses the phases in the main or stator current. A solution of dilute potash is used as the liquid resistance. This solution is circulated and cooled by a small centrifugal pump which is mounted on the same spindle as the circulating pump. The cones are of nickel and thus non-corrodible, and are counterbalanced, so that the power required to turn the hand wheel is nominal.

The switches are of the ordinary open type, the pressure in the rotor current of the generator being automatically lowered before the circuit is broken; they are found to work perfectly satisfactorily. For larger powers, oil switches are used.

The elasticity of control is considerable, the speed of the propeller ranging from about 12 R.P.M. to 90 at full speed. The total time of propeller reversal from full speed ahead to full speed astern was carefully tested on the trial trip of the *Mjölner*, and averaged fifteen seconds.

LABOUR DEMANDS AND RESPONSIBILITIES AFTER THE WAR.

(Some Mistakes Which Must not Recur.)

By JOHN MARKS.

One of the best features of the Electrical Review is that it appeals to the workmen of the electrical industry as well as to the most advanced scientific workers who are busily engaged in furthering new ideas and advances in the matter of applying electricity to ever wider and more varied uses.

This being the case, the writer considers that if a short time is spent in consideration of mistakes which in the past have not only tended to embitter workmen and their employers, but also to injure seriously the calling by which they both obtain their livelihood, it may have a really good chance of influencing the more thoughtful workmen to take a more reasonable view of the difficulties under which the manufacturer works; to realise that in any struggle between the manufacturer and themselves they must necessarily come off a bad second; and to hope that the influence of such men may have a deterring effect on the more erratic and hot-headed portion of their fellows.

The writer proposes to point out where, in the past, the workmen in various engineering trades have allowed themselves to be badly injured by following out the usual policy of antagonism towards the manufacturer in season and out.

The latter expression is purposely used, for the writer's own personal experience teaches him that too often the attitude of suspicion has had its rise in dealings, which were far from fair, on the part of manufacturers of an older school, who, for the most part, are now gone from us for ever.

Why should the unfair methods which obtained in days gone by make the workman suspicious of an employer who wishes to-day to treat him fairly? Why should the good and skilful man be forced to work, and work hard, for no greater return than the mediocre man, or even the duffer, who, in times of good trade, must be employed?

It is often stated, from the workmen's side of the question, that the demanding of a minimum wage, and the utter refusal to work on some type of piece or bonus system, does not prevent the manufacturer from rewarding a smart man with greater wages than the poor man. This, however, is quite a fallacy; the manufacturer has to average the cost and output of each man he employs when he is making up an estimate of what any particular contract will cost. He now pays all men the same level rate, and the good man must restrict, and does restrict, his output, in order not to show up the slower and less skilful man. Thus the manufacturer only gets a meagre output compared to what might be possible; he is not only compelled to refuse to pay the smart man a better wage, but, in order to face competition, he is also bound to take such precautions in the matter of providing supervision, that the slower man is kept constantly at his work, and is, in fact, made to accelerate his output to a degree which for him is uncomfortable, in order that the total cost for labour on any contract shall not be so heavy as to be prohibitive. The writer speaks from practical experience of both sides of the question.

Apprenticed to a firm who would not allow its premium men to idle, but forced them to work, or cleared them out, the memory of the work in the shops, though very pleasant, has this thought constantly at the back of it. The almost hopeless nature of the state of a man, who perhaps gifted with good brains and clever fingers, is compelled to go on year after year turning out so many parts per day, often of the same machine, and sometimes of one style and size, for a wage at the end of the week which will be the same when he is 50 as it was when he was 25. Surely there is some way of remunerating a man's skill and the result of his accumulated years of experience; and what better form could this remuneration take than extra wages, which would contribute to his everyday comfort, and tend to make him a more independent member of society, as well as to render him much more valuable to the community as a whole?

It may be said that the smart man will always rise from the bench or machine; that, however, is not true, in that we cannot all hold supervising and managerial positions. The correct policy then is to make the prospect before a workman better than it has been in the days before the war. The most important member in this matter is the workman himself.

If he will, he can raise himself to a far higher plane than he occupied before the war, and he can make his own position more certain and less liable to attacks of short time due to bad trade. This can only be accomplished if he assists the manufacturer by turning out a greater volume of work per man, and by assisting and not hindering the turning out of much more work from every individual machine used.

The level at which wages now stand cannot be maintained after the war unless the workman will consent to work with the firm and look upon the well-being of the firm as his very particular and personal interest. The writer is stating no mere empty platitude when he calls attention to the fact that the manufacturer has gone as far as he can in helping the workman; any further help must come from the workman himself, or it will not come at all.

It may be asked, what is meant by the idea of the workman helping himself, and the employer being unable to help him further.

The matter is simplicity itself; before the war, people who had money to invest, first asked about the security of the trade they intended to put their money into; next they wished to learn the probable dividend they might reasonably expect would be payable year after year. After some such inquiry, they very often decided to invest their money otherwise than in the electrical trade. Why? Because they could see but little in the way of good dividends paid throughout the trade as a whole, and also because they noted that in many cases the capital invested was none too safe; that is, a share bought for £1 to-day, stood a good chance of being only valued at 18s. in the course of a few months or a year or two.

People who advise persons who are about to make investments, would always draw the attention of their clients to the element of risk in the engineering, and particularly in the electrical engineering, trade.

Now these matters may not appear to affect the workman, and far too many men declare that they do not and cannot affect him.

They do affect the workman, however, because when such a state of things occurs in any industry, it becomes difficult to obtain capital with which to put down fresh machinery, or to erect new works. In order to attract sufficient capital, the management of such an industry must promise, and must pay, a somewhat high return on the money invested. Thus the works must now earn a greater margin than ever between the cost of constructing and selling its products, and the price it receives from the customer; as the manufacturer is subject to keen competition, he is forced to speed up the output of his men. There is no other explanation of the matter, he is absolutely forced to make the men work at a hot pace, in order to preserve the industry by which they both earn their livings.

Also we have the spectacle of the workman's adviser, whether he be his Trade Union representative, or the leader writer in the labour paper to which he subscribes, stating that all piecework or bonus work systems, are methods of inducing the workman to *sweat himself*. Let us suppose for a moment that they are for this purpose; it will at least be admitted that at the end of a self sweating week, the wages packet is considerably heavier, than under the ordinary datal system of paying wages, and to that extent the workman is a considerable gainer. Under the present system, the Trade Union rules actually make it imperative for the master to drive his men, in return for a smaller wage than they might easily earn by using their skill, experience, and brains, for the purpose of expediting their output; and every man knows that when a workman has a direct monetary incentive to turn out more work, he does not feel the speeding up, simply because he does it willingly; whereas at present he is kept to his task whether he wishes or not.

Now let us take a glance at what will be the after-war conditions of our industry, in relation to the obtaining of sufficient capital. It is no use arguing that the State should own the means of production and exchange; the State does not own them, and will not do so for many a long year, if ever. Meanwhile both the manufacturer and workman have to live, and whilst it is a fact that most manufacturers could get a fairly comfortable living if they retired from trade and invested their money in Government securities, it is equally true that not one workman in 10,000 can so exist, simply from lack of capital.

Thus, for the present, we depend on capital flowing into the industry, in order to make a living possible for anyone.

Before the war a man could get, with safety, 4 per cent. on

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money he invested with municipal or equivalent safe concerns. He put his money into business because he anticipated making a clear 8 or 10 per cent. out of it. In some cases he preferred to take 5 or 6 per cent. in order to be a little safer, but he always demanded considerably more than the safe rate of 4 per cent. In short, he would not take risks for the sake of an extra 10s. per cent. dividend.

The manufacturer not only looked to this return on his invested money, but he recognised that by using his managerial abilities in a trade in which he had some degree of interest, he could earn for himself a good salary as a manager. Thus, such a man has everything to persuade him to enter and keep in business, and will often do so when the return on his invested capital is really low. The shareholder, however, has not this double interest, he is interested only in the dividends earned, and will not bring his money to the industry if the return is low; as this man is the person who finds the majority of the necessary capital, he must be considered, or the business goes to the wall for want of money to work with.

It is quite certain that after the war people with money to invest will be somewhat scarce, and that they will require a high return on their money, simply because they can obtain Government security with a dividend of 5 per cent.; if they are to take the risks of an industry subject to keen competition, they will require much more.

Also, the manufacturer with money and ability will, if the returns of business are meagre, simply refuse to be subject to the worries inseparable from the management of a large business; he will save himself worry, improve his health, and prolong his days by the simple method of investing all his money with the Government, and none in industry.

The writer makes no philanthropic claim for the manufacturer, he simply states what will be the policy dictated by common sense; no man in his senses is going to submit his capital to the risks of business, and himself to heavy and responsible duties, unless he is able to get a good consideration for so doing.

Now in every dispute between the workman and the employer the workman is at a disadvantage, owing to the fact that the employer can, and the workman cannot, live without working; consequently, it should not be necessary to point out that only in the greatest extremity should the workman resort to a strike, simply because it injures him and those dependent upon and connected with him to a far greater extent than it can ever injure the employer.

Take a recent case when a few years ago the late secretary of the A.S.E. advised the men on the North-East Coast not to strike; they threw his sound advice in his teeth, and, as usual, dubbed him traitor. Mr. Barnes knew both sides of the question, and, on that account, he advised the men not to strike. He was publicly flouted and insulted, and as a consequence resigned his position as secretary.

The strike lasted nine months, and the men went in on the employers' terms, after subjecting their wives and children to the misery and serious privation of a long strike, and the wicked wasting of sufficient capital to bring in an income of over £10,000 a year at a 4 per cent. rate.

During the great coal strike of a year or two ago over the minimum wage, the proprietor of certain iron mines, asked permission from the Miners' Union, to obtain sufficient coal from his own pits in order to keep his blast furnaces going.

This situation was somewhat peculiar, and is thus more interesting. The owner of the iron mines was a member of a family who had worked those particular furnaces for over 130 years; he was on the best of terms with his men, and owned valuable coal pits 5 miles away. The iron ore he raised was so good that he had received many offers from iron masters in different parts of the country to buy the ore from him at a price which would have left him a much greater profit than he obtained from the iron run at the blast furnaces. He was a very wealthy man, and to the writer's knowledge refused three times to sell the ore instead of smelting it, on the grounds that the furnaces were going to be worked by him as his family had worked them before him.

His proposition was that he should pay for a check man at his coalmines who would see to it that no coal went from the mines other than to the blast furnaces; every man employed on working coal for this purpose was to be paid a lump sum at the end of the dispute, which would have represented the agreed increase of wages from the start of the trouble; that is, any advance obtained was to be made retrospective.

In vain did this owner plead that if the miners persisted in shutting down the furnaces, they would throw out of employment 200 men who were comfortably situated, and in vain did he point out that every man working coal for those furnaces would be paying into the Union funds, instead of drawing from them. So serious did he consider the matter, that he addressed mass meetings of the local men, in order to lay the proposition before them. Finding nothing but stubborn rebuffs, he warned the men that if they shut the furnaces down, they would not be started up again in his lifetime; neither persuasion nor warnings had any effect. The furnaces must close in order that as far as possible the whole nation should suffer and sit up over the coal strike.

The furnaces were shut down; the strike progressed, and ended. Knowing members of the strike-mad section of the community waited for the furnaces to start up again, and even gave the dates of the restart. The iron ore men certainly restarted, and then loaded the stuff into the railway wagons, to go away and be smelted elsewhere; the offer of other iron masters had been accepted, and 200 men were done out of a comfortable living by the unparalleled folly of their own class.

The critic may retort, that as the smelting had to be done elsewhere the men were not done out of a living. It is true that those who still possessed their youth and pluck packed up and followed the ore, after waiting about for a month or two to see what would happen. Finding their resources absolutely at an end, they sought work elsewhere, and found it—not amidst the country surroundings of the old place, but in the dirty and high-rented quarters of a large industrial district. The writer's contention therefore that they were done out of a *comfortable* living is quite correct.

Some of the men who did not wish to leave the district, and who had one or two permanent ties in and around the locality, were forced to take up any sort of a job that they could find.

The writer will not easily forget the spectacle of a healthy man of about 45 asking a relative for a labouring job at an adjacent works, and stating that his family obligations would not permit him to remove; that he had been provident and made some provision for bad times and old age, but that work he must have if he was not to start realising his capital, which consisted of two cottages, and an excellent plot of gardening ground.

This man plainly stated that he had worked for the iron company for over 30 years, that he had never had any quarrel with them, and that the miners' attitude had thrown him absolutely on his beam ends.

This man was no slacker, and no fawning humbug; his frugal investment made it impossible for him to follow the iron ore without great sacrifice, and an objectionable change for his family and himself, into a dirty industrial district. He was willing to walk, and did walk three miles from his home to the next works which could offer him even a pittance, providing that he could stay where his interests were.

Thus folly on the part of one section of men brought distress to another section of working people; distress of a permanent nature. The greatest folly of the whole matter was that the man they had worked for was admittedly a thorough gentleman, and a most considerate employer.

This last statement brings the writer to his final argument. Why should workmen so often tantalise and aggravate those firms which treat them best? This is simply folly of the worst description, and if persisted in will ultimately throw all control into the hands of the less desirable type of manager.

Let anyone with extensive experience of municipal control think of the manner in which advantage is taken of the known sympathy of the Council towards the Trade Unions; this experience, like those mentioned above, has been personal with the writer, and is no hearsay matter. Often has the question been asked, "Why do you not leave us alone instead of badgering us in this fashion?" "Why do you not annoy some of the worst paying firms in the town until the management there gives you something like what you get here, both as regards wages and conditions of work? Why do you follow a stupid policy which must alienate men with a friendly feeling towards you?"

No satisfactory answer is usually offered, except that it is considered good policy to squeeze where squeezing can be done; and so the shortsighted game goes on, and results in the opposition to Trade Union methods spreading even to those officials, who in theory have at one time approved the Unions.

The plea is advanced that ideal conditions will bring out the best in the worker; this is absolutely incorrect.

Let us take an example of an industry run by working men themselves for their own benefit. The reference is to the factories run by the Co-Operative Wholesale Society.

This society is not only up-to-date in its manufacturing methods, but its constitution insists that full Trade Union wages shall be paid, the shortest possible hours worked in return, and that the best of conditions must be maintained for the workers in those factories.

Now do we find unalloyed contentment in those places? The answer is in the negative; on more than one occasion strikes on trivial and absolutely piffling matters have broken out and caused annoyance and loss to the management.

Again, taking the retail side of that same movement, the writer knows of discontent obtaining amongst a number of employés who are paid above the district rate for their labour, and who work many hours less per week than the ordinary shopmen. Yet here, again, we get the pettifogging, annoying manufacturing of petty grievances, which could enter the mind of no man who was busy with a fair day's work.

In one instance in a large town, the managing Committee, mostly composed of working men and Trade Unionists, were so disgusted and hurt at the spirit displayed towards them by a well treated set of employés, that they placed their regret in writing on the minutes of that particular society.

In conclusion, the writer assures the workman that no way of improving his status and pay will avail permanently other than that of assisting the employer to reduce the cost of manufacture. This he can do by agreeing to work on a bonus system whereby he turns out more work in a given time, and receives more money for doing so.

The manufacturer's share comes from the fact that the charges for rent, rates, taxes, cost of maintaining the establishment, lighting and running, are very heavy. More work turned out means a lower standing or dead charge on each finished article, and a quicker realising of the profit thereon. Thus a smaller profit can be taken on each article because it is taken on more articles per year.

The cost of each article is reduced by the time saved, and the cost to the customer can, therefore, be reduced; by following the above method of intensive production, the customer gets a lower price, the man a greater wage, and the manufacturer a larger profit.

If works A can make an engine of a certain type for £100, and works B cannot make it for less than £120, then works B will

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have to shut up. Apply the comparison to countries A and B with regard to the whole of their manufactures, and it follows that country B will have to go down.

8 Which we are to be is in the hands of our workmen. If they will try to abolish old time suspicion and work hand in hand with the manufacturer to speed up output, both the country and themselves will benefit by long-continued prosperity; and under such a system the present rates of wages could be maintained after the war has finished.

The war will not finish to-morrow, but to-morrow will be too late to consider the matter. It must be considered now, and with an open mind.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

CHILE.—With reference to the announcement in the REVIEW of March 17th respecting a proposed new specific Customs Tariff for Chile, it appears that the enactment of the new Tariff has now been reported (by cable on April 16th) by H.M. Minister at Santiago, who states that merchandise cleared through the Customs within 30 days of the promulgation of the new Tariff will be assessed for duty at the old Tariff rates, notwithstanding that the new Tariff will, in principle, take effect from the date of promulgation.

JAPAN.—The Government Bill proposing to modify the Customs duties on various articles imported—see the REVIEW of April 21st—has now been passed by both Houses of the Diet, and was promulgated in the *Official Gazette* of March 6th. The new rates of duty provided for by this measure came into operation on April 15th.

FRANCE.—A Government Bill has been laid before the Chamber of Deputies, proposing to authorise the Government, so long as hostilities continue, to prohibit by Decree the importation of foreign goods, or to increase the Customs import duties thereon.

FRENCH INDO-CHINA.—Owing to the difficulties experienced at the present time in regard to the shipment of goods from the United Kingdom to Indo-China, the French Government have decided that, subject to the necessary "authorisation" being given by the French Consul-General in London, the "Minimum" Tariff rates of duty will be applied during the continuance of the war to all British goods forwarded from the United Kingdom to Indo-China, whether in British or French bottoms, with possible transhipment at Marseilles, Singapore, or Hong-Kong.

The above-mentioned concession is in addition to that notified in the REVIEW on March 10th, under which transhipment at Singapore only was allowed.

SPAIN.—In virtue of a Royal Decree of October 22nd, 1914, bonded warehouses have recently been established in Cadiz, reports the British Vice-Consul at that port. Goods placed in these warehouses remain free of import duties, transport and port works dues, until imported for consumption into Spain. If re-exported from bond they are not subject to these taxes. Merchandise may remain in the bonded warehouses for a period up to four years, except where it is liable to decay. Goods such as explosives and articles dangerous to the preservation of other merchandise or to the security of the buildings are not admitted.

A table of warehousing charges for deposited merchandise is included in an explanatory pamphlet forwarded by the Vice-Consul, a copy of which (in Spanish) may be inspected at the Commercial Intelligence Branch of the Board of Trade.

The prohibition of the exportation of articles wholly or partially manufactured with copper or brass has been withdrawn.

BERMUDA.—A new Customs Tariff came into force on January 1st, and will continue in force till December 31st. With few exceptions the rates of duty and the free list are identical with those previously in operation. It is provided, however, in the present Tariff that on all goods which are liable to specific or to *ad valorem* duties a surtax shall be levied of 10 per cent. on the amount of duty so payable.

EGYPT.—Revised Tariff valuations for use in assessing duties on certain metals imported into Egypt have been issued, with effect from April 1st to May 31st.

A Lamp Test.—A projecting bracket, beneath which was suspended an opal glass sign with the letters "G.E.C." upon it, was blown down during one of the recent gales, outside the branch premises of the General Electric Co., Ltd., at Swansea. An illustration that lies before us shows that the bracket terminated in a hook bearing a reflector and an Osram lamp. The opal sides of the sign was completely smashed, but the 1,500-watt Atmos-type Osram was found to be unbroken, and, when tested, gave forth its light as usual, the filament being intact.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

5,874. "Magnetic blow-out furnaces." G. H. NEEP AND SWITCHGEAR AND COWANS, LTD. April 25th.

5,875. "Intercommunication telephones." J. W. DUNGEY. April 25th.

5,884. "Electrically-operated temperature alarms." J. P. M. A. STRUYVEN. April 25th.

5,933. "Electrical switches." L. G. CAUNTER. April 25th.

5,934. "Electric locomotives." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). April 25th.

5,945. "Shields or guards for electric lanterns, electric torches, &c." N. J. AUSTIN & G. E. TAYLOR. April 25th.

6,003. "Lighting fittings." BRITISH THOMSON-HOUSTON CO. April 26th.

6,005. "Dry cells, and batteries thereof." C. F. BURGESS LABORATORIES. April 26th. (U.S.A., May 28th, 1915.)

6,031. "Electric devices for automatically turning lights on and off." E. STEIGER. April 27th. (Switzerland, April 28th, 1915.)

6,036. "Electric welding apparatus." E. WOLTMANN. April 27th. (U.S.A., May 1st, 1915.)

6,039. "Electrical generators for aircraft." G. E. MORTLEY. April 27th.

6,042. "Dry battery." F. P. BAUMANN. April 27th. (Switzerland, February 4th.)

6,044. "Assembling and uniting accumulator plates." A. ALLEGRANZA AND A. FORT. April 27th.

6,079. "Electric switches." P. L. DAVIES & J. H. WOOLLISCROFT. April 28th.

6,082. "Reflectors and shades for arc lamps, electric lights, &c." H. LEVY. April 28th.

6,089. "Electrolysis of brine in the manufacture of sodium hypochlorite, and apparatus therefor." R. S. CHAMBERS. April 28th.

6,091. "Acid and fume, gas, water, and vapour-proof electric lamp-holding device." A. WARNE. April 28th.

6,095. "Electrical indicating devices for taxicabs, &c." H. E. GILL & H. RICHARDSON. April 28th.

6,104. "Method of automatically taking up shrinkage of coils of electric transformers, &c." J. HALL & J. R. KIRK. April 28th.

6,106. "Distributors for magneto-electric machines." F. B. HALFORD. April 28th.

6,129. "Method of operating electrodes for projectors." E. A. SPERRY. April 28th. (U.S.A., June 28th, 1915.)

6,131. "Electrical resistances." A. H. CURTIS. April 28th.

6,150. "Method of automatically taking up shrinkage of coils of electric transformers." J. HALL & J. R. KIRK. April 29th.

6,151. "Electro-magnetic guns." D. S. CROWTHER & W. ROUTLEDGE. April 29th.

6,160. "Electric motor control systems." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). April 29th.

PUBLISHED SPECIFICATIONS.

1914.

22,045. ARRANGEMENTS FOR AUTOMATICALLY SWITCHING-OFF OR INDICATING DEFECTIVE SECTIONS OF ELECTRIC DISTRIBUTING NETS. M. Hochstadter. November 5th.

1915.

1,997. TELEGRAPH MACHINES. L. M. Potts. February 8th.

2,163. SYSTEM OF TELEGRAPHY. E. C. R. Marks (Delany Foreign Co.). February 10th.

5,168. MAGNETO IGNITION FOR INTERNAL-COMBUSTION ENGINES. J. W. T. Cadett & C. Percy. April 6th.

5,201. CIRCUIT BREAKERS, CURRENT LIMITERS, EXCESSIVE CURRENT INDICATORS, AND THE LIKE, FOR ELECTRIC CIRCUITS. E. T. R. Murray & G. F. Shotter. April 6th.

5,323. MINERS' ELECTRIC SAFETY LAMPS. J. G. Patterson. April 8th.

5,557. ELECTRIC RECTIFIERS AND METHODS OF OPERATING THE SAME. British Thomson-Houston Co. (General Electric Co., U.S.A.). April 13th.

5,596. ELECTRICAL RELAYS. J. Savin & Automatic Telephone Manufacturing Co. April 14th.

5,623. ELECTRICAL ALARM SYSTEMS. Siemens & Halske Akt. Ges. April 14th. (April 16th, 1914.)

5,731. PORTABLE PRIMARY BATTERIES OR CELLS. C. H. Elliot & Solectric Co. April 16th.

5,783. AERIAL CONDUCTORS FOR WIRELESS TELEGRAPHY. Marconi's Wireless Telegraph Co. & C. S. Franklin. April 17th.

6,991. SHORT-TIME ELECTRIC SWITCH. Landis & Gyr Akt. Ges. May 10th (May 23rd, 1914.)

7,263. APPARATUS FOR PNEUMATIC CONVEYING OF SOLIDS. British Thomson-Houston Co. (General Electric Co., U.S.A.). May 14th.

7,826. ELECTRICAL TRANSFORMERS. S. Z. de Ferranti & Ferranti, Ltd. May 26th.

7,827. ELECTRICAL APPARATUS EMPLOYING OIL INSULATION. S. Z. de Ferranti, J. Roothaan & Ferranti, Ltd. May 26th.

7,840. VIBRATING MAKE-AND-BREAK DEVICES FOR USE IN ELECTRIC SIGNALLING. A. C. Brown. May 27th.

7,987. ROTARY ELECTRIC CONVERTERS. British Thomson-Houston Co. (General Electric Co., U.S.A.). May 29th.

8,546. ELECTRIC FUSE CARRIERS. A. C. Robinson. June 9th.

9,584. ELECTRIC WATER-HEATERS. G. P. Elmen, S. O. Salisbury & A. R. Talbot. June 30th. (December 26th, 1914.)

10,272. AMPLIFICATION OF WIRELESS SIGNALS. A. J. Roberts. July 14th.

11,033. MAGNETOS. M. A. Codd. July 29th.

11,208. DEVICES FOR GUIDING ROPES OR CABLES. Pickerings, Ltd., & J. Fothergill. August 3rd.

12,614. ELECTRIC ARRANGEMENTS FOR DISTANT CONTROL. Fried. Krupp Akt. Ges. September 2nd. (September 2nd, 1914.)

15,330. SWITCHING DEVICES FOR THE LOW-TENSION INDUCTION CIRCUIT OF AUTOMOBILE ENGINES. F. Bacon. October 30th.

18,084. TELEPHONE SYSTEMS. H. S. Turner. December 28th. (June 20th, 1914. Divided application on 6,480/15, April 30th.)

1916.

503. CABLE CLAMPS FOR ELECTRIC WIRING INSTALLATIONS. G. S. Boothroyd and Callender's Cable & Construction Co. May 21st, 1915. (Divided application on 7,647/15.) Patent No. 100,233.

4,402. TELEGRAPH MACHINES. L. M. Potts. February 8th, 1915. (Divided application on 1,997/15.) Patent No. 100,239.

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THE

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SCIENCE IN THE FACTORY.

IN our last issue we referred, in passing, to the excellent address of Sir Wm. Beardmore to the Iron and Steel Institute; there is so much of value in this address that we have thought it well to reproduce a large portion of it, and have omitted the remainder with regret. The author speaks with knowledge based on an exceptionally wide experience in connection with engineering undertakings of the first magnitude, and we are glad to see that he wholeheartedly advocates the application of scientific method to industrial affairs, giving many striking instances of the improvements and economies which have resulted from its adoption. The fact that immediate benefits may not accrue is clearly brought out in the address; in the case of the great dye industry which the Germans built up on the scientific foundation provided by British genius, no less a period than 17 years was spent in patient and unflagging research before success was achieved, at a cost of a million sterling—but the desired end was eventually attained and immense profits were secured. On the other hand, examples are given of investigations which bore valuable fruit within a comparatively short time of their inauguration.

Another feature of the address to which we would direct attention is his appreciation of the importance of pure scientific investigation, with no apparent bearing upon industrial matters. The researches and discoveries of Faraday, which have given rise to the electrical industry, afford a familiar example of this nature; but others even more striking are adduced by Sir William, such as the discovery—first by pure theory—of Thomson and Joule that a gas expanding through a porous plug was lowered in temperature, upon which is based the liquefaction and separation of gases, now employed on a large scale in various branches of industry, or the recalescence of iron studied by Prof. Barrett, a well-known phenomenon, the investigation of which has led to revolutionary improvements in the manufacture and treatment of steel alloys of the utmost importance to the engineering industries.

There is, however, a jarring note which runs through Sir William's address—the reluctance of the workers to "play the game." He demonstrates, with startling clearness, the fact that *even in war time*, they deliberately restricted their output, and to such an extent that girls, with necessarily very little training, were able to turn out more than double the production of thoroughly trained mechanics working under the same conditions and for the same hours. The gravity of such a statement cannot easily be over-estimated, and the author's conclusion that men capable of such unpatriotic conduct are unworthy of the privileges of citizenship is thoroughly justified. It is not thus that Germany

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wages war. We fear that his forebodings as to the future due to the lack of a sense of duty on the part of the worker are only too well-founded. That in pursuing a policy of restriction of output the workman is acting against his own interest is undeniable, and if he could be induced to make a trial of the "square deal" he would soon realise the fact. But the difficulty is to persuade him to try it, and probably past errors on the part of foremen in cutting down piece rates unduly when a man increases his output have a good deal to do with his suspicious attitude towards the employer. It is not only the worker who is selfish.

National Industrial Organisation.

FROM articles which have been appearing in a number of leading newspapers during the last ten days, we gather that the scheme for combining the several movements which have for their object the formation of a strong national organisation of manufacturers and industries has been advanced a further stage. Circulars are understood to have been issued bearing the signatures of Mr. F. Dudley Docker, C.B., Mr. F. J. Nettlefold (chairman of the Institute of Industry), and Mr. W. P. Rylands (representing the "Central Association"), intimating that as soon as one hundred preliminary members, each guaranteeing an entrance fee of £1,000, have been obtained, the new Association of Manufacturing Interests will be established. Nearly half that number have been secured.

It is safe to assume that the great majority of our numerous large industrial concerns are by now fully convinced of the crying need for such an organisation efficiently to watch over British manufacturing interests, and worthily to represent those interests in the right circles without antagonising Labour. That being so, if these concerns can be convinced, as we think they can, that the combined effort now seeking their co-operation is a serious one, with very substantial backing of influence and funds, they will throw in their lot with those who are eager for the organisation to get to work in time to assist in putting our industrial house in order before Peace is declared. The Association will embrace practically all classes of manufacturing industry—"a sort of industrial Parliament," are the words credited to Mr. Dudley Docker in the Press—but engineering and electrical manufacturing form so extensive and vital a part of the industrial life of the nation that they will inevitably rank very prominently in such an organisation. It is stated that Mr. A. W. Tait, of Basildon House, E.C., is acting as honorary secretary *pro tem.*, and that all correspondence on the subject should be addressed to him.

A Diesel Engine Explosion.

THE recent fatal explosion of a compressed-air receiver in connection with a Diesel engine at the Smithfield Markets electric lighting station has been very fully dealt with at the meetings of the Diesel Engine Users' Association, of which reports have appeared in our columns. In some respects the accident was of a similar nature to that which took place at the Bray electricity works in 1912, with most unfortunate results. In both cases, apparently, a mixture of oily vapour with air (enriched with oxygen at Bray) exploded and fractured the containing vessel—the intermediate "purge pot" or receiver in the present instance, the blast bottle at Bray.

While in the latter case the presence of excess of oxygen was probably the main cause of the accident, we pointed out at the time that the insertion of a check valve in the course of the pipe from the blast receiver to the fuel valve would have prevented the explosion. It will be noticed that the makers of the air compressor at Smithfield Markets recommend a similar precaution in the case of the pipe from the compressor to the blast receiver, to prevent the return of air from the receiver to the pump, in the event of faulty operation of the high-pressure valves on the latter.

The dangers arising from the association of compressed air and oil vapour have been well known for many years, and as both these elements are necessarily present in the working of the Diesel engine, in which, moreover, the risk is aggravated by the exceptionally high pressures employed, elaborate precautions to prevent the possibility of accident would be fully justified. All the more, therefore, is it incumbent upon the makers and users of these engines to adopt the simple and inexpensive expedients to which we have referred, and we hope that both parties will by such means endeavour to render the Diesel engine as safe as any other prime mover. The Association, which, though necessarily small, is one of the most active and efficient of our technical societies, may be trusted to throw its influence into the scale of safety and progress.

Lead.

NOTWITHSTANDING the prohibition of speculative dealings under the regulations in force, the run of business has been fairy active within the last week or so, at a somewhat lower range of prices, however, due to the fact that the market for early delivery has been chiefly fed by the disposal of controlled lead or metal that was ear-marked or held on behalf of the British Government. Developments, as a matter of fact, have been chiefly the outcome of the operations conducted by Government brokers. The supplies now coming to this country from Australia and Spain are, apparently, largely under Government control; but the fact is worth noting that this control has not resulted in any very material cheapening of the price of the commodity, which, after all, depends chiefly on the law of actual supply and demand. Considering the very liberal quantities of metal which have come on the market of late, the latter has certainly given a good account of itself. The price of prompt delivery dropped to about £33 12s. 6d., thus showing a depreciation of quite £2 15s. a ton from the extreme highest point recorded this year, which has given consumers who were rather short of stock an excellent opportunity of replenishing on more advantageous terms than generally anticipated. A fair number of transactions have just lately taken place in forward positions, whereas business has been for some time past, or since the enforcement of the new regulations, almost entirely confined to near lead. Forward metal is certainly not offering with anything like freedom, which is not surprising, for indications as to future supplies do not point to any excessive surplus.

As shown by the official returns of imports for the past month, the deficit of supplies as compared with the previous year is greater than ever, though this is, to a considerable extent, offset by the fact that the re-exports have fallen off materially this year, which is partly due to the Government restrictions upon export business. For several weeks past, indeed, licences have been very hard to get. So far this month, the arrivals have been again very light, and the surplus for near delivery having been whittled down to moderate proportions, the market now shows greater resistance, although dealers are not disposed to carry much stock, and, in fact, they chiefly confine their purchases to actual demand from consumers. The chief sustaining factor in the situation continues to be the big outlet for munitions, while the demand for ordinary industrial purposes is considerably under the normal, which is explained by the marked slackness of the building trades. Rollers, however, are being kept fairly busy by the large Government orders for war purposes.

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The fact may be mentioned that operations on the part of white and red lead manufacturers are seriously hampered by the ever-growing scarcity of labour, while a keen demand has been experienced for this material for some time past. The bulk of the English output of white lead is, apparently, absorbed or reserved for Government purposes, and those consumers who placed orders in America find considerable difficulty in securing shipments through lack of freight, while American terms have been raised considerably. The position of pig lead in America is not quite so tight as it was a few weeks ago, the demand having fallen off somewhat, both for domestic and export, and prices have eased off appreciably, but they still stand at a relatively high level, which practically prohibits the resumption of shipping business with this side. The French takings from Spain direct continue on a large scale.

The Working of "Unsealed Patents."

A NEW range of patents—"the unsealed patents"—is now thrown open to applicants for licences. An application of considerable moment, the first under new legislation of this year, was made to the Controller of Patents, Mr. Temple Franks, and the Deputy-Controller, Sir Cornelius Dalton, on Thursday last week. The Patents Court was set up by special legislation to deal, under the Patents, Designs and Trade Marks (Temporary Rules) Acts, 1914, with the patents of alien enemies. Hundreds of German patents, a good many electrical, have been applied for by British manufacturers, who desired to manufacture under a Board of Trade licence for the supply of the British and Colonial trade. The novel application heard last week was made under new legislation passed only a few weeks ago—the Trading with the Enemy Amendment Act, 1916. This relates not to letters patent already granted, but to an important department of the newest examples of inventive skill—the applications which have been received from the Continent since the outbreak of the war, or immediately before it, for British patent rights for new devices, for which as yet no sealed patent has been issued. Specifications have been required to be filed, but the authorities in this country have done nothing in the direction of conferring rights and transforming the applications into sealed patents. These "unsealed patents," as they are called, are now thrown open for the investigation and application of British manufacturers and users. The first application under this new legislation is, therefore, a significant event, not to be overlooked by those who are consulting the needs of the public and of British industry in these times.

The first application for an "unsealed patent" had to do with the German Timmer machine for grinding blades, and was made by two Sheffield firms in order to fulfil War Office contracts of so extensive a kind that they could not ordinarily comply with them.

The machine, curiously enough, comes from the German Sheffield—Solingen. The Controller made clear the procedure in this new class of case. The Public Trustee will probably be made custodian of the "unsealed patents," and while the licence has been issued by the Board of Trade hitherto, the new type of licence will be executed by the Public Trustee and granted in his own name, though it will be prepared by the Solicitor of the Board of Trade. The Public Trustee will hold the royalties, and it will be necessary (the Controller pointed out) for somebody to pay the sealing fee, for the unsealed patents must be sealed to someone before they can be used.

It is stated that there are some two thousand of these "unsealed patents" filed, together with their specifications. The first application, the Controller announced, would be granted.

CENTRAL ARGENTINE ELECTRIFICATION.

AN important railway electrification scheme, which is approaching completion, is that comprising the Central Argentine Co.'s suburban line from the new Retiro Station (Buenos Aires) to Tigre (*viâ* Victoria), which has a route length of 28 km. From a description of this scheme which appeared recently in the *Central Argentine Railway Magazine*, it appears that Messrs. Merz & McLellan reported favourably on this project in 1910, and that the scheme, having received the approval of the Argentine Government, steps were subsequently taken to carry it into effect, with the result that it is practically completed. Electrical energy will be generated in the company's power-house at Canal San Fernando, and transmitted through 20,000-volt underground cables to sub-stations at the Canal San Fernando, Victoria, Olivos, Palermo and Retiro. The sub-stations at Canal San Fernando, Olivos and Palermo will convert to direct current at 800 volts, at which pressure the current will be supplied to the third rail. The sub-station at Victoria is a static sub-station, and will supply three-phase current at 440 volts for power and lighting requirements at the Victoria workshops and station. Retiro sub-station will convert to 220-volt direct current for the supply of light and power to the new Retiro station and goods yards.

Electrical energy will be supplied to the trains by means of a third rail, and will return to the traction sub-stations by means of the track rails. The rolling stock is arranged on the unit system, and each unit will consist of one motor coach coupled to one trailer coach. A train can thus consist of one to six units, that is, two to twelve coaches.

With the exception of Tigre C. and Victoria the electric lighting at the local stations on the electrified system will be supplied direct from the third rail. At Victoria, the Victoria sub-station will supply the current, while at Tigre C. motor-generators will reduce the current at 800 volts from the third rail to a pressure of 200 volts, at which pressure the lighting will be carried out.

The power house is situated on railway property midway between the Canal San Fernando station and the River Lujan. The foundations are in the form of an armoured concrete raft supported on about 3,000 piles driven to a depth of 10 metres.

The power house, with its machinery, is now completed. The building is of steel framework, with walls of reinforced cement plaster, and is divided into two main parts, the engine house and boiler house. There is a bay along each side of the engine house; in one the high-tension switchgear is housed, and in the other, which is adjacent to the boiler house, all the water tanks and feed pumps are situated. The engine house is spanned by an electrically-driven travelling crane.

The boiler house has three main floors: a basement, or ash-handling floor, a boiler house floor, and an economiser floor. The boilers and economisers are arranged on each side of the boiler house, and above them are coal-bunkers which have a capacity of 1,000 tons. Alongside the boiler house in the open is a coal store for 6,000 tons of coal.

In the engine room are installed four 3,300-KW. turbo-alternators of the Parsons type. The alternators generate at 2,500 volts, 25 cycles, and run at 1,500 R.P.M.; they are direct coupled to step-up transformers, which raise the voltage to 20,000. Below each turbine is situated its surface condenser and auxiliary machinery.

The circulating water is obtained from the River Lujan by means of four electrically-driven circulating pumps which pump the water from the river to the condensers.

The high-tension switchgear is installed in concrete cells reaching from the basement to the roof of the switch house.

There are six boilers of the multitubular type fitted with mechanical stokers, superheaters, induced and forced draught. Each boiler has its economiser placed directly above it, the waste gases from each pair of boilers being dealt with by the one chimney. The ashes and soot are handled by means of the vacuum ejector system.

Coal, as a rule, is brought from Campana, or Villa Constitucion in wagons, and lifted by an electrically-driven jib

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crane, with grab attachment, into the open coal store, or into receiving hoppers. Two coal-crushers reduce the coal to a small size; a bucket elevator conveys it to the top of the boiler house, where it is transferred to a tray conveyor running over the overhead bunkers. It is expected that about 50 tons of coal will be burned per day.

Practically all the cables have been laid and jointed, and are ready for use. The H.T. cables are all of the three-core, paper-insulated, lead-covered and wire-armoured type, and are in duplicate. In general, the cables have been laid in the ground at the boundary lines on each side of the track. Each H.T. feeder has laid alongside it a pilot cable for the automatic protective gear for cutting out faulty feeders.

Telephonic communication has been arranged for by means of underground telephone cables, which link up the various points of the electrified system.

The three traction sub-stations are practically identical, and have been completed. The buildings are of the same type as the power-house building. Each sub-station contains three rotary converters, each of 1,000-KW. capacity. The direct-current feeders are paper-insulated, bitumen-sheathed, and are laid in fibre conduits filled with bitumen.

Work has just been commenced on the foundations of the Retiro sub-station. Besides the machinery required to convert the H.T. current, there will be installed a large battery to ensure a continuous supply at Retiro station, in case of repairs to, or breakdown of, the power-house plant or distribution cables. It is expected that this sub station will be ready for use before the end of the year. Victoria sub-station will be completed in a month's time.

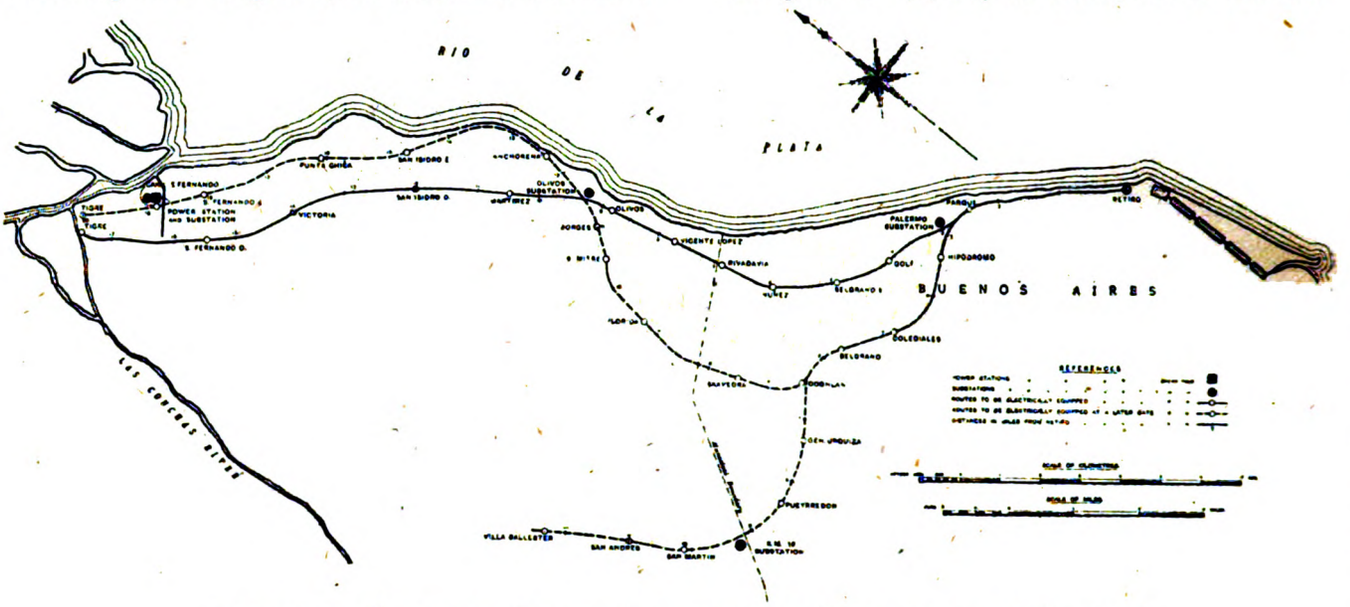
Most of the third rail has been laid. It is in the form of a channel with the open side of the channel towards the track. The shoes on the train make contact with the underside of the top flange of the third rail. The whole third-rail system is divided into sections controlled by switches and circuit-breakers housed in the traction sub-stations and several of the signal cabins. The third rail will be protected throughout by means of creosoted boards attached to the top and side.

In all, 117 electric coaches have been ordered. Of these 50 are trailer coaches, 55 are motor coaches fitted with two motors per coach, and 12 are motor coaches fitted with four motors per coach. The four-motor coaches will be used principally for express trains and special trains on race meeting and regatta days.

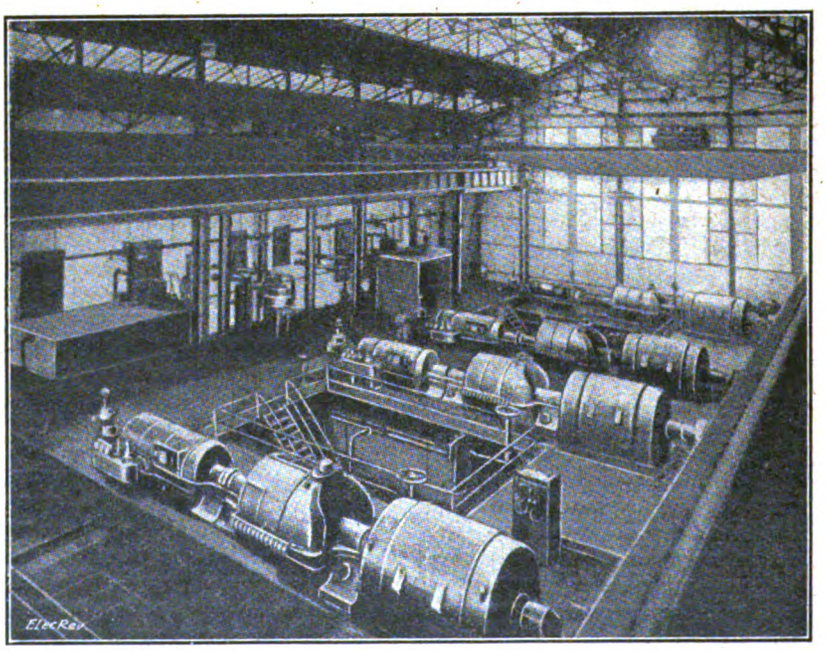
Owing to the war, only 30 trailers and 42 two-motor coaches have been received. The balance is not expected until some time after the war has ceased. The trailer coaches were received about two years ago, and lately the electric equipment has been fitted to these coaches. The 42 two-motor coaches are practically ready for service. The coaches are equipped with 250-H.P. motors and control gear.

It is expected that with this stock the express trains from Tigre to Retiro will make the journey in about 30 minutes, making two stops on the way, while the electric trains stopping at all stations will be able to make the journey in approximately 45 minutes. Repairs to the rolling stock will be carried out at Victoria workshops, at which large alterations and additions to the buildings and machinery are being made for the carrying out of this work.

The tracks between the Canal San Fernando Station and the Tigre (R.) Station have been equipped with the third rail, so that electric trains can be run there for the purpose of giving motormen a thorough course of instruction and training before the electric service is commenced. Since the middle of September an electric train composed of two motor and two trailer coaches has been running daily for the purpose of showing up any faults there might be in the electrical equipments. So far, this train has run 3,600 km., and not a single fault has developed.



PLAN SHOWING PRESENT AND PROPOSED ELECTRICAL LINES, CENTRAL ARGENTINE RAILWAY.*



TURBINE PLANT AT THE CANAL SAN FERNANDO POWER HOUSE.

* Map reproduced from *Proceedings*, West of Scotland Iron and Steel Institute.

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ACCOUNTING FOR POWER FACTOR IN THREE-PHASE SUPPLY TARIFFS.

THREE-PHASE generation and distribution being undoubtedly the standard system of the future in all industrial districts, and industrial loads being frequently of low power factor, any proposals for taking power factor into account in charging for A.C. supply are of quite special interest. That the wattless current demanded by a load of poor power factor does involve considerable idle investment in generators and cables is well known, and no doubt readers are acquainted with the investigations and proposals of Prof. Arno in this connection. Broadly, these proposals are that costs due to low power factor be covered by charging each consumer for his true consumption plus a fraction of the difference between his real and apparent consumption, this fraction varying with circumstances from 25 to 50 per cent. Taking 33 per cent. as an average value for this fraction, the power for which the consumer has to pay (in a case where the real power is E I cos ϕ and the apparent power E I), is $\frac{2}{3}$ E I cos ϕ + $\frac{1}{3}$ E I. The method proposed by Arno for measuring this complex quantity was displacing the driving pressure-coil field backwards with regard to the driving current-coil field by an angle greater than 90°, and varying (according to the range of power factor for which the meter is designed), between 100 and 150° or so.

On non-inductive load the reading of such a meter is identical with that of an ordinary watt-hour meter, but on inductive load the special instrument reads higher. The units in which it records are, however, "complex" units, so that even if the law of the country does not preclude the use of an Arno meter as the sole basis of charging, there is no indication for the benefit of the supply engineer and the consumer concerning the actual power consumption and power factor. It is obviously desirable that the supply engineer should know the actual power and power factor, otherwise he cannot judge properly the development of his undertaking, and remodel tariffs from time to time. The consumer is more than likely to chafe at the mystery of the "complex unit" on which he is charged, and there is certain to be trouble if, due to lower power factor, his bill comes to more than in a preceding period, for which his ordinary working records show that the true power consumption must have been greater. The consumer has every right to demand that, if he is to be charged on power factor as well as true power, his meter should give him such information as will enable him to check, and possibly improve, both these quantities. Finally, there is the serious objection that an Arno meter reading, say $\frac{2}{3}$ E I cos ϕ + $\frac{1}{3}$ E I will not give correct readings with any other fractional coefficients, though it is obviously quite likely that, due to extensions or other changes in the supply station and network, the fraction of wattless current charged for should vary from time to time. Similarly, if a consumer's installation gave at first a power factor between unity and 0·8, but subsequently was extended by the addition of a number of motors, so that the power factor then varied between 0·85 and 0·6 it would be necessary to substitute a differently adjusted meter. These difficulties, though not insuperable in a laboratory or special installation, become of the gravest importance under commercial conditions where continually varying loads are concerned.

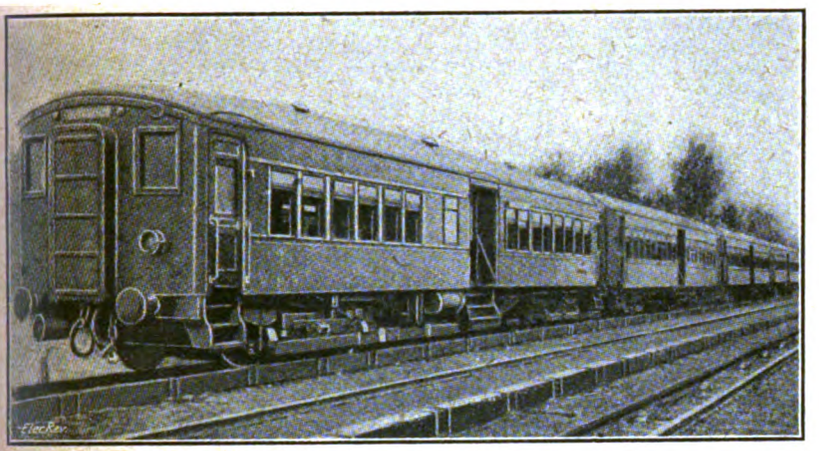
It is not necessary, however, to use the special Arno meter (which is inferior in electrical and mechanical characteristics, to most modern watt-hour meters), in order to work on Arno's principle of charging for real power plus a proportion of the wattless demand. R Stoppler, in a recent copy of the *Elek. Zeitschrift*, points out that separate measurement of the two products E I cos ϕ and E I sin ϕ provides all the essential information and requires only the use of meters of standard construction, whilst overcoming all the objections cited above. If the load current lags on the supply pressure E (fig. 1), a meter reading E I cos ϕ would record the watt component E i_1; and a meter reading E I sin ϕ would record the wattless component E i_2.

Connections for such meters are given later. Assuming for the moment that their readings are available, they may be used for a complete analysis of the load conditions by aid of fig. 3. In this chart values of ϕ and cos ϕ are plotted against values of tan ϕ as as abscissæ (tan ϕ = E I sin ϕ/E I cos ϕ = reading of sine meter/reading of cosine meter = wattless component/watt component).

The meanings of the factors n and k introduced on this chart are as follows:—Arno's basis of charging is [real power + n (apparent — real power)] where n is a fraction. This reduces to (E I cos ϕ + n (E I − E I cos ϕ) = (1 − n . E I cos ϕ + n . E I), which may be expressed as k × E I cos ϕ, where k is the factor by which the real power reading must be multiplied to give the value of Arno's complex power. It will be seen, therefore, that from the readings of meters recording E I cos ϕ (*i.e.*, true power) and E I sin ϕ respectively, there can be deduced the power factor and the correct total for charging on Arno's system for any value of n and for any load power factor. To eliminate calculation of tan ϕ, a chart can be prepared on the principle shown in fig. 2, setting E I cos ϕ along the axis of ordinates, and E I sin ϕ along the axis of abscissæ, the length A B represents the apparent power E I to scale and the angle O A B = ϕ.

In applying this system of metering it is simply necessary to add to the existing meter which records real power (E I cos ϕ), a similar meter so connected as to record E I sin ϕ. In the case of a balanced three-phase load an ordinary A.C. motor meter may be connected as in fig. 4, the current coil in one phase, and the pressure winding across the two other phases. The driving fields are then in phase and the meter registers proportionally to E I sin ϕ. In the vector diagram to the left of fig. 4, the flux F_2 lags 90° on the E.M.F. E_2 which produces it, and is in phase with i_1 so long as the load is non-inductive.

A better arrangement for recording the wattless component E I sin ϕ correctly in any three-phase system, at all power factors and states of load balance, is indicated in fig. 5, and really amounts to duplicating the arrangement in fig. 4. The flux F_2 is made to lag 60° on E, and hence to lead 30° on i_1; and the flux F_1 is made to lag 120° on E_1 and hence to lag 30° on i_3. When thus arranged the meter yields high torque, has small internal loss and is easily calibrated.



ELECTRICAL TRAIN, CENTRAL ARGENTINE RAILWAY (see p. 556).

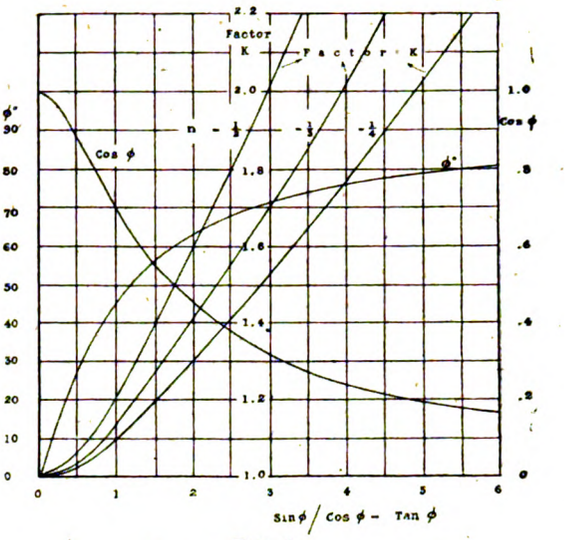


FIG. 3.

FIG. 1.

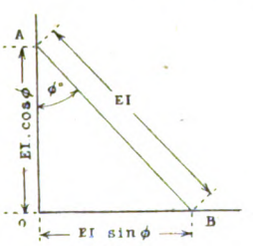


FIG. 2.

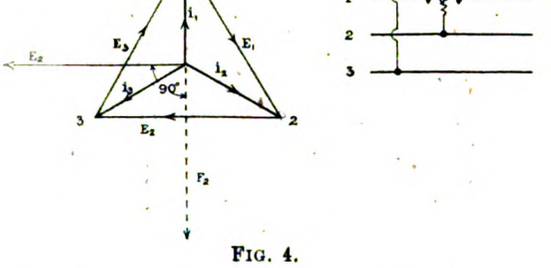


FIG. 4.

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For a three-phase, four-wire circuit, three measuring systems are required, connected as in fig. 6 with the pressure windings in star, and each connected to another phase than the one containing the current coil with which it works. The fields of the pressure coils being made to lag 60° on the E.M.F.'s producing them, they

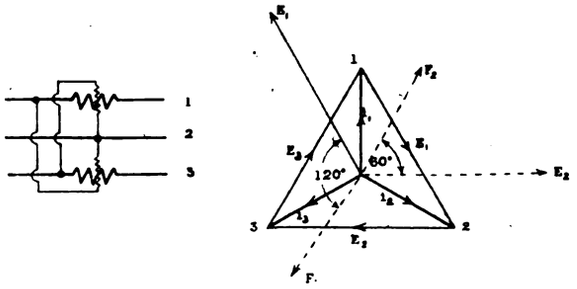

FIG. 5.

come in phase with the main current fields when the main load is non-inductive and the torque produced is proportional to the wattless power of the outers against the neutrals. Other arrangements are possible in the above and other cases, but enough has

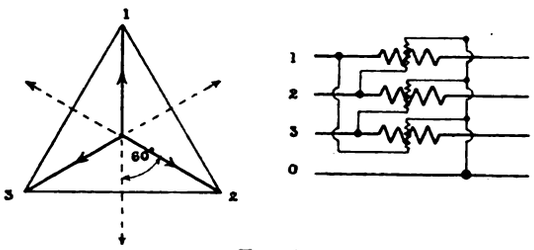

FIG. 6.

been said to illustrate a convenient means of applying the admittedly sound principles enunciated by Arno, without incurring the practical difficulties involved by using meters designed to record automatically a composite quantity which includes an arbitrary and gradually changing numerical factor.

A RAILLESS TROLLEY-BATTERY VEHICLE.

THE new motor-wagon designed by Mr. C. J. Spencer, general manager of the Bradford City Tramways, for the conveyance of goods in connection with the ordinary passenger tramway service, which was referred to in our "Notes," was given a trial recently, and the *Yorkshire Observer* says it was found to work with smoothness and efficiency in every respect. The new vehicle is quite simple in design, but wonderfully adaptive to the purposes to which it is to be put. Taking the chassis of an old railless trolley-car, Mr. Spencer has built upon it a long, broad lorry, similar in shape and dimensions to the motor-lorries which have become so familiar in recent times. The great difference is, that instead of using petrol, which is so dear in these days, the new transport wagon is run by means of the existing electric tramway equipment. It may thus have the advantage of greatly reducing the demand for the precious petrol, minimising running costs, and at the same time contributing greatly to the public convenience at a time when there is so serious a deficiency in transport services.

The adaptability of the new wagon was demonstrated to the chairman of the Bradford Tramways Committee (Mr. Enoch Priestley) and several other interested persons, at a test of the vehicle on the 8th inst.; at the Thornbury tramway depôt it was seen manœuvring with the facility practically of an ordinary motor-car. A load of two tons was put on the wagon, and with this it made a satisfactory journey to Wibsey. The great advantage of the new wagon is that it can travel either by means of the electric equipment of the tramway system or independently of it, by means of a battery carried on the vehicle.

The equipment of the chassis of the railless trolley-battery vehicle is similar to that of the ordinary railless trolley-chassis, with the addition of the battery, and includes two 20-H.P. motors with ordinary series-parallel control, and it will therefore operate on a 500-volt circuit. The earthing device is an extension of the steering arm of the vehicle, bearing on the track by the medium of a cast-iron block, and at the same time automatically steering the vehicle. (This device, which has been used with considerable success for some time in connection with the Bradford railless trolley-cars when taking them over the tramway routes to the depôt, was designed by Mr. E. Cross, the general manager of the Rotherham Tramways.)

The accumulators employed are 120 cells of the Edison type, giving a normal voltage of 150.

These supply current to the ordinary 500 volt motors, the only difference being that the motor with battery supply runs correspondingly slower, that is, *pro rata* to the voltage, but as the torque of a series motor is proportional to the current passing through the windings, the vehicle is capable of climbing steep gradients, but at a speed corresponding to the low voltage.

Whilst the vehicle is running on the 500-volt circuit the battery may be in series with the motors, thus charging it whilst the car is in trolley service. The battery is capable of running the vehicle about 10 miles.

The change-over from battery to overhead wire is merely a question of throwing over a switch, the putting of the trolley on the wire and the earth connector on to the steering gear.

We are indebted to Mr. C. J. Spencer for these details and for our view of the vehicle.

DIESEL ENGINE USERS' ASSOCIATION.

AT the May meeting of the Association reference was made to the fact that the list of membership was now representative of upwards of 30,000 B.H.P. of Diesel engine plant. Several further engineers having control of such plant were elected members.

Discussion on the Smithfield Market explosion was resumed.

MR. R. L. QUERTIER, the London manager of Messrs. Reavell and Co., Ltd., who attended the meeting by invitation, made some remarks on behalf of his firm, who were the makers of the air compressor concerned. While not wishing to be dogmatic, he said, they had a theory which seemed to fit the case, and which, if correct, showed that quite a simple precaution should prevent further accidents of a like nature. The abnormal conditions shown by the examination of the compressor after the accident were, so far as they knew, confined to the high-pressure suction and delivery valves, which were exceedingly badly carbonised, and to the relief valve on the intermediate purge-pot, which, when tested after repair, only blew off freely at about 380 lb. per sq. in. This relief valve was set by the makers to blow off at about 275 lb. per sq. in., so that it must have been re-adjusted by screwing up the spring to the limit.

The accident occurred almost immediately on starting up after the engine had been out of service for some hours, and therefore the temperature of the compressor was very much lower than normal, and it would seem that the conditions were not at all favourable for an explosion to take place. There seemed no doubt, however, that an explosion did occur, as, in the first place, a calculation of the strength of the purge-pot showed that the bursting pressure would be in the neighbourhood of 2,500 lb. per sq. in.; and, secondly, the fact that it was broken into fragments indicated a heavy and instantaneous shock, and not the fracture at the weakest section, which one would expect with a steadily-increasing load, even if that were rapidly applied.

RAILLESS TROLLEY-BATTERY VEHICLE FOR GOODS SERVICE ON TRAMWAYS.

Assuming, therefore, that an explosion occurred, and that this was caused by the ignition of lubricating oil, it had been suggested that such explosions were caused by the ignition of oil in the form of mist or fog. One, therefore, had to account for the oil fog and for the means by which the temperature was raised to ignition point. His firm's theory was as follows:—

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The high-pressure valves were not functioning, with the result that there was, more or less, open passage connection between the final delivery-pipe to the blast-bottle and the intermediate purge pot. The valve between the blast-bottle and the compressor was opened just before the accident, and this would allow the dense air in the blast bottle to rush back along the pipes to the intermediate purge pot by way of the high-pressure cylinder. They suggested that the velocity at which the rush took place and the density of air caused it to lick up and carry away any oil deposited on the pipes and to churn this into a fog. The intermediate relief valve, as tests recently made proved, was capable of dealing with all the air aspired by the compressor with a rise in pressure of not more than 30 lb. per sq. in., but it was obviously incapable of dealing with an almost instantaneous rush of air from the blast bottle, and consequently the pressure rose till a balance was attained. All the while, of course, the intermediate cylinder was delivering air, and had now to compress against this greatly increased pressure, so that the temperature of the delivered air rapidly increased till it was sufficient to ignite the oil mist in the purge pot and cooling pipes. It was not necessary for this rush back of air to take place immediately the blast bottle valve was opened, because the compressor was at work and the conditions necessary, namely, a more or less free passage into the I.P. purge pot and coils, might not have been immediately present. Again, the same conditions would be obtained with a slower leak back if for any reason the I.P. relief valve were not in proper working order.

If this theory were the correct explanation of the explosion, it was clear that the greatest safeguard possible would be a back-pressure valve inserted in the final delivery pipe between the blast bottle valve and the compressor. Mr. Quertier thought that this valve should be fitted close to the blast-bottle end of the pipe, as there the air pulsation would be less definite and the air would be cooler. These conditions would ensure the valve working freely without undue wear or tendency to stick.

Quite apart from the accident above referred to, he thought it was clear that no undue rise in temperature could occur in the compressor, even if either or both the high-pressure valves failed, if in the first place the air in the blast bottle were prevented from rushing back by the above-mentioned check valve, and, secondly, if the intermediate-pressure relief valve were kept in proper working condition, so that it would prevent the I.P. delivery pressure rising, by blowing off all the air aspired by the compressor with the reasonable rise in pressure for which the relief valve was designed.

The next meeting of the Association will be held on Friday, June 23rd, when Mr. Geo. E. Windeler will read a paper on the subject of "Methods of Lubrication and the Difficulties of Efficiently Lubricating a Diesel Engine."

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Special X-ray Reflectors for Half-Watt Lamps.

To permit advantage to be taken of the well-known merits of the X-ray lighting system, when using half-watt lamps for the direct lighting of shop windows or other interiors, the British Thomson-Houston Co., of Mazda House, 77, Upper Thames Street, E.C., have developed three new reflectors for use with Mazda half-watt lamps. These reflectors embody the same merits as the ordinary X-ray reflector in respect of scientific design, freedom from striation, and permanently high reflecting efficiency. The distinctive feature of the new patterns is the provision of a special backing to withstand the high temperature of half-watt lamps, which would destroy the silver backing of the ordinary X-ray reflector.

The "Jove" X-ray reflector, which is very similar in appearance to the "Scoop" type, is intended for use with 100-watt Mazda half-watt lamps, and is suitable for windows of average proportions. It throws an equal amount of light back and down, which distribution is suitable for windows from one to one and a-half times as high as they are deep. If the window height be about twice as great as its depth (measured from the front glass to the background), the "Jupiter" X-ray reflector, in conjuction with a 100-watt Mazda half-watt lamp, throws a powerful beam of light downwards, and thus meets the needs of the case. In general appearance, the "Jupiter" reflector much resembles the "Helmet" pattern of ordinary X-ray reflector.

The "Jumbo" reflector, for use with 500, 750 or 1,000-watt half-watt lamps, is altogether a unique production. It is the largest one-piece glass reflector ever blown (16½ in. diameter, 13¾ in. high), and is particularly suitable for the efficient direct illumination of very large interiors. This reflector requires a special metal hanger, at the top of which a special holder can be supplied with an adjustable feature, which makes it possible to obtain two or three degrees of spread to the light.

The makers confidently anticipate that the "Jumbo," "Jupiter" and "Jove" super-X-ray reflectors will continue for half-watt lighting the sterling services already rendered by X-ray reflectors in the development of good lighting.

Westinghouse Flour Mill Plant.

A description of a flour mill installation, in which the electrical equipment was supplied by the British Westinghouse Co., of Trafford Park, Manchester, appeared in a recent issue of the *B. W. Gazette*, from which the following notes are abstracted.

The original engine-drive included a good deal of gearing which it was desired to supersede. The main mill consisted of four floors, each with a line of shafting, while a wing of the building contained the cleaning and conditioning plant. The question of the electrical sub-division of the drive was considered, and it was decided to install a 110-H.P. motor to drive each of the four main lines of shafting, while the drives for the cleaning, conditioning and auxiliary plant were determined by the circumstances in each case.

The mill contains a 35-40 (280 lb.) sack plant, and is fitted throughout with three-phase slip-ring motors.

Owing to the lack of space, the motors for the main mill were let into the lines of shafting, and coupled up by flexible couplings, as shown in fig. 3; in order to use high-speed motors, the shafting speed was increased from 175 to 375 R.P.M., and, as changes in pulleys were necessary, it was decided to increase the break-roll speed by 15 per cent., and that of the reduction-rolls by 25 per cent., the result of which has been quite satisfactory.

In order to ensure that the four motors shall be started simultaneously, the starters for the rotor circuits, shown in fig. 4, are geared together, and operated by one handle; the starters are also interlocked with stator circuit-breakers on the wall behind, so that the latter cannot be closed unless the former are in the off

"Jove" type for low windows.

"Jupiter" type for high windows.

FIGS. 1 & 2.—X-RAY SILVERED GLASS REFLECTORS FOR MAZDA HALF-WATT LAMPS FOR WINDOW LIGHTING.

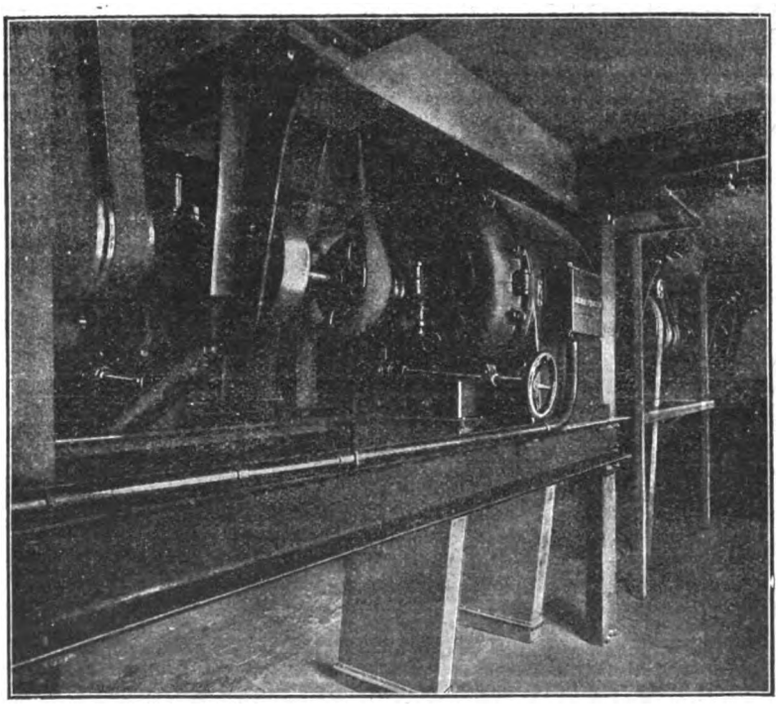

FIG. 3.—WESTINGHOUSE SLIP-RING PIPE-VENTILATED MOTOR DRIVING LINE SHAFT

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position. The circuit-breakers, which are oil immersed, are fitted with time-element overload and no-volt releases, and, in addition, emergency push-buttons in various parts of the mill can operate the latter releases.

The speeds of the scalpers, centrifugals, &c., were not altered.

The wheat-washing and conditioning plant has a separate motor drive, as also the wheat-cleaning plant.

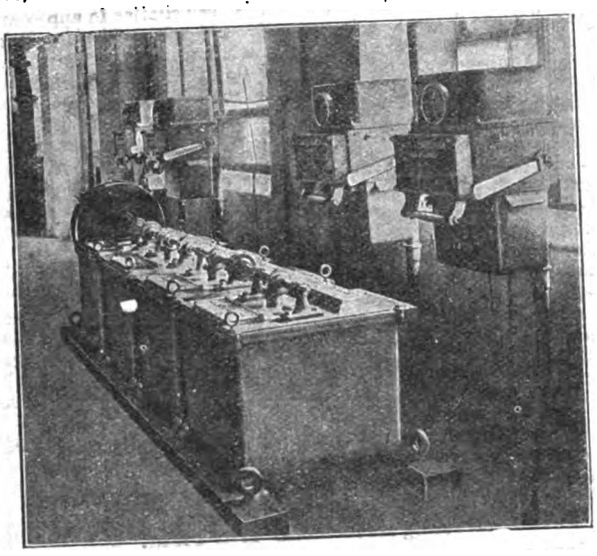

Fig. 4.—Coupled Westinghouse Liquid Starters.

Separate motors are also installed for driving the grain intake plants, sack hoists and general warehouse plant. In practice, it is found safe to speed up sack hoists 25 per cent.

The current is derived from a supply company's transformer, and passes through a distribution board. The work was carried out by the British Westinghouse Co., under the supervision of Messrs. Horace Boot & Partners, consulting engineers.

Large Direct-Current Switchboard.

During the last few years the General Electric Co., Ltd., of 67, Queen Victoria Street, E.C., has produced a considerable number of heavy-current switchboards for various municipalities, and a recent example of this class of board is shown in fig. 5. This board consists of 23 panels, comprising generator panels for controlling the continuous-current side of two 1,620-kw. motor-generators, with Witton-Kapp phase-advancers, which are being manufactured by the G.E.C. at Witton. It also includes a large

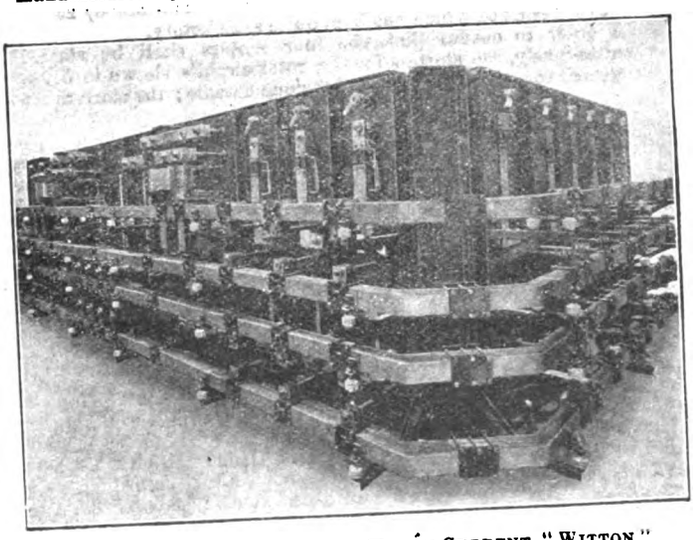

Fig. 5.—View of Back of Heavy-Current "Witton" Switchboard, Showing One of the Side Portions.

number of feeder panels for distributing the energy. The board has been constructed in a form occupying three sides of a rectangle; the panels have a thickness of 2½ in., being composed of oiled slate slabs; in addition, all the circuit-breakers are mounted upon their own slabs, 2½ in. thick. The circuit-breakers controlling the generators have a capacity of 10,000 amperes. Some idea of the heavy character of the gear can be gained from the size of the bus-bars, the latter being composed of 24 strips of copper, each 4 in. × ½ in. thick.

The Employment Department.—The Board of Trade announces that the Labour Exchanges and Unemployment Insurance Department will in future be known as the Employment Department of the Board of Trade.

THE APPLICATION OF SCIENCE IN FACTORIES.

By Sir William Beardmore, Bart.

(*Extracts from a Presidential Address to the* Iron and Steel Institute.)

The war, with its revelation of great influences at work, has taught us all lessons which must be assimilated and acted upon to the fullest extent. These lessons are ethical, political, and industrial. They are interdependent; each affects the other; and it is difficult to discuss one without involving the other. But, obviously, in this Institute we are more concerned with the industrial and economic factors of the problems. Even with this limitation, the subject offers wide scope for consideration. The industrial lessons involve science and technics, design and manufacture, volume and economy of production, and, finally, the relation of both employer and employé to all of these. All are correlated, and we can only achieve our aim if everyone, from the least skilled of workers to the greatest of industrialists, resolves to consider the bearing of each not only upon himself, but upon the prosperity of the Empire.

Science comes first. It is the dominant factor, because it should be the beginning of all things, and yet it is only one element in the problem, because there must be co-operation between laboratory research and manufacturing development. This should be strongly enforced, as there is a tendency at the moment to neglect the other factors. There is a great need for the extension of research and experiment, and my experience is that much of this work is highly remunerative, either positively in improved processes of manufacture, or negatively in eliminating faults and obviating wastage. Much of it, however, is unremunerative, and in any case all of it requires money. Excessive competition in manufactures narrows profits, and leaves little money for such work. Manufacturing firms have therefore difficulty in finding the wherewithal to embark initially on scientific research work, or they are compelled, after starting it, to limit expenditure on its continuance. The refusal of workers to utilise to the best advantage improved methods of manufacture, evolved by experimental research, discourages industrialists in their evolution and application. These are axioms whose truth could be established by many examples. When a charge of lack of enterprise is made against manufacturers, blame should at the same time be laid at the door of workers who do not realise that their interests are intimately affected by the attitude they display in all such cases. There lies the political connection with the problem. It is not enough for the State to assist or otherwise encourage scientific research and experiment. The nation is equally concerned with the profitable application of the results, in order that national prosperity shall be augmented by ensuring that the fullest utility will be derived from scientific research and experiment. The question, therefore, is a national one. The employment of the people and their well-being depends upon plenty of work. This, in turn, requires the maintenance of a great export trade. Efficiency and economy in manufactures can do much to win and retain foreign as well as British Imperial markets. This necessitates advance towards perfection of design and greater volume of output, through improvement in the mechanical means of production evolved by experiment. It follows that research should be a charge on the selling price. To counterbalance this charge it is essential that the volume of output should be increased. Thus, when we reach the bedrock of industrial conditions we find that, unless restrictions and limitations dictated by workers' organisations are abolished, much of the gain possible to the nation due to research and experiment must be lost.

An example may here be given of the influence of the restrictive methods of Trade Unions. Early in the war it was found at the Parkhead Forge that the output from the respective machines was not so great as what the machines were designed for, and one of the workers was induced to do his best to obtain the most out of a machine. He very greatly increased his output, notwithstanding his predilection for trade union restrictions. When it was found that the demands of the Government for a greatly accelerated production of shells required the employment of girls in the projectile factory owing to the scarcity of skilled workers, these girls in all cases produced more than double that by thoroughly trained mechanics—members of the trade unions—working. Representative cases may be quoted thus: In the turning of the shell body the actual output by girls with the same machines and working under exactly the same conditions and for an equal number of hours was quite double that by trained mechanics. In the boring of shells the output was also quite double, and in the curving, waving and finishing of shell bases quite 120 per cent. more than that of experienced mechanics. These conditions applied to war time, when the peril of the nation demanded unselfish, patriotic exertion by everyone, and the men who thus limited the output can only be regarded as unworthy of the privileges of citizenship. In peace time the same results, due to restrictive measures, must necessarily handicap severely all manufacturers in their aim to advance the prosperity of the nation by ensuring adequate employment for all.

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There is little need to demonstrate that ideal conditions in manufacture are associated with a higher rate of wage and large total earnings per worker per week, and this is attainable without forfeiture of a satisfactory profit, provided—and this is the crux of the whole problem—all workers make the most of all the appliances which scientific research and mechanical experiment may place in their hands, by increasing the volume of production per unit of time and by working full time. These, again, are well-known economic laws, but they are not enforced often enough. Until they are applied, the gain from the application of science to industry will not be fully realised for the benefit of the workers of the nation.

The awakening of the worker to such responsibility is thus as important as the arousing of the nation to the need for more scientific methods. But that does not in any way excuse the manufacturer for any deficiency in enterprise. In fairness, however, it should be made clear that some progress has been made in this direction in our own history. A few iron and steel manufacturers as long ago as the 'eighties began tentatively to carry on chemical and metallurgical research work, and they have been steadily and continuously increasing the extent of the work done, with very satisfactory results. The present crisis and the prospect of a great trade war in the near future justify a consideration of the importance of increased diligence in this essential department of industrial activity and of the encouragement afforded by results in the past.

Scientific research falls naturally into two main divisions, and in considering how such work can be extended it is important at once to differentiate between the two. The work may be characterised in the one case as purely theoretical, almost classical; in the other as distinctly technical or practical. In the one, the results are indicative of potentialities for the future, more or less remote; in the other they are for immediate application, or generally contemporaneous with actual manufacture. Obviously only a limited amount of what I have termed classical research can be undertaken by the manufacturer, particularly where the current demands for chemical, metallurgical, or mechanical research for practical work monopolise much time and apparatus. Such classical work must, therefore, be separately undertaken. Where it is not dependent upon experience in every-day industrial work, it would seem that State or other public laboratories could readily undertake it. This condition would apply to new processes, to new discoveries, or to new materials. This line of demarcation of scientific work is further justified, because in public laboratories the difficulty of practical direction or control is often experienced. Where there is an attempt to do work capable of immediate application, it becomes essential that the guiding influence should be immediately conversant with every-day practice in the factory. In this category there are, therefore, included improvements, whether in chemical or mechanical processes, in combinations of metals, or in the reduction of the cost of production. All of these are more or less dependent on precedent, and consequently require complete intimacy with existing conditions.

There should be no disposition to limit the original or purely classical work in scientific research. When this is borne in mind only good can accrue from close association, even in such purely scientific research, between the industrial and the theoretical scientist. What is distinctly theoretical to-day may become the practice of to-morrow, and no one who has been associated with such work can fail to realise that there are no more difficult questions presented for decision than the potentialities, from a commercial point of view, of problems solvable in the laboratory.

Purely theoretical research may yield important commercial results, and we are thus brought into contact with one of the difficult problems associated with national expenditure on such work. It is admitted that science knows no boundaries; but at the same time there is the important commercial rule that national expenditure must be justified by national gain. Where humanitarian work is involved no one will object to the gain from national expenditure being universal. Thus, all work for the prevention of accidents in mines, or in other employments, may be undertaken by the State, and the publication of results broadcast be justified. But where a new discovery, a new process, or new materials of great advantage to the industry of a nation are evolved, the advantage ought to accrue to that nation. It is admitted that between the discovery of the germ of a great idea and its application to manufactures much diligent work must be done, and that, too, of an important scientific character. But with the disclosure of the basic idea the subsequent work becomes inviting, perhaps comparatively easy, even if it is expensive or requires long and expert experiment. With the conduct of research in public laboratories a difficulty arises in connection with the publication of scientific results.

There should, however, be a great extension of the practice of conducting experiments on behalf of firms who direct and pay for such research, particularly of firms who desire to follow a definite line of research not immediately connected with any of their manufacturing processes, and whose current work does not permit of such researches being undertaken. No doubt in the future there will be much of this work for such public institutions, and a satisfactory measure of secrecy will be attained. There would no longer be the objection that the fullest experience of current works practice is not available by those engaged in the public laboratory if there were such direct and close contact between the public laboratory and the works of the firm directing and paying for the research.

One of the difficulties in finding a scientific staff for the factory is the limitations of our educational system. It has been put on record recently that at Cambridge only four colleges are presided over by men of scientific training; at Oxford not one; and that of the 35 largest and best-known public schools 34 have classical men as headmasters, and in no case do scientists hold a high place. It may be contended that such institutions were intended originally to give a classical or liberal education; that they were based on the concept that the fundamental principle of education is the cultivation of the mental faculty. On the other hand, science has become so essential, not only to the industrial, but even to the domestic life of the nation, that scientific training might be made to serve a greater part in the future than in the past in cultivating the mental faculty. In any case, the accepted principle that entrance to the largest number of posts in the Civil Service should be contingent on an examination where science plays the smallest, if not a negligible, part, tends to encourage the youth of the country to neglect scientific training, and to bring into the service of State departments, many of which are concerned with scientific work, men with little knowledge of and less sympathy with science. The State endowment of research has been delayed, and is now hampered, by the absence of this influence in Government staffs. Until there is an educated and liberal-minded control of our industrial and commercial Government departments, the true relation of the State to science can never be realised nor its benefits fully materialised. It is because of the gradual awakening of publicists to these considerations that many look with the greatest measure of hope to a quickening of interest in scientific research within factories. No firm which neglects such work can expect to achieve the highest success, industrially or financially. We must still pursue a vigorous policy of enlightening the working classes on the importance of the fullest advantage being taken of all chemical and mechanical improvements conducive to increased production. But, at the same time, no opportunity should be neglected of enforcing the need for a more active participation in research and experiment by manufacturers in all processes of production.

I am persuaded, from my own experience, that reward follows from the pursuit of scientific methods. Continuous investigation by a trained staff is absolutely necessary for efficient work, and it is essential that managers and works superintendents should be sufficiently acquainted with the scientific side of their work to apply in a practical way the recommendations made from the laboratory and ensure the desired results. This presupposes co-ordination between the manufacturing staff and the research staff, so that we have here, again, a proof that scientific work must be done in the works, under the stimulus of the chief. For this reason, too, it is desirable that young men should have at least the first part of their practical laboratory training within the works. Educational authorities should maintain a closer contact with the works, so that not only would these young men be grounded in school laboratories for practical work, but the student would have a better chance of being placed subsequently in a position in the works laboratories where his ability would more readily be developed. And here I cannot refrain from the suggestion that the training in works laboratories should be regarded as part of the higher education of the future metallurgist, and that there should not be an immediate desire for high remuneration. Experience is of far greater permanent value than the earning of a big wage at the commencement of a scientific career.

While we should be masters in one branch of science we should know a little of all others, and watch all progress sympathetically and intelligently.

In 1889 Sir Robert Hadfield dealt before this Institute with alloys of silicon and iron, and his investigations, taken up by others, led to the important discovery that certain elements, like silicon and aluminium, could render steel more permeable under low magnetic fields than the purest commercial iron then available. The usefulness of this discovery to the electrical engineering trade was at once recognised, and a special silicon steel was shortly afterwards applied to the manufacture of transformers. From this purely scientific work there has sprung the trade in special transformer sheets, &c., and it has been computed that in the nine years from the introduction of this material the aggregate output in America alone of machines using it amounted to no less than 14,000,000 KW., and the annual saving in the latter year in electrical energy, due to its better magnetic properties, was about 10,000,000 dollars.

A further illustration of the value of organised research applied to the improvement of an industrial product is afforded by that undertaken to find the factors which prevented the present metallic-filament lamp from being run at a higher efficiency than one watt per candle-power. By adopting the results arrived at, a lamp was made which had an efficiency of 0.5 watt per candle-power and an average life of 2,000 hours—the now well-known "half-watt lamp." This, it is safe to predict, will ultimately supersede all other forms of glow lamp, and be a serious rival even to the flame arc itself.

Scientific methods applied in the works can achieve much in avoiding wastage, in ensuring greater reliability in processes, in providing labour-economising mechanical appliances, and by recovering all by-products. Every industrial process should be examined constantly and methodically by

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the trained scientific staff, whose sole duty it would be to elucidate the principles upon which the process depends, and to ascertain, in the laboratory first, and afterwards in the works, the conditions of maximum efficiency. Every failure and every flaw should be recorded and explained, so that the cause may be avoided and the process of manufacture improved. Responsibility, therefore, rests upon all manufacturers to make such research work part of their productive methods.

A great duty and responsibility rests also upon the State and upon the worker. Instead of being hampered by legislation manufacturers should be encouraged, because on manufactures the prosperity of the nation will depend much more in the immediate future than in the past. What is required is that everyone, scientist, technologist, employer, and worker shall do his best for the common weal. It would be easy to demonstrate that many developments towards improvement and increase in production, in a great variety of factories, have been regarded as mediums only for justifying the same wage earnings for the same output with less physical effort. Were the highest efficiency of all such improvements realised by the workers, their earnings would be higher and the output would be greater without any increase in physical effort. Charges would be spread over the greater volume of output, manufacturers would be encouraged to prosecute research work to a still greater extent, and by the improving of the character of the production and the cheapening of its price the nation would be better equipped to face the keen competition in all the markets of the world which is bound to arise in the immediate future. There would be no unemployment problem. Thus, while we foster metallurgical science, we must not neglect the equally important subject of industrial economics and the duty of the State and the worker towards such problems.

WAR ITEMS.

The German in British Commerce.—At the annual conference of the Association of Trade Protection Associations of the United Kingdom, held last week in London, in bringing forward a resolution on behalf of the London Wholesale Hardware Club, which recommended the affiliated societies to ask their members to print names of partners or directors on their stationery, and against these names to put the country of the partner's or director's birth, Mr. Nettlefold (according to the *Ironmonger*) thought that a main object of every trade society and Chamber of Commerce ought to be to get rid of the Germans who had come over to do business here. "Most business men left at home were now unfitted for shouldering the rifle, but they might well take the knife and try to get rid of the cancer which had been undermining the country's strength. There were two classes of Germans involved: one was the unnaturalised, which was being dealt with by the Board of Trade, which, like all Government departments, moved slowly. If the war went on another ten years they might perhaps dispose of 20 per cent. of this class. The Association should suggest that an Advisory Committee of every trade in the country should be brought together to help the Board of Trade in this matter in their own special individual trades. If, however, they were going to get rid of the naturalised Germans in trade, it must be done by showing there was a feeling of repugnance against them."

Exemption Applications.—At the Saltburn Tribunal an application for extension made by an electrical engineer was refused.

At Stockton-on-Tees, Ald. T. B. Watson applied for exemptions in the case of John Thomas Walton, aged 39, the manager of the electrical fitting and plumbing business of T. B. Watson & Son, at Middlesbrough, and of his son, Coun. H. C. Watson, aged 36, who is in charge of the plumbing and electrical department at Stockton. Exemption for three months was granted in the case of the manager at Middlesbrough, and the application in regard to Coun. Watson was adjourned.

At Stalybridge, last week, Mr. F. Schofield, commercial manager of the Joint Tramways & Electricity Board, appealed for the exemption of Samuel Holt, aged 25, traffic clerk. The three other clerks formerly employed in the office are now on military service, and it was urged that special training was required for the position of traffic clerk. Conditional exemption was granted.

At the Exeter Tribunal, an electrician who applied for a wireman said it was true that women were being trained in this calling in the city, but they would not be able to do the work for at least six months, if they could then, which was very doubtful.

At the West Sussex Appeal Tribunal, a Worthing Kinema appealed for the exemption of a single man, aged 27, an electrician, wireman, and spare-part maker. His was claimed to be a certified occupation. The Local Tribunal had refused exemption as the occupation was not certified. Capt. Dawes said that this was the very class of man who was wanted for the Army. A wireman was no longer an exempted occupation, and recruits of the class were wanted for the Royal Engineers. The appeal was dismissed.

At the Southwark Tribunal, Messrs. Alexander Hawkins and Sons, electrical engineers, applied for the exemption of the manager of their dispatch department, who was responsible for the repair of electric motors in works where Government contracts were being carried out. He was granted exemption as being in certified occupations, the stipulation being that he should join the Volunteer Training Corps for Home Defence, if required. Mr. F. J. Hawkins, a member of the firm, was also granted a similar exemption. He was a fully-trained electrical fitter, and was superintending the erection of motors in munition works. The firm had lost 13 men since the outbreak of the war.

At a sitting of the Newcastle Local Tribunal on 9th inst., Mr. E. Hatton, manager of the Corporation Tramways, appeared in support of the application for the exemption of certain tramway employés from military service. He said they had a number of married men conductors who were being trained as drivers. Out of 823 employés, there were 133 who were eligible for service. There were 30 single motormen he must keep, and there were 100 married men who had received conditional exemption. There were 107 conductors who were being trained as drivers, and these he desired to be exempted. In reply to the Chairman, Mr. Hatton said if the Government would release soldiers who were no longer needed for service, he would be glad to release some of the Corporation employés, but the Government would not hear of it. There was, too, an increasing difficulty in getting hold of women. The Chairman suggested that an application be made to the Ministry of Munitions to secure released men so that further tramway employés might be released. It was agreed that the motor-men should be given conditional exemption, and a similar course was adopted with respect to 32 single drivers, who were being trained as drivers, and 75 married conductors. It was also decided that all up to and including Group 7 (men under 25) should be refused exemption, all inspectors up to and including Group 40, and all labourers at the power station also should be refused exemption.

Total exemption has been granted to Mr. Ernest Bond (31), applied for by the Wedmore Light & Power Co., Ltd. It was stated that Mr. Bond was the only one left to supervise the gas plant, engines, dynamos, batteries, and other apparatus, and to do the necessary repairs.

Before the Herts. Appeal Court, a Luton electrical engineer appealed against a period of exemption granted by the Local Tribunal. He said that he was induced to start business through being misled at the recruiting office, where he was told that he would not be required by the Military. The appeal was refused.

At Colchester, the manager of an electrical engineering business at Marks Tey, owned by a lady, was granted three months' exemption. The employer stated that appellant was the only one left in her employ, and if he went the business would be closed, and she would be without means.

The Southend-on-Sea Tribunal has exempted until June 1st an electrical engineer, who has been in business for nine years at Westcliff. He said that he had contracts to complete, and that he employed two assistants who were under military age.

A Buxton electrical engineer appealed to the Local Tribunal for himself and one of his men. He stated that all his capital was invested in the business, and military service would mean financial ruin. He was engaged on military hospital work, which would take some months to complete. Five of his staff had enlisted, and he had failed to find a successor for the man appealed for. The employer was given six months, and the employé two months.

The Heckmondwike Tribunal has granted conditional exemption to an electrician engaged by a local firm.

Conditional exemption has been granted to the resident electrical engineer at the Keswick generating station. It was stated that he was the only electrician available, and that if he went the works would have to be closed.

At Coventry, Messrs. Hutt Bros., electrical engineers and contractors, appealed for Mr. A. Franklin, electrical engineer, the only eligible man left. Mr. Hutt stated that he was running the business single-handed, and was himself called up. The matter was put back for 14 days with a view to badges being secured for Mr. Hutt and his employé. Mr. Frank D. Chambers, electrical contractor, who also appealed, was exempted until May 31st.

At Buxton, application was made for exemption for the engineer-in-charge of the electric light plant at a local hydro, who, it was asserted, could not be replaced. The Tribunal allowed exemption until October 5th.

At Dover, on May 10th, the manager of the Burlington Hotel, appealed for the hotel electrical engineer (30). The Advisory Committee recommended no exemption, and this was agreed to.

The Amersham Tribunal has refused extended exemption to Hugh R. Butler (24), electrician to Mr. Freeman, of Chartridge, who stated that he was engaged upon important experimental work, and that Mr. Butler was essential, as he maintained the plant.

An electrician, 32 years of age, married, applied to Clayton-le-Moors Tribunal, on May 12th, for exemption on business grounds. He had contracts to complete, and he could not

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get anyone to take his business. He was the only electrician in Clayton-le-Moors. Exemption granted to July 10th.

At the Tynemouth Tribunal application was made on behalf of an electrician, aged 27, employed by a local firm. The head of the firm stated that the young man was the only qualified electrician left in the town (North Shields), the others having either gone into "controlled" establishments or joined the Colours. Conditional exemption was granted.

At Oldham, an electrical engineer and contractor who had lost four men, appealed on his own behalf, and was exempted till September. He also appealed for his brother-in-law, aged 19, who was employed by him as an electrician and wireman. He urged that he was absolutely indispensable, but the appeal was disallowed, the man, however, not to be called up before June 1st. Temporary exemption for two months was sought by another Oldham electrician for an employé in order that existing contracts might be completed. This appeal was disallowed, but the man is not to be called up before July 1st.

At Warrington, an electrical engineer and contractor appealed for exemption, and it was stated that seven of his employés had joined the Army. He was responsible for the maintenance of the electrical plants at some of the local munition works. Application had been made for badges for himself and some of his employés, and on hearing this the Tribunal adjourned the case for a month.

Johannesburg and Trade After the War.—In our last issue we reprinted from a South African contemporary a series of recommendations respecting after-the-war trade which had been before the Johannesburg Chamber of Commerce. This report, it is interesting to state, was adopted at a general meeting of members called at the suggestion of the B.E.A.M.A. South African Overseas Committee, and held on April 3rd. All the B.E.A.M.A. Overseas Committees are working towards the same end, namely, the protection and maintenance of the British electrical export industry, and in connection with these efforts they are enlisting the co-operation of engineering and commercial associations in their respective territories in bringing their objects before the various Dominion Governments.

To be Wound Up.—The following appear in the latest list of enemy businesses to be wound up by order of the Board of Trade:—

Bleichert's Aerial Transporters, Ltd., 36, New Broad Street, E.C., constructors of aerial wire railways. Controller: Mr. W. Hancock, 90-91, Queen Street, E.C.

The Flender Co., Broad Street House, E.C., wooden pulley manufacturers. Controller: Mr. J. Baker, Eldon Street House, E.C.

Hammer, Bayreuther & Co., 21, Mincing Lane, E.C., rubber merchants. Controller: Mr. R. J. Knight, 3, Raymond Buildings, Gray's Inn, W.C.

Prohibited Exports.—A number of pages of the "Board of Trade Journal" for May 11th are occupied with a lengthy list (revised and complete) of prohibited exports.

The list will also be found in the "London Gazette" for May 12th.

Germany's Investments Abroad.—A Reuter dispatch from Christiania states that the German firm Schuckert, of Nuernberg, which owned half the shares in the Hafslund Joint Stock Co., has recently sold its shares to a Norwegian firm. It is understood that the purchase price was 18,000,000 kroner (about £1,000,000).

INDIAN NOTES.

[From Our Special Correspondent.]

The present week, April 21st, ends the longest period which India has been without a full mail since the war began; the last mail received being dated March 17th, and the next mail in will be April 22nd. The mail of home date, March 25th, was apparently on the ill-fated *Sussex*, and only a very few bags reached India. Electrical firms are inconvenienced as much as most others, as one looks out for home mails these days with extraordinary anxiety, for our invoices of goods long ordered and still not advised.

A stroke of extraordinary luck overtook a particular well-known firm recently. With big lamp orders booked, and not a word of advice of their shipment from home, a message was unexpectedly received from the harbour authorities that a consignment of 10,000 lamps was lying in the goods sheds awaiting delivery with demurrage daily mounting up! Delivery of the lamps was soon taken.

Metal-filament lamps are about the only electrical goods which have not advanced in price in India since the war began. In fact, if anything, the prices have decreased somewhat. The principal lamps marketed are the Osram, Mazda, Ediswan, Phillips, and Wotan.

An attempt was made some time ago to regulate prices, and meetings were held, attended by representatives of the different lamp interests, but nothing practical was done; in fact, worse price-cutting than ever took place afterwards. This is somewhat of a pity, because electrical business in plant and other electrical material is slack and is bound to continue so, and consequently a legitimate profit on lamps would be welcome.

The Calcutta Supply Co. has recently offered a reduction in its rates from July 1st, to five annas for lighting units and three annas for fan and small-power units or, if preferable, a flat rate of four annas all round, with substantial rebates after the first 5,000 units. Although this seems a substantial reduction, it only affects the large consumer to any extent. A flat rate has been asked for by the public for some time as it simplifies installations, lessens meter rents to half, and incidentally reduces the first cost of wiring by about 20 per cent. This, in itself, is something, but the small consumer still cries out for more reduction.

LEGAL.

Röntgen Ray Electric Apparatus.

In the Patents Court, on Wednesday last week, Messrs. Watson and Sons (Electro-Medical), Ltd., applied to avoid or suspend Letters Patent Nos. 9,499, of 1912, and 13,903, of 1913, registered in the name of the Siemens & Halske Aktien-Gesellschaft, Berlin, in order themselves to manufacture in this country an electrical appliance for use in connection with Röntgen-ray radiographs.

The applicants' case was presented by Mr. E. C. R. Marks, and Mr. Imray appeared for the patentees, the patents being nominally registered as owned by the German company, though they were said to be beneficially owned by Messrs. Siemens Bros. and Co., Ltd., of Woolwich.

The patents cover improvements on the ordinary form of electric apparatus, in order to obtain a more satisfactory discharge in the X-ray tube. The invention aims at reducing the time constant of the apparatus, by varying the primary circuit at the moment of commutation. Immediately prior to commutation the whole of the primary winding is in circuit. The commutator automatically cuts out half the primary, so that at the moment of commutation only half the primary coil is in circuit. The same result may be obtained by having two primary windings with different time factors. Before the commutation, the patentees have the primary of higher time constant in the circuit, and at the moment of commutation they automatically cut in a second primary having a lower time constant.

A statutory declaration was read by Mr. Geoffrey Pearce, managing director of Watson & Sons (Electro-Medical), Ltd., who explained that the applicant firm were a sub-company of a very old-established British company, Messrs. W. Watson & Sons, Ltd., of 313, High Holborn, London, and were on the contractors' list of the Admiralty, the War Office, the India Office, and many foreign Governments, and were engaged in the manufacture of X-ray and electro-medical apparatus.

The company possessed every facility for the manufacture at their own works by their own British workpeople of apparatus constructed in accordance with the specifications, and they desired to manufacture the apparatus to fulfil an urgent Government order which they had obtained. They had also other orders and inquiries for the apparatus, and it was highly desirable at the present time that this apparatus should be manufactured to an adequate extent in this country, to meet the growing demand.

Mr. Imray pointed out that Messrs. Siemens Bros. & Co., Ltd., were beneficially interested in the patents, were doing a great amount of Government work, and were prepared to carry out the manufacture of this type of apparatus. However, as the Government had approached Messrs. Watson & Sons (Electro-Medical), Ltd., Messrs. Siemens Bros. & Co., Ltd., would not object to a licence being granted to them. The only question that remained was the question of royalty.

Mr. Marks offered 2½ and 3 per cent. on the patented part of the apparatus, roughly half of the entire apparatus, which would cost about £100. Finally, the applicants agreed to pay 4 per cent. on the selling price of the entire machine.

The Controller of Patents (Mr. Temple Franks) intimated that he favoured the issue of a licence to the applicants, and stated that they would hear from the Board of Trade on the subject in due course.

Adams v. Broadbent.

With reference to our report of this case, Mr. Frank Broadbent writes as follows:—

"One or two little inaccuracies have crept into your report of the above case, but there is only one which I desire to correct, namely, the statement that the counsel for the plaintiff expressed the opinion that my later patents were not valid. This is not the case: the plaintiff's witness admitted in cross-examination that if my patents were valid his company had infringed them, but he expressed no view at all as to the validity."

Munitions Cases.

At the Oldham Munitions Tribunal, last week, a Trade Union secretary appeared on behalf of two men who desired leaving certificates from their employers—an electrical firm. When the case was called, the representative of the firm said he thought he could save time by making a short statement. The two men, he said, were in a reserved occupation, being engaged on certain work in the meter department. The firm had communicated with the

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military authorities, and it had been agreed that they should release as many of their hands as possible. They had stuck to that, and the firm could now release these two men who were applying for leaving certificates, as they would be able to replace them with female labour. He proposed, therefore, to inform the military authorities that his firm no longer desired to keep these men in the reserved occupation, and he took it that they would enter the Army. The Trade Union secretary was commencing to address the Tribunal about something that was said by the firm's representative at a sitting of the Tribunal some months ago, when the Chairman (Mr. James Hodgson) interrupted, and said that had nothing to do with the matter. The applications of the men were granted. The Trade Union secretary said he should take the matter up elsewhere, and would instruct the men to register as munition workers. The Chairman said he was afraid he could not hear the secretary any further. The firm's representative had undertaken to grant the leaving certificates, and there was nothing before the Court.

At the same Court, a man appealed for a certificate enabling him to leave the electrical works where he was engaged, and return to his former employment as a coal miner. The firm's representative said they left it to the Court to decide whether the man was rendering greater national service where he was than if he were in the pit. The appeal was refused, the Chairman stating that the man had made out no case for a certificate.

PETITION FOR PROLONGATION OF PATENT.

THE hearing of a petition for the prolongation of the patent of 1902, granted to the Runcorn White Lead Co., Ltd., Mr. George Vincent Barton and others, for improvements connected with the production of lead oxide, was concluded by Mr. Justice Sargant in the Chancery Division on May 12th.

MR. FAIRFAX, K.C., with whom was Mr. Moritz, said the subject matter of the patent was litharge, an oxide of lead which had a very extensive application, especially in the construction of storage batteries. This particular substance was also converted into white lead or red lead. Mr. Barton, while manager of the Runcorn White Lead Co., made the invention which was the subject of the patent. Messrs. Rowe Bros. & Co., Ltd., of Exeter and Runcorn, were now the owners of the patent, and though the business carried on under the patent had not up to 1915 been successful, in that year the receipts were greater than the expenditure, and Messrs. Rowe now hoped to turn the patent to advantageous account. They had had to face labour difficulties at Runcorn and heavy cost of freight, besides German dumping and competition among British manufacturers, but they had purchased land at Liverpool and were to erect thereon works on a larger scale for the manufacture of litharge and its conversion into white and red lead, and they expected to save 15s. a ton in respect of freight for raw material and products. In these circumstances Messrs. Rowe and Mr. Barton, who was paid a royalty on the products, petitioned for an extension of the term of the patent.

The Crown, represented by the Solicitor-General, K.C., and Mr. Austen Cartmell, opposed the petition on the ground that the patent was of no commercial value.

At the conclusion of the arguments his Lordship reserved judgment.

HILL v. JOHN LYSAGHT, LTD.

IN the King's Bench Division on Tuesday this action came on for hearing.

Plaintiff, an electrical fitter living at St. Albans, claimed to recover damages from defendants for personal injuries sustained through the alleged negligence of a servant of the defendants.

The defendants denied the alleged negligence.

The hearing was adjourned till Wednesday.

BUSINESS NOTES.

Book Notices. — *Electrical Apparatus Making for Beginners.* By A. V. Ballhatchet. London: Percival Marshall and Co. Price 2s. net.—This is an excellent guide for the novice, being obviously written by one who has been through the mill, and knows from experience the troubles and difficulties that will be met with. He recommends a liberal equipment of tools, and with this we cordially agree; but the whole of the work described in this book can be done without a lathe. The construction of primary cells of various types, simple galvanometers, a moving-coil galvanometer, a rheostat, electromagnets, bells and indicators, a Morse sounder and key, simple motors, an induction coil, telephones, voltmeters, &c., is clearly explained, with great detail, on the basis of the author's own work, and we think the ambitious amateur will find the book of the greatest interest and value.

The Arc is "a magazine written and edited by No. 3 Coy. L.E.E., R.E. (T.)," at its station on the coast; it has reached its fourth issue, and is going strong, with numerous advertisements, and all the usual symptoms of prosperity. We have been turning over the pages of the last three issues, and note that the contents are varied in the extreme, brightly written, and full of local and topical interest, while the many jests are proof of the cheery spirits of our comrades on active service. The following specimen of frightfulness occurs in a column of queries: "What condition the editor must have been in to spell Mesopotamia, Messupathomehere?" Nevertheless, we congratulate the producers on the energy and originality displayed in their scanty leisure, and wish success to their lively magazine.

"Scientific Papers of the Bureau of Standards." No. 273: General Design of Critically-damped Galvanometers. Washington: Government Printing Office.

Sale of Tyneside Plant.—MESSRS. D. H. LONGBOTHAM & CO., LTD., of Ings Foundry, Wakefield, have purchased from the Newcastle-on-Tyne Electric Supply Co., Ltd., several Parsons turbo-alternator sets, with condensers, &c., ranging from 2,500 to 5,000 KW. These sets are being taken out for the sole reason that it is necessary to make room for larger sets, consequent upon the continued development of the company's undertaking.

Trade with Russia.—THE RUSSO-BRITISH TRADE EXCHANGE, LTD., 16, Regent Street, London, announce that they are taking steps to establish in Moscow a series of exhibition showrooms and salesrooms, with Anglo-Russian technical and clerical staffs, for the representation of British and Colonial manufacturers and merchants on a co-operative basis. The details are set forth in a circular which has just been issued.

Stoker Contracts.—We have received a list of contracts for stokers recently received by the UNDERFEED STOKER CO., LTD. Among these are many contracts for municipal corporations, a number of collieries in this and other countries, mills, ironworks, &c., also the Midland Electric Corporation for Power Distribution, and the Compagnie Generale de Distribution Electrique, Billancourt.

The National Electrical Code 1915.—The office of H.M. Trade Commissioner in Canada has forwarded copies of the "1915 National Electrical Code." This Code has been adopted by the Canadian Fire Underwriters' Association, and British firms are notified of the necessity of complying with the requirements of the Code before undertaking the sale of their goods in the Dominion of Canada. A few copies of the Code are available for distribution to United Kingdom manufacturers of electrical apparatus, and they may be obtained by such manufacturers on application to the Commercial Intelligence Branch of the Board of Trade, London, E.C.—*Board of Trade Journal.*

For Sale.—The City of Leeds Electricity Department has for disposal 1,000-B.H.P. triple-expansion, 3-cylinder vertical Bellis engine, 2 sets horizontal surface condensing plant, with pumping and circulating engines, six 700-KW. two-phase alternators and exciters, and one additional circulating engine.

A sale by public auction, by order of the liquidator of the Consolidated Diesel Engine Manufacturers, Ltd., and Diesel Engine Co., Ltd., will be held at the Ipswich Works, Hadleigh Road, Ipswich, by Messrs. Wheatley Kirk, Price & Co., on Wednesday, June 7th, of the stock of Diesel engines, spare parts and stores.

For further particulars see our advertisement pages to-day.

Advance in Prices.—THE WALSALL ELECTRICAL CO., LTD., announce that, from June 1st, their prices will be increased by a further 10 per cent., owing to the heavy increase in cost of labour and material.

Canadian Trade.—The Ottawa correspondent of the *Times* states that a Commission of six leading Canadian business men is to visit Great Britain, France, and Italy, to study ways of developing Canadian commerce. The Commission may be accompanied by Sir George Foster, Minister of Trade and Commerce. Sir George Foster has arranged with the British Board of Trade to have sent to Canada a display of German and Austrian products to be exhibited in leading Canadian cities. He is making plans for the encouragement of chemical and industrial research work in Canada, with the co-operation of the Universities and chemical societies.

Dinner.—The employés of MESSRS. H. T. BOOTHROYD, LTD., electrical engineers, Bootle, sat down to dinner together on Saturday, May 6th, at the Bear's Paw Restaurant, Liverpool. The guest of the evening was Mr. J. H. Woolliscroft, who has just resigned from the position of general manager, in order to commence business on his own account. Mr. Woolliscroft was presented with a silver rose-bowl and a silver match-box, and, in response, he suitably expressed his appreciation. For a concert which followed, the talent was provided by a number of the employés.

Liquidations. — BALDUR ENGINEERING AND SUPPLY CO., LTD.—A meeting of creditors is called for May 22nd, to accept the resignation of the liquidator, Mr. H. C. Caley, who is now on active service abroad, and to appoint Mr. J. W. Buck, of 39, Victoria Street, S.W., in his place.

BIDDLE AUTOMATIC SIGNAL, LTD.—This company is winding up voluntarily with Mr. W. Braby, 25, Victoria Street, S.W., as liquidator. A meeting of creditors is called for May 22nd.

UNIVERSAL CHEAP CABLES, LTD.—A meeting of creditors is called for May 16th, at 30, Bush Lane, E.C.

COLSTON ELECTRICAL WORKS, LTD.—A petition for the winding up of this company presented by Haslam & Stretton, Ltd., Cardiff, creditors, will be heard at Bristol on May 31st.

R. E. CONNOLD, "late electrician," carrying on business at Canterbury, now R.N.A.S.—Receiving order made May 11th on debtor's petition.

LANCASHIRE MOTOR AND ENGINEERING CO., LTD., Preston.—First meetings of creditors and contributories, May 25th.

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Bankruptcy Proceedings. — ARTHUR FARADAY HAWDON, electrical engineer, Yetholm, Elmfield Gardens, Gosforth, Northumberland.—The application for discharge of the above-named debtor was fixed for May 11th, at the County Court, Westgate Road, Newcastle-on-Tyne, but was withdrawn. Bankrupt not to be at liberty to apply again without the leave of the Court and notice to the Official Receiver and payment of the costs.

Trade Announcements.—MR. R. E. CONNOLD, electrician, of 6A, The Parade, Canterbury, having joined the Forces, has discontinued the business. The stock is to be sold by auction on May 23rd.

The firm of H. HARTJEN & CO. has been turned into a private limited company under the title of Holder, Harriden, Ltd. Mr. F. W. Lang is the sole director.

MESSRS. A. HURST & CO., announce that their address is now again, 59, Farringdon Road, London, E.C.

Catalogues and Lists.—MESSRS. SIMPLEX CONDUITS, LTD., Garrison Lane, Birmingham.—Sixteen-page publication in which Mr. L. M. Waterhouse gives an illustrated account of the protective coverings of Simplex conduits—their new "Zenex" and "Negrex" finishes. The former is a pure zinc covering, and the latter is a pure zinc finish subsequently treated with enamel. The firm have recently installed at their Birmingham works what is said to be probably the largest automatic plant in the kingdom for dealing with the deposition of pure zinc on the surface of steel conduits. It is claimed that the extra expense involved in initial outlay will be more than compensated by the increased life and freedom from faults and breakdowns. "Simplex" fittings are finished in exact conformity with the "Zenex" and "Negrex" finishes of the conduits.

"Z" ELECTRIC LAMP MANUFACTURING CO., LTD., Southfields, London, S.W.—Three book-markers are being issued to the trade generally as part of the company's publicity measures relating to "Z" lamps.

MR. C. E. MILLER, New York.—Catalogue and price list of automobile and other like supplies.

LIGHTING AND POWER NOTES.

Accrington.—LOAN SANCTIONS, &C.—Ald. Higham, the chairman of the Electricity Committee, referring to the loss of £3,410 on the electricity undertaking last year, following a loss of £3,670 in the previous year, pointed out that they were losing money on the contracts made before the war. He was sanguine, however, that their finances would improve considerably during the coming year. They had made out their case, that the load on their station was such as they could not cope with without the extension of plant. The B. of T. had intimated that on formal application, sanction would be given to borrowing £7,000 for a new chimney, boiler, and flue to the destructor plant, and £14,000 for new electrical generating plant, cooling tower, boiler and feed pumps.

Australia.—The *Australian Mining Standard* states that there is every likelihood of the proposed electric light and power scheme for Ipswich (Q.) being carried out, if the Queensland Treasurer agrees to allow 12 months' grace to the company, in view of the difficulties arising from the war. The terms of the Order-in-Council granting the concession stipulate that the period shall not exceed 25 years, and that the local authorities and probably the State Government shall have purchasing rights at the end of 15 years and 25 years, under certain conditions. The price to be charged to local authorities for tramway supply is to be £5 per KW. of maximum demand per annum plus ½d. per unit, and for the city pumping plant, should the city decide on electric pumping, ¾d. per unit plus a reasonable KW. charge. The municipal authorities have agreed not to exercise their purchase rights before 25 years, and to request the Minister to grant the 12 months' grace asked for.

Barnes.—Owing to the fact that the net profit (£769) on the electricity undertaking for the past 12 months is not sufficient to meet all eventualities, more especially as in the eight years immediately prior to the war the average net profit amounted to £2,500, the electrical engineer suggests that as from the June quarter an amount equivalent to 10 per cent. should be added to all accounts. This proposal would, the engineer states, provide a sum of approximately £1,250, and provided the cost of materials remains the same, would ensure a net profit of about £2,000 for the year 1916-17. The Lighting Committee will consider the question at its next meeting.

Canada.—The Court of Appeal has upheld the claim of North Vancouver municipality for power to expropriate the electric distributing system within its borders, this being part of the B.C. Electric Railway Co.'s system.

A bill has been introduced in the local legislature of New Brunswick to permit the development of electrical energy from the St. Croix River.

Continental.—SPAIN.—A new central station has just been inaugurated in Segovia by the Sociedad Co-operativa Electra Segovians, a company supplying light and power. The first equipment comprises two hydroelectric groups of Francis turbines, built by Escher, Wyss & Co., and two alternators furnished by the Swedish General Electric Co.—*Industria e Invenciones.*

Dover.—LOANS, &C.—The Loaning Authority has agreed to renew for five years, at 5 per cent., the loan of £157,000 for the electricity undertaking.

Gravesend.—PROPOSED LOAN.—The T.C. has decided to approach the L.G.B. with regard to a loan for an electric supply to the Town Works, Northfleet, of the Thames Metal Co. The estimated outlay is £3,000, and the company guarantees for three years a minimum annual payment of £400. Without any guarantee, the company now pays over £2,000 a year for current supplied to its Rotherhithe works.

Great Harwood.—PROV. ORDER.—The U.D.C. has instructed its clerk to apply to the B. of T. for the renewal of the E.L. order.

India.—RANGOON STREET LIGHTING.—The chief engineer of the Rangoon municipality, while in England, will inquire into the various systems of street lighting. The need for this has arisen from the fact that the present electric lighting of Rangoon is not considered satisfactory by the Municipal Committee.—*Indian Engineering.*

Kendal.—The T.C. has offered to supply current for power, during the present year, at 1½d. per unit, to Messrs. Atkinson & Griffin, and Mr. H. J. Croft, if each guarantees a consumption of 8,000 units during that period.

Knottingley.—PROV. ORDER.—The B. of T. has extended the Electric Lighting Order for one year from July, 1916.

Leigh.—LOAN SANCTION.—The T.C. recently applied for permission to borrow £18,300 for extensions at the electricity works, and sanction has now been received for the borrowing of £5,536. It appeared that if the full scheme had been sanctioned there would have been danger of men being drawn from more urgent work.

Lincoln.—REVISED PRICES.—The various firms taking power under contract have agreed to pay the increased price for electricity decided upon by the T.C. some weeks ago.

Llanfyllin.—PUBLIC LIGHTING.—With reference to the offer of Mr. R. A. Jones to light the town by electricity, mentioned in the last issue of the ELECTRICAL REVIEW, the T.C. has decided to take the opinion of the ratepayers on the matter. The present price of gas is 8½d. per 100 cb. ft., and Mr. Jones offers to undertake the public lighting at a cost which will save 2d. in the pound on the rates.

London.—L.C.C.—The Finance Committee recommends the sanction of the Council to the borrowing of £3,000 by the Hammersmith B.C. for electricity mains, transformers, switchgear and house services; and of £3,000 by the Hampstead B.C. for purchase of a new switchboard.

STOKE NEWINGTON.—The Electric Lighting Committee recommends the installation of surge arresters at the electricity substation, at an estimated cost of £61.

SHOREDITCH.—LOAN SANCTION.—The L.C.C. has advised the B.C. that it is prepared to advance the £2,000 required by the electricity department for house services and meters, and the B.C. has been recommended to take up the loan. The B.C. is making representations to the B. of T., the Railway Executive Committee, and the Admiralty Coasting Trade Office on the matter of coal supply.

WESTMINSTER.—The City Council has been recommended to agree to the increase in charges for electricity supplied by the Charing Cross and St. James's Companies to the Council Buildings.

Middlesbrough.—The Electricity Committee has decided to extend the supply to a large local works.

New Zealand.—The installation of the Kaponga Town Board's hydro-electric plant was expected to be completed last month; the township is situated on the Kaupokonui stream across which a concrete dam has been built. The plant consists of a single-discharge horizontal-shaft type Boving turbine capable of developing 70 B.H.P., coupled to a 45-KW., 230-volt dynamo; a D.P. battery of 128 cells, and about 2 miles of pole line. The system is two-wire D.C., with the street lighting on a separate circuit.—*Commonwealth Engineer.*

Licences have been granted for electrical installations and lines in Thames County, in the borough of Spreydon, in Kidnapper survey district and in Mangohua County.—*Board of Trade Journal.*

Pendlebury.—The new power station which has been erected and equipped for the Acme Spinning Co., Pendlebury, is expected to be running by the end of the present month. The firm has used electricity for driving purposes for several years at the No. 1 Mill, and now the electric drive is being adopted at the firm's other factory, the whole of the power to be derived from its own power station. Hitherto the electric supply for the newer of the two mills has been obtained from the Lancs. E.P. Co. The B.T.H. Co., of Rugby, has supplied the electrical machinery.

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Rochdale.—Extensions and Loans.—The recommendation of the Electricity Committee that sanction should be sought from the L.G.B. for the borrowing of £60,900 for extensions at the electricity works was considered at a special meeting of the T.C. on May 11th. Councillor Walker said the Committee did not propose to spend the whole of the money now or in the immediate future. The outlay proposed now was on a new chimney, economiser, induced draught plant, and other work, estimated to cost about £10,000. The other money would be spent as required, and the Council would be able to consider the development step by step. An amendment that borrowing powers be sought to carry out the portion of the scheme stated to be urgently required—No. 3 chimney, induced draught plant and economiser—was adopted by 22 votes to 10.

In a supplementary report on the electricity undertaking, Mr. S. L. Pearce (Manchester City electrical engineer) recommends that the question of a further increase in the prices charged for current should be considered.

Swansea.—Public Lighting.—The Electricity Committee has approved the proposal of the engineer to change over the whole of the existing enclosed arc lamps to incandescent lamps.

West Hartlepool.—Year's Working.—It was reported last week that the income from the Corporation electricity undertaking for the past year showed a net increase of £1,295, chiefly from power supply. The income from public and private lighting was greatly reduced. The expenditure increased by £1,023, the principal item being for the purchase of coal. After meeting all expenses there was a credit balance of £316, against £44 in the previous year.

Worcester.—Loan Sanction.—The T.C. has received permission from the L.G.B. to borrow £240 for the extension of the supply to the works of Messrs. Heenan & Froude.

TRAMWAY and RAILWAY NOTES.

Astley.—Owing to the extension of coal mining in the Astley district, the South Lancs. Tramways Co. is being urged to extend its system in this area.

Birmingham.—The Corporation tramways last year carried 14 million more passengers than in the previous year, and the traffic revenue increased by £125,000.

Bury.—Year's Working.—The total mileage worked by the Bury cars in Bury and adjoining areas, during the year ended March 31st last, amounted to 1,549,366, and 15,810,869 passengers were carried. The gross traffic receipts in the several areas, were: Bury, £45,837; Radcliffe, £14,361; Heywood, £7,438, and Salford, £1,986, making a total of £69,622, as compared with £68,908 in the preceding year. The total receipts amounted to £69,792. The financial result showed a net surplus of £18,334, of which £7,315 represented the net profit on the Bury undertaking, after paying £1,645 war allowances. The profit was allocated as mentioned on page 482. The Bury generating station supplied 1,404,707 units, and the Radcliffe station 389,014 units, the energy consumption showing a slight increase per car-mile, owing to the lack of skill of the new men, while the price of electricity has also been increased by 10 per cent. Mr. Clough, the manager, points out that of the estimated life of the rails, 15 years, about 12 have now expired, and that the period for renewals is fast approaching. A fund of £30,000 is available for this purpose.

Canada.—According to the statement of the general manager of the Western lines, the Canadian Pacific Railway is still considering the electrification of its lines through the mountains of the British Columbia division. The matter has, of course, often been mentioned before.

East London Railway.—Assessment.—The electrically-operated East London Railway, which is worked by a joint committee of six companies, and runs from Shoreditch, under the river, to New Cross, has for the last 30 years been assessed at a figure varying from £2,000 to £8,000. The joint committee, which had unsuccessfully appealed to the London Quarter Sessions on four previous occasions, has now, on its fifth appeal, obtained a reduction on rateable value from £5,092, recently fixed by the Assessment Committee, to a nominal figure of £100. The Assessment Committee was ordered to pay the joint committee's costs.

Heywood.—Year's Working.—There was a loss of £518 on the tramway undertaking during the past year. In the previous year there was a loss of £1,042.

Leeds.—Tramway Goods Traffic.—The annual report on the Corporation tramways points out that since October the tramways have been used for carrying fireclay across the city for a local firm. Mr. Hamilton (the manager) has been asked to report fully on the possibility of using the tramways for goods traffic, particularly those in the northern area, which is unserved by railways or canals.

London.—L.C.C.—The following comparative statement shows the income and expenditure relative to the working of the Council's tramways in respect of the two years, 1914-15:—1914, income £2,268,669, expenditure £1,615,466; 1915, income £2,399,847, expenditure £1,700,572. The expenditure for the year ended March 31st, 1915, includes a charge of £42,209, in respect of allowances made to officers and employés of the tramway department serving with H.M. Forces. The surplus on (working) revenue account for the year 1914-15 amounted to £699,276; the net revenue account showed a deficiency of £33,173, which was met out of the balance standing to the credit of the general reserve fund.

The Finance Committee has had under consideration the question of the periods to be allowed for repayment of capital expenditure in connection with the substitution of turbine sets for reciprocating plant at the Greenwich generating station, and after conferring with the Highways Committee and with the approval of the Treasury, recommends for:—

Expenditure on river works, foundations for new machinery, and alterations to buildings (for completion of works of a permanent character (£23,640)—60 years.

Other alterations to existing buildings (£1,310)—25 years.

Expenditure on new plant and machinery (other than additional steam, exhaust, feed condenser, &c., pipes)—15 years, on the understanding that, in the event of payments into the renewals fund on the agreed basis being resumed at any future date, the question of the period for repayment shall be reviewed.

Expenditure on additional steam, exhaust, feed condenser, &c., pipes—25 years.

Cost of re-blading turbines and re-winding generators to be charged to revenue account or renewals fund.

Outstanding debt in respect of each of the old machines—to be provided for in two years, from the end of the financial year during which the old machine in question is replaced.

The Highways Committee during the quarter ended March 31st, 1916, has settled 483 claims against the Council in respect of accidents arising in connection with the working of the Council's tramways, amounting to £6,478. In 22 other cases actions were brought against the Council. In 13 of these a verdict against the Council was given, and sums amounting to £1,023 and costs had to be paid. The remaining nine actions resulted in the Council's favour; £584 has been received in settlement of claims made by the Council in respect of damage to tramway property.

Luton.—Assessment.—In November last the Commissioners of Taxes dismissed the T.C.'s appeal against the assessment of the Corporation for income tax under Schedule D in respect of the rent received from the tramway lessees (Messrs. Balfour, Beatty & Co., Ltd.) A claim was thereupon made that the Council should have an allowance made for depreciation. The lessees contended that they alone were entitled to the depreciation allowance, but after protracted negotiation an arrangement has been made with the lessees and the Inland Revenue authorities, whereby the Corporation shall have the benefit of so much of the usual depreciation allowance as will release the Corporation from the payment of income tax except to a small extent during the two last years of the existing lease.

Nelson.—The Tramways Committee has decided to have five additional cars fitted with new bodies by the United Electric Car Co., of Preston.

Plymouth.—Electric Vehicle.—The City Council has decided, by 29 votes to 20, to purchase an electric lorry at a cost of £1,055.

Ramsbottom.—Wages.—The Traction Committee has refused to grant an application of the tramway men for an increase of wages, on the ground that the present rate of pay is equal to that paid to drivers on small tramway systems like that of Ramsbottom.

Rochdale.—Three persons were injured as the result of a tramway smash on Friday, last week. A car in Drake Street got out of control owing to the failure of the brakes on the greasy rails, and collided with two coal carts, subsequently running into a double-deck car. Several passengers received a shaking.

Southampton.—Year's Working.—The tramway manager strongly recommends the levying of a charge for excess luggage on the cars, that is to say parcels other than personal luggage not exceeding 28 lb. in weight. For the twelve months to March 31st last, the receipts of the undertaking amounted to £78,064, an increase of £10,022 compared with the previous year. There was also an increase in the number of passengers carried to the extent of 2,228,651, although the mileage run fell short of the figures for 1915 by 66,929. There was a decrease of 4,499 units in the energy used. The receipts, passengers carried, and units consumed per car mile all show an increase as compared with twelve months ago, the former by 1·862d., the second by 1·675d., and third by .045d. The manager is to report upon the penny sections, and as to the advisability of revising them.

Southend-on-Sea.—The Light Railways Committee has instructed the electrical engineer not to proceed with the proposal for engaging women as temporary drivers, but to apply for the exemption provisionally of 17 motor-men, and to appoint temporarily other suitable men for the season traffic when the necessity arises. The Committee has considered the question of the fares at present charged on the tramways, and the rates charged for the supply of energy, but has decided to make no alteration at the present time.

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Salford.—War Bonus.—A recommendation has been put forward that female conductors shall be paid the same bonus as males for similar duties.

Swansea.—Extension of Time.—The Tramways Committee proposes to instruct the town clerk to make application for an extension of time for the construction of the Carmarthen Road and Port Tennant Road tramways.

U.S.A.—Electric Freight Yards.—The detailed plans of the West Side Improvement in New York city, which have been filed by the New York Central Railroad, include the electrification of the company's 12-mile freight entrance to the city, and extensive track reconstruction work, involving the covering of the tracks through several miles of parks, at an approximate cost of $50,000,000. Particular interest attaches to the work because of the large scale of the freight switching operations which will be involved; there are four important freight yards on the route. The trains will operate on either 1,200 or 600 volts, and the locomotives will be insulated for 1,200-volt operation, according to the company's practice in connection with its recent passenger locomotives. The locomotives will be available for either 1,200 or 600-volt working; it is expected that 75 will be required, and these will handle two classes of service, viz., through freight trains and switching service. Under present conditions trains of 3,000 tons are handled, but most of the trains are 1,500 tons or less in weight. Much of the traffic has to be handled at relatively high speed on account of the dense passenger traffic on the New York Central's electrical route to which the West Side tracks connect. The road locomotives will operate between New York and Croton, the northern end of the present electric zone, a distance of 34 miles. A new 20,000-kw. turbine set will be installed in the company's Yonkers power station which supplies this section of the railway, and three substations will be provided for the new electrical lines.

A new public service terminal building has been opened in Newark, N.J., which is stated to have cost $6,000,000. Electric cars enter the terminal from the east over an elevated structure and from the west through a subway. The ground floor or concourse contains public gas and electric showrooms, &c., while the upper floors contain offices. The terminal is connected with surrounding districts by 10 lines, and has been provided to accommodate this traffic and prevent interference between it and local traffic.

West Hartlepool.—Year's Working.—To the Corporation, last week, it was reported that the past year's revenue from the tramways was £19,482, against £19,506 in the previous year, the working expenses being £13,126, as against £11,574 in the preceding 12 months. Notwithstanding the increase in working expenses, a sum of £1.278 was carried to the reserve fund, making the total amount of that fund £5,706.

It was reported that an application from motormen and conductors for an increased war bonus, had been referred to the Management Sub-Committee.

TELEGRAPH and TELEPHONE NOTES.

Marconi Station in Danger.—The Dublin correspondent of the *Daily Telegraph* states that a large body of rebels plotted to seize the Marconi station at Skerries, county Dublin. The local police got word of the attack on Easter Tuesday; there was only a small military force at the station, but every preparation was made to meet the attack. On Wednesday the rebels captured the villages of Swords and Donabate, and prepared to march on Skerries, but just then a destroyer came along and landed 200 men, who at once entrenched themselves around the station. The rebels, on learning of the presence of the destroyer, went off in the direction of Dublin.

Spain.—The city of Seville possesses a telephone system, but the municipal authorities have refused to extend it beyond the bounds of the city. An interurban company serves the principal provincial capitals of Spain: but its system has no direct connection with the urban system. Now it is suggested to combine the urban and interurban systems, and to extend the interurban system to the cities and towns in the neighbourhood of Seville. In the six provinces adjacent to that of Seville there is a population of 5,170,000 inhabitants, with 48 important cities and 319 of lesser grade. The Interurban Co. which is studying these extensions is the Compania Peninsular de Téléfonos Interurbanos. —*Industria e Invenciones.*

United States.—The annual report of the directors of the American Telephone and Telegraph Co. (the Bell system) states that at the end of 1915 there were over nine million stations connected, an increase of half a million; the total mileage of wire in use was 18½ million miles, 93 per cent. being of copper, and 10½ million miles are underground, the total cost of the underground conduits and cables being 41 million pounds sterling. The length of phantom circuits in use amounted to 196 841 miles; this item is reported this year for the first time. The effect of adopting phantom circuits is to obtain three speaking circuits from four wires, and it is possible to use two phantom circuits in like manner for a super-phantom called a "ghost," giving 7 circuits from 8 wires—but this is not used commercially, as the gain does not justify the added complications. The daily average traffic in 1915 was 26 million messages, making the immense total of 8 652 million effective connections per annum, exclusive of all uncompleted calls. The expenditure on capital account during the year was 6½ millions sterling, compared with 10 millions in 1914. Provision for depreciation of plant absorbed 9 millions, an average of 5·2 per cent. on the cost of plant, it being a firm policy of the company to provide each year out of revenue a sufficient amount to cover the estimated wear and tear, obsolescence, and inadequacy of plant accruing during that year, so that when any plant has to be superseded sufficient reserve is available to meet the resulting loss of capital. This is the only way in which present telephone users can be made to pay for the wear of the plant they are using.

The total capital expenditure of the system amounts to no less than 273½ million pounds sterling.

During the year trans-Continental communication was accomplished, and the service proved so satisfactory that the work of extending the improved form of construction was at once put in hand. It is now possible to talk from any State in the Union to at least some point in any other. The engineering department also succeeded during the year in transmitting speech by wireless telephony from Arlington, Virginia, to California, Paris, and Hawaii, and the transference of the speaking vibrations from wire to space, and *vice versâ*, was also achieved. As regards the possibility of wireless telephony ever taking the place of wire telephony, the engineers of the company emphatically state that, so far as present knowledge and indications are concerned, there is no such prospect.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—June 20th. Municipal Council. Two-ton electric lorry. City Surveyor, Town Hall.

Melbourne.—June 14th. Victorian Railways. Electric lamps and lampholders for signal system.*

Bedford.—May 25th. Coal for the Corporation Electricity Works; Mr. Chas. Stimson, Town Clerk.

Belfast.—May 24th. Electricity Committee. Chain-grate mechanical stokers. See "Official Notices" May 12th.

Keighley.—May 22nd. Wiring of Fever Hospital and Sanatorium, Morton Banks Specifications (10s.), Mr. H. Webber, Borough Electrical Engineer, Coney Lane.

Liverpool.—May 31st. Liverpool Overhead Railway. Twelve months' supply of electrical fittings. Particulars from General Manager, 31, James Street.

Manchester.—May 23rd. Coal (best steam cobbles). Tramways Committee. J. M. McElroy, General Manager, 55, Piccadilly.

May 26th. Electricity Committee. Stores for one year. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall.

New Zealand.—June 23rd. Oamaru Borough Council. Overhead mains and street-lighting equipment (Contract No. 2); power-station equipment (Pelton wheels, alternators, &c.) (Contract No. 3); service meters (Contract No. 4); line transformers and accessories (Contract No. 5).*

Pahiatua.—July 10th. Borough Council. Overhead wires, poles, street lamps, gas engines, producers, dynamos, auxiliary apparatus and accumulators. Specifications from Borough Offices or E. J. Fenn, Consulting Engineer, Auckland.*

Rochdale.—May 24th. A 110, economiser; A 111, electrically-driven induced draught; A 112, chimney and flues; A 113, ash-handling plant. Specifications, &c., £1 1s., from Mr. C. C. Atchison, Engineer, Dane Street.

Spain.—Municipal authorities of Almorox (Province of Toledo). Tenders for the concession for the electric lighting of the town during six years.

May 30th.—Municipal authorities of Figueras (Province of Gerona). Tenders for the concession for the electric lighting of the town during five years.

May 31st. Municipal authorities of Adradros (Province of Segovia). Concession for the electric lighting of the town during ten years.

Swindon.—May 30th. Corporation. Steam coal for the electricity works and waterworks respectively. See "Official Notices" May 12th.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

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CLOSED.

Government Contracts.—List of new contracts for April, 1916 :—

War Office.

Distribution boards.—Dorman & Smith, Ltd.
Battery boxes.—Hewson Manufacturing Co., Ltd.; Marshall, Sons & Co., Ltd.; Ransomes, Sims & Jefferies, Ltd.
Bridge meggers.—Evershed & Vignoles, Ltd.
Electric cable and wire.—Craigpark Electric Cable Co., Ltd.; General Electric Co., Ltd.; Johnson, Matthey & Co., Ltd.; Johnson & Phillips, Ltd.; Liverpool Electric Cable Co., Ltd.; St. Helens Cable & Rubber Co., Ltd.
Electric cranes.—Babcock & Wilcox, Ltd.
Electric secondary station.—D.P. Battery Co., Ltd.
Electrolysers and accessories.—Mather & Platt, Ltd.
Engines, dynamo, switchboard, &c.—Petters, Ltd.
Generating sets.—Austin Motor Co., Ltd.
Electric lamps.—Honig & Mock, Ltd.
Switchboards.—Drake & Gorham, Ltd.
Works services.—Electric equipment for power house, British Westinghouse Electric & Mfg. Co., Ltd.; electric lighting, telephones, &c., T. Clarke & Co.; electric lighting installations (various), T. Clarke and Co.; G. E. Taylor & Co.; Ellis & Ward, Ltd.; Foote & Milne, Ltd.; S. Dixon & Son, Ltd.

India Office Store Department.

Backs and cups.—Bullers, Ltd.]
Cells.—Siemens Bros. & Co.
Elements.—General Electric Co., Ltd.
Engines.—Lancashire Dynamo Co.
Switchboards.—Eckstein, Heap & Co.
Transformers.—British Electric Transformer Co., Ltd.
Wire.—T. Bolton & Sons; Shropshire Iron Co.; Callender's Cable Co., Ltd.

Post Office.

Electric lighting, Bolton new Post Office.—Grindlay, Ross & Co., Ltd.
Testing apparatus.—General Electric Co., Ltd.
Telegraph cable.—Telegraph Construction & Maintenance Co., Ltd.
Telephone cable.—London Electric Wire Co. & Smiths, Ltd.; Telegraph Construction & Maintenance Co., Ltd.
Dry cells.—Siemens Bros. & Co., Ltd.
Telephone cords.—London Electric Wire Co. & Smiths, Ltd.
Insulators.—Doulton & Co., Ltd.; Taylor, Tunnicliffe & Co., Ltd.
Telegraph ironwork.—Bullers, Ltd.
Glow lamps.—British Thomson-Houston Co., Ltd.; Edison & Swan U.E.L. Co., Ltd.; General Electric Co., Ltd.
Bronze wire.—F. Smith & Co. (incorporated in the London Electric Wire Co. & Smiths).

Hants.—The Hants County Council has entered into an agreement with the Chloride Electrical Storage Co. for the maintenance of the storage battery at the Park Prewett Asylum for ten years from the date of its first charge, for £61 a year.

Kirkcaldy.—Council. Electricity meters for one year. Chamberlain & Hookham, Ltd.

London.—L.C.C.—The Highways Committee has accepted the undermentioned tenders for the supply during 1916-17 of tramways equipment, &c.—

Electrical equipment (motor and generator) spares.—A. Clare & Co. (six months only); British Westinghouse Electric and Manufacturing Co., Ltd.
Electrical equipment (controller, circuit-breaker and other switch details, and magnetic brake) ares.—British Westinghouse Electric and Manufacturing Co., Ltd.
Contact fingers and parts, segments, &c.—British Westinghouse Electric and Manufacturing Co., Ltd.; Dyer & Young; E. Showell & Sons, Ltd.; Tramway Supplies, Ltd.
Electric cable, fuse wire, and cotton-covered wire.—Liverpool Electric Cable Co., Ltd.; Callender's Cable and Construction Co., Ltd.; British Insulated and Helsby Cables, Ltd.; London Electric Wire Co. and Smiths, Ltd.
Copper bonds.—Watlington & Co.
Moulded insulators.—British Westinghouse Electric and Manufacturing Co., Ltd.; Crystalate Manufacturing Co, Ltd.; Ebonestos Manufacturing Co., Ltd.; Litholite, Ltd.
Track insulators and porcelains for electric track work.—Bullers, Ltd.; Taylor, Tunnicliffe & Co., Ltd.
Machined bronze bearings.—Anti-Attrition Metal Co., Ltd.
Brake shoes.—Pease & Partners, Ltd.

Malvern.—U.D.C. Contract renewed for a year for electric meters with the Electrical Apparatus Co.

Southend-on-Sea.—Light Railways Committee. Material for the fixing of the new overhead equipment on the Leigh route :—

D. B. Rose.—Ears, £49.
R. W. Blackwell.—Strainers, wire bolts, and mechanical frog, £25.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, May 19th. At 6 p.m. At Great George Street, S.W. Paper on "Spur-Gearing," by Mr. D. Adamson.

Royal Society of Arts.—Monday, May 22nd. At 4.30 p.m. At John Street, Adelphi, W.C. Cantor Lecture on "Vibrations, Waves and Resonance," by Dr. J. Erskine-Murray (Lecture IV).

Wednesday, May 24th. At 4.30 p.m. Peter le Neve Foster Prize Essay, on "Zinc, its Production and Industrial Applications," by Mr. J. C. Moulden.

Royal Institution of Great Britain.—Friday, May 26th. At 5.30 p.m. At Albemarle Street, Piccadilly, W. Lecture on "X-rays," by Prof. C. G. Barkla, F.R.S.

NOTES.

Resuscitation After Electrical Shock.—In the *Electrical World* Mr. W. P. Strickland recently wrote as follows :—Recently one of our foremen after climbing a pole preparatory to stringing primary wires received a shock that caused him to fall to the ground. It is inferred that in adjusting his belt and shifting his position his spur cut out, and that to save himself he instinctively reached out and touched the wires carrying 2,300 volts. When the other linemen and ground hands reached him to all appearances the man was dead. One of the linemen, following instructions, immediately took hold of the ankles of the limp body, lifting it until the whole weight rested on the neck and then letting it fall. He then took a pair of connectors and hammered the soles of the injured man's feet without removing his shoes. Another lineman opened the man's mouth, pulled forward the swallowed tongue (which occurs in electric shock) and was about to begin the Schaefer prone method of resuscitation when the man returned to life. He was removed to the hospital and is alive and well to-day, though suffering severely from his burns.

For the past year the writer has been teaching his men to strike the feet without removing the shoes in all cases of electric shock. Some years ago an accident occurred where a man came in contact with 6,600 volts, fell from the pole, and was restored to consciousness by this means, although he was terribly burned and died three days later. Another accident that came to the writer's attention happened in New Jersey when a man came in contact with a wire carrying 2,200 volts. This man was struck violently on the feet, his tongue was pulled out, and he was restored to consciousness before the arrival of the doctor.

A Canal Comedy.—The *Times* has received from a correspondent copies of a correspondence which would be merely amusing if it did not reveal a lack of serious thought and energetic enterprise on the part of some of those who are responsible for the working of canals in this country. It appears that the South Metropolitan Electric Light and Power Co. wanted to avoid paying the high freight for the carriage of coal from the north, and inquired of the Grand Junction Canal what facilities that company could offer. A reply was received stating that as the company was not a carrier, the letter had been passed on to a canal carrier. A discouraging note was appended to the effect that it was practically impossible to bring coal from Yorkshire collieries to Greenwich. A letter to the Regent's Canal Co. brought forth a reply in which the writer gave his enthusiastic blessing to the scheme, but said that the matter had been referred to another canal company which, owing to its greater length of waterway, ought to be more interested. Another difficulty arose at this stage owing to one of the canal companies suggesting that it might be necessary to tranship the coal at Brentford, as it was rather dangerous for the canal barges to venture so far down the river as Blackwall. Meanwhile, communication having been established with the canal carrying concern, it was learnt that the canal carrier had died, and his executors, after carefully examining the position, had come to the conclusion that no further work could be undertaken owing to the extra demand made for boats by the usual traders. The South Metropolitan board communicated further with the canal companies, but so far the only help it has derived from them is a suggestion that it should form a syndicate to buy or build barges!

The Chemical Society and Alien Enemy Members.—As the result of vigorous action on the part of the members, the Council of the Chemical Society called a special general meeting to consider the question of removing the names of nine alien enemies from the list of members; the meeting took place on Thursday last week, when an amendment retaining the names on the list was carried by 93 to 91 votes. The society is constituted by Royal Charter and provided by the nation with free quarters at Burlington House. After a long and heated discussion, the meeting was adjourned, and on its resumption the amendment will be submitted as a substantive motion.

We hardly need remind our readers that it is to the fiendish ingenuity of German chemists that such loathsome devices as poisonous gas, lachrymatory shells, and "liquid fire" are due, and of all classes of German scientists, these have achieved the most brilliant success in debasing their manhood and befouling the fair fame of science in the eyes of the human race.

The Electrochemical Equivalent of Silver.—According to No. 271 of the Scientific Papers of the Bureau of Standards, U.S.A., which deals with the question of inclusions of foreign materials in silver voltameter deposits, the value adopted for the electrochemical equivalent of silver by the London Electrical Congress of 1908 (1·11800 mg. per coulomb) is the closest figure that can be assigned to this constant, and appears to be correct to within a few parts in one hundred thousand; the atomic weight of silver is not known to this degree of accuracy. Taking the present international value of the atomic weight, 107·88, the value of the Faraday is 96,494 coulombs, but for general purposes the round figure 96,500 is recommended.

Longitude by Wireless.—The determination of the difference in longitude between Paris and Washington with the aid of wireless telegraphy, which has been in progress since October, 1913, has been completed. The distance between the stations is 6,175 km. The result, expressed in terms of time, is 5 hours 17 minutes 35·67 seconds, and has a probable accuracy of the order of 0·01 second.

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Association of Electrical Station Engineers.—The most active branch of the A.E.S.E. at present is Manchester, which has become concerned with the introduction of female labour into various stations in the district. The following resolutions were passed at a recent meeting.

1. *Attitude of Association.*—That this branch views with extreme disapproval the introduction of female labour into electrical stations unless convinced by the authorities that the same is a military necessity.

2. *Wages.*—That the wages paid for female labour be the same as that to the men displaced.

3. *Guarantees.*—That guarantees be obtained that the positions shall be restored to the men displaced, at the termination of the war.

With respect to No. 3, the chairman of the meeting emphasised the fact that guarantees could only be enforced and maintained by a strong united body of station engineers.

During the last few weeks, the number of members of the A.E.S.E. who are undertaking military and naval service has considerably increased, and very few of these are able to continue their subscriptions to the Association. Some anxiety was occasioned to the Executive. Extra efforts were therefore made to obtain new members, and the result has been extremely satisfactory.

American Electric Cooking Campaign.—A special meeting of representatives of electric stove manufacturers was held at the offices of the Society for Electrical Development, New York, to consider the question of a national electric range campaign; the meeting was preliminary to the appointment of a national electric range committee representative of all electrical interests, and it is considered that the Society for Electrical Development should organise the campaign, collecting and publishing data, advertising, &c. A special committee is to meet at the N.E.L.A. Convention in Chicago to elaborate plans.

Scientific Research in Australia.—At a meeting of the Circle of Scientific, Technical, and Trade Journalists, held at the Institute of Journalists on Tuesday, Mr. Gerald Lightfoot, a member of the staff of Mr. Hughes, Prime Minister of Australia, explained the scheme for the promotion of scientific and technical research which is being developed by the Commonwealth Government. In December last Mr. Hughes stated that the Government was prepared to spend half a million sterling, if necessary, for this purpose, and in January a committee was appointed to draw up a scheme. The proposals of the committee provide for the formation of a Scientific and Industrial Advisory Council of nine members, and an Executive Committee of three, the chairman to be a man of wide experience and proved ability, with a full appreciation of the value of the application of science to industry, and the other two to be men of high scientific standing. These three would confer with the Advisory Council, which would consist of representatives of industry and science, but they would not be obliged to adopt the advice of the Council; they would be free from political control, and would occupy positions similar to those of judges, having salaries of £2,000 to £2,500 a year, and being removable only by a resolution of Parliament.

The Executive Committee would go about the country and ascertain the problems immediately calling for solution; it would then allocate the work of investigation to the existing scientific institutions, laboratories, &c. The Federal Government would furnish liberal grants to defray the cost of equipment and maintenance in carrying out the researches, and it was hoped that by this means it would be possible quite soon to organise and stimulate the development of research in the Universities.

A second object was to establish a Bureau of Information, which should collect information on industrial and scientific subjects and distribute it to manufacturers.

Thirdly, there were certain important fundamental investigations which should be carried out in Australia, and which necessitated the foundation of national physical and chemical laboratories, which would be centralised, and engineering laboratories for which, it was thought, the existing laboratories of colleges, &c., could be utilised. Also an Agricultural Bureau would be established, on the lines of that of the United States, which had proved highly successful.

The whole scheme would be based on co-operation between the Federal and State Governments and Universities, and with the employers' and employés' associations. A stimulus would also be given to the teaching of science in the elementary schools. The scheme had not yet been definitely adopted by the Government, as Mr. Hughes was awaiting information as to what was being done in England and the United States; but an assessment was being made by the Provisional Committee in Australia, and steps were being taken through the colleges and universities to ascertain the problems that were pressing for solution.

An associated proposal was that the formation of a central authority in England was essential to the proper co-ordination of effort, to prevent duplication; it was suggested that an Imperial Bureau of Information should be established to act as a sort of clearing house on an imperial basis. It was considered that co-operation throughout the Empire was indispensable to success.

Charge Dismissed.—At the Salford Police Court, on May 12th (according to the *Manchester Evening News*), Joseph Atkinson, secretary of the London (South-Western) Branch of the Electrical Trades Union, of Salford, was summoned on a charge of wilfully withholding £20, the moneys of the Union. Defendant did not appear, nor was he legally represented, but Mr. J. Brown, general secretary of the Union, said that defendant had admitted the deficiency. The Stipendiary said he could not hold that the money had been wilfully withheld, and he accordingly dismissed the summons.

Engineering Industry in the Economic War.—Mr. T. C. Elder, of the British Electrical and Allied Manufacturers' Association, spoke at a meeting in Glasgow, under the auspices of the Institution of Engineers and Shipbuilders in Scotland, the West of Scotland Iron and Steel Institute, and the Glasgow Chamber of Commerce, on Tuesday, May 16th, Lord Provost Dunlop presiding. Mr. Elder traversed much the same ground as he had covered at similar meetings held in other parts of the country. He summed up what he described as a somewhat straggling address in the form of the following propositions:—

1. That it is necessary for the world's peace that Germany shall be restrained, as far as possible, from retaining her past and present proportion of military power.

2. That to accomplish this it is necessary to cripple her engineering industry, and force her populace into peaceful pursuits.

3. That this end can be attained by an international convention of the Allies and the British Empire.

4. But that it will also need a reconstruction of British trade policy, with special regard to the engineering and allied industries.

5. And such a reform will need to be accompanied by a practical conception of the common interests of all engaged in British engineering trade, and by the exertion of collective power on the part of manufacturers for the development of business abroad.

The author's remarks evoked an interesting discussion, in the course of which Sir Archibald Denny, Bart., Dumbarton, said he had to confess that the attitude of those who said they would never again trade with Germany was not a correct one. But if they did trade with Germany again they should do it with their eyes open and armed to resist insidious trading. He was a born Free Trader, and while there was something wrong with their Fiscal trade relations, he had not quite made up his mind that total exclusion was the best way of dealing with organised dumping. Every trade should organise itself now. His great hope was in the organisation of the employers. The men were fully organised and loyal in one direction, and if they joined up with the employers he had not the slightest feeling of despair. Mr. Murray, chairman of directors, Glasgow Chamber of Commerce, pointed out that at the outbreak of the war there were certain industries essential to this country which were practically controlled by Germany, and commercial men were blamed for want of foresight in allowing the deliberate undermining of our trade, which had been going on for many years. They must all admit the partial justice of that condemnation, but he asked if our commercial men were solely to blame. Personally, he did not think so. It had been the ingenious policy of the German Government to staff their Ministry of Commerce with business men who knew a great deal in the way of getting over difficulties which were inevitable in the opening up of foreign trade. The unanimous opinion of business men was that the Board of Trade was overburdened, and was unable, as at present constituted, to deal promptly with any problems which might arise. They were determined, as business men, to make it clear to the Government that the demands of the business community must have attention. Sir John Cowan (Edinburgh) expressed himself in entire sympathy with the appointment of a Ministry of Commerce, provided they got the right men to manage it. If they did not get the right men they would be no better off than they were now. They, as engineers and business men, had the matter in their own hands. Engineers in this country must wake up and do a great deal better than they had done in the past. He emphasised the necessity for complete organisation. It did not matter what their organisation was. It might be perfect, but unless the management and equipment of their works was right the organisation could not pay. Mr. W. S. Workman (Glasgow) agreed with Sir Archibald Denny. What they had seen and heard within the past six months made one think that they would have to change their minds and introduce some new machinery in the shape of tariff reform. They realised that Parliament could do a great deal for them if the Government would only go in the direction business men wished. Another speaker drew attention to what was being done in the United States in preparation for the coming economic war. A naval consulting authority had secured the co-operation of the five national engineering societies, whom they had asked to appoint a representative from each State, who was charged with the preparation of an inventory. That was their first step towards industrial preparedness. Such a system might with advantage be copied in this country.

On the call of Mr. W. W. Lackie, the speaker was thanked.

Prospects in South Africa.—A correspondent inquires whether any of our readers can give information as to the present prospects in South Africa for a man, as described below:—

Sound knowledge of electrical engineering, both theoretical and practical. Undoubted business ability, though the latter has not been developed by actual experience. Born in Holland, of Dutch parents, but father of English descent; name English; married into English family. Speaking, reading, and writing, almost like a native, English, Dutch and German; French also very well. A very important question is: Would those who know advise a man to go out to South Africa with his family "on spec"?

[Perhaps some of our readers will kindly assist our correspondent, who, it will be seen, is of Dutch nationality.]

America's Electrical Week.—This is the title selected for a great electrical celebration, after the style of the "Electrical Prosperity Week," which is planned for December 2nd to 9th, 1916; a start has already been made with the preparations, under the guidance of the Society for Electrical Development.

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Appointments Vacant.—Meter and mains assistant for Rotherham Corporation electricity works; mains engineer (£156), for the Borough of Eastbourne Electricity Department.

Educational.—Manchester Municipal School of Technology.—We have received the prospectus of summer evening classes, which were to begin this week; they include mechanical, electrical, and municipal engineering, chemical technology, &c. Prof. Miles Walker is at the head of the electrical engineering department.

Sheffield University.—One of the bequests contained in the will of the late Sir Edgar Allen was a legacy of £32,000 to the University of Sheffield, of which £5,000 is to be allotted to the Applied Science department, the remainder being devoted to providing scholarships. Sir Joseph Jonas, chairman of the Applied Science Committee, has added another £5,000 to the legacy, and the total sum of £10,000 is to be used in erecting a laboratory for testing engineering materials.

Imperial College of Science.—Yesterday a party of Members of Parliament was conducted over the College by the Rector, Sir Alfred Keogh, and the Commercial Committee of the House of Commons, in order that the members might be shown the original research work which has been done at the College in connection with industry.

Fatalities.—An inquest was held at Fence Houses (County Durham) on Monday, touching the death of Henry Allison (25), who was killed electrically on the previous Friday while following his employment as a cleaner-out in the Lady Ann coal mine at Lambton. Deceased was found dead, his body being in contact with the frame of an electric coal-cutting machine. The jury found that death was due to an electric shock accidentally received through contact with the framework of a coal-cutting machine, which was "alive" due to a fault in the cable.

John James Jevons (16), of Droylsden, was killed through falling into a coal hopper at the Manchester Corporation electricity works. At the inquest on Monday it was stated that it was not a boy's duty to go into the hopper, and that it was customary for anyone going into the hopper to have a rope tied round his body. The youth had been told not to go into the hole, but he simply laughed and went down.

Volunteer Notes.—1st London Engineer Volunteers.—Orders for the week by Lieut.-Col. C. B. Clay, V.D., Commanding.

Monday, May 22nd.—Technical for Sections 1 and 2, No. 3 Company, 46, Regency Street, S.W.; Squad and Platoon Drill, Sections 3 and 4, No. 3 Company; Signalling Class and Recruits.

Tuesday, May 23rd.—School of Arms, 6 to 7; lecture, Mr. J. Roberts, "The Geology of Otford," 7.15; Recruits, 7.15 to 8.15, Archbishop's Park.

Wednesday, May 24th.—Platoon Drill, No. 2 Platoon, No. 1 Company.

Thursday, May 25th.—Platoon Drill, No. 6 Platoon, No. 2 Company; Shooting for Sections 3 and 4, No. 3 Company, Miniature Range; Recruits, 5.45 to 7.45; Instructional Class, 5.45.

Friday, May 26th.—Technical for Sections 3 and 4, No. 3 Company, 46, Regency Street, S.W.; Squad and Platoon Drill, Sections 1 and 2, No. 3 Company.

Saturday, May 27th.—Route March: Parade, Golder's Green Station, 2.30; Uniform.

Sunday, May 28th.—Entrenching at Otford: Parade, Victoria Station (S.E. & C. Railway Booking Office), at 8.35 a.m.

Musketry.—For Nos. 1 and 2 Companies, see Notice and Tables A and B, at Headquarters.

Notice.—Unless otherwise indicated, all drills, &c., will take place at Chester House.

Macleod Yearsley, *Adjutant.*

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, May 18th, 1916:—

Week-End Parades.—Saturday.—The Battalion will Parade at Baker Street Station, at 2.30 p.m., and proceed by train to Wembley Park for Drill under Company Officers.

Sunday.—The Battalion will Parade at Liverpool Street Station (Low Level entrance, G.E.R.), at 9.30 a.m., and proceed by train for Entrenching duties.

Derby Recruits.—Members called up under Lord Derby's scheme are requested to send in their names to the Adjutant before 9 a.m. on Saturday next, the 20th inst., with a view to application being made for them to serve together in the same Battalion.

Musketry.—The range at Bisley will be open to members. Morning train, 9.20 a.m., Platform 6, Waterloo Station. Afternoon train, 12.45 p.m., same platform.

A. G. Joiner, *Major and Adjutant*, O.B.C.

Institution and Lecture Notes.—Illuminating Engineering Society.—The report of the Council for the past year states that the membership has been maintained. The Presidents of the Institutions of Gas and Electrical Engineers, Mr. John Young and Mr. C. P. Sparks, have consented to act on the Council. The Interim Report of the Committee on Research was presented at the annual meeting last week, and contained a long list of subjects on which research was desirable.

Association of Mining Electrical Engineers.—At the last meeting of the Yorkshire branch, Mr. J. W. Harbottle read a paper on "The Winkey Detector" for earth faults.

Daylight Saving.—On Wednesday the Summer Time Bill received the Royal Assent, and the Act will come into force next Sunday morning, when the clocks on all railways and in Government buildings, and public clocks generally, will be put forward one hour. The "summer time" will remain in force up to and including September 30th.

Enemy Firms.—In reply to a Parliamentary question, the President of the Board of Trade says that he is aware that lists of enemy companies have been published in Australian journals. The names of companies and firms in this country ordered to be wound up are given in the *London Gazette*, and he does not think it advisable to publish the names of other companies and firms in which there are enemy interests, on account of the injustice which would result in certain cases to the British shareholders, and the undesirability of damaging a business when the enemy interest may be transferred to British subjects.

Engineers and the War.—At the annual meeting of the Institution of Engineers and Shipbuilders of Hong-Kong on March 31st, Prof. C. A. Middleton-Smith, the president, delivered an address, in which he referred to the part that engineering and engineers were playing in the war, to the achievements of British engineers in all parts of the world in the past, and to their intentions for the future. In alluding to the future course of trade in China, he emphasised the advantage that would ensue from Chinese and British co-operation in utilising and developing the great mineral and other resources of China. The speaker also referred to the great commercial struggle that would commence when the war was over. Engineers must inevitably take a great part in that struggle, and they must carry out the British tradition and play the square game. The meeting accorded a hearty vote of thanks to Prof. Middleton-Smith upon his retirement from the presidency.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Mr. G. H. Browne, acting engineer and manager, Ilkeston tramways and electricity department, has been appointed engineer and manager to the Mexborough & Swinton Tramways Co.

Mr. E. Fisher, junior assistant and temporary mains superintendent in the Nelson electricity and tramways department, has resigned on receiving an appointment at Heywood.

The Ashton T.C. last week adopted a recommendation of the Tramways Committee that the salary of Mr. Ernest Holt, manager of the tramways department, be increased from £200 to £260 per annum.

Dover T.C. has appointed Mr. A. H. Jones as a charge engineer at the electricity works. The mains superintendent, the senior charge engineer, and the works superintendent at the electricity works have been granted 10 per cent. increases of salary on account of the high cost of living.

Roll of Honour.—Private G. B. Wivell, of the Royal Fusiliers, who has fallen in action, was at the time of his enlistment on the staff of the British Westinghouse Electric and Manufacturing Co., Ltd., at Manchester. Just before the outbreak of war he was engaged for the firm at Johannesburg.

Private A. E. Taylor, of the 2nd Leicestershire Regiment, who is reported killed in action, after being missing since May 15th, 1915, was, prior to joining the regiment, on the electrical staff of the Holwell Ironworks, Asfordby, Melton Mowbray. He was 26 years of age.

Rifleman H. A. Clarke, of the Machine Gun Section of the Rifle Brigade, who was, at the outbreak of war, on the Rugby staff of the British Thomson-Houston Co., Ltd., has lost his life at the Front in a mine explosion.

Sergeant J. Hindle, of the Lancashire Fusiliers, formerly a member of the staff of the British Westinghouse Co., Trafford Park, has been killed. Deceased was 34 years of age, and he has left a widow and five children.

Lieutenant Edward Wilson, South African Infantry, whose death is reported, went out to South Africa after taking his degree at Cambridge, and, through an introduction to Rhodes (says the *Times*) was placed in charge of the transport of the Transcontinental Telegraph Co., on the section from Chindi, on the Zambesi, to the north end of Lake Nyassa.

The *Times* states that Captain R. J. Smith, Lancashire Fusiliers, who fell on May 5th, was an Associate of the Royal College of Science, Ireland. When the war began he was in the service of the British Westinghouse Co., Manchester, before which he had been a teacher in Newry Technical Institute.

General.—The Post Office Provincial Superintendents and the Headquarters Staff of Traffic Managers have now been amalgamated into one establishment, under the control of Mr. R. A. Dalzell, with the title of Chief Inspector of Telegraph and Telephone Traffic. His two principal assistants will be Mr. L. Harvey Lowe, late Deputy Controller of the London Telephone Services, and Mr. J. Lee, with the title of Deputy

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Chief Inspector of Telegraph and Telephone Traffic. Mr. W. A. VALENTINE, late Provincial Superintendent, has been appointed Deputy Controller of the London Telephone Service.

Mr. J. W. TURNER, Post Office engineer of Darlington, has retired after 45 years in various positions in the Post Office Telegraph Service. His late colleagues presented him with a draught screen and other gifts Mr. Turner, in replying, recalled the occasion when he attended the first telephone experiment by Sir W. Preece at the Guildhall, Plymouth.

Obituary.—MR. EDWIN THORNTON.—At the funeral, at Barrow-in-Furness on Saturday last, of the late Mr. Edwin Thornton, A.M.I.E.E., whose untimely death occurred as the result of a motor-car accident on the road near Carnforth on April 29th, those present included Ald. J. P. Smith, Chairman of Barrow Electricity Committee; Mr. Wm. Drysdale, A.M.I.E.E., representing the Barrow Chamber of Trade; representatives of the Barrow Technical Schools and Barrow Master Builders' Association, &c. The deceased, who was 50 years of age, and eldest son of the late Mr. W. R. Thornton, was managing partner of the firm of Messrs. W. R. Thornton and Son, electrical engineers. The deceased's only son is in the Army in Egypt.

MR. RICHARD S. BLACKBURN.—Mr. Richard S. Blackburn, electrical engineer and contractor, of Hebden Bridge (Yorks.), died suddenly on May 8th after undergoing an operation. He was 54 years of age.

MR. EDGAR W. SALIS.—According to the *Times* "Deaths" column, Mr. Edgar W. Salis, representative at Rio, Brazil, of the Marconi Co., third son of the late Major-General Salis Schwabe, C.B., died in London last week aged 41.

LADY CROOKES.—Lady Crookes, wife of Sir William Crookes, O.M., passed away last week at the advanced age of 80 years. We tender our sincere sympathy to Sir William in his loss.

MRS. WORDINGHAM.—The many electrical friends of Mr. C. H. Wordingham will regret to learn of the death, on the 11th inst., of his mother, the widow of the late W. H. Wordingham. The loss of a parent is one of those misfortunes which no one may hope to escape, but in some cases the blow is heavier than in others; and without intruding too far into so delicate and personal a subject, we may venture to say that it is an open secret amongst his intimate friends that to his mother Mr. Wordingham ascribes all that he has achieved—to her he looked for sympathy, inspiration, and encouragement, and he looked upon her as a true comrade. We sincerely condole with him in his bereavement.

MR. W. DEAN.—The death is notified of Mr. W. Dean, assistant electrical engineer with the Merthyr Electric Traction Co., Ltd. He was 28 years of age, and in the new year had a serious attack of pneumonia.

PRIVATE G. L. F. EDWARDS.—Private G. L. F. Edwards, of the King's Shropshire Light Infantry, who has lost his life through the accidental discharge of a revolver, was, prior to the war, engaged as an electrician with Messrs. Lea & Son, electrical engineers, of Shrewsbury. He was the son of Capt. Geo. Edwards, of the same regiment, and had been at the Front since last July.

NEW COMPANIES REGISTERED.

British Graphite & Trading Co., Ltd. (9,597).—This company was registered, in Edinburgh, on May 13th, with a capital of £12,000 in 8,000 participating pref. shares of £1 each and 80,000 ord. shares of 1s. each, to carry on the business indicated by the title. The subscribers (with one pref. share each) are: J. Logan, 95, Bath Street, Glasgow; J. J. Fisken, 20, West Campbell Street, Glasgow. Private company. The number of directors is not to be less than two or more than seven; the first are J. Logan and J. J. Fisken. Qualification, 200 shares of either class. Remuneration, £100 per annum. Solicitor: D. Gardner, Glasgow. Secretary: A. Grimmont. Registered office: 53, Bothwell Street, Glasgow.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Wakelins, Ltd.—A memorandum of satisfaction to the extent of £130 on April 15th, 1916, of debentures dated May 7th, 1914, securing £730, has been filed.

Brilliant Arc Lamp & Engineering Co., Ltd.—Memorandum of deposit on April 25th, 1916, charged on certain contracts, to secure all moneys due or to become due from company to London & South-Western Bank, Ltd., 170, Fenchurch Street, E.C.

Llandrindod Wells Electric Light & Power Co., Ltd.—Particulars of £2,200 debentures, created December 11th, 1915, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd.—Particulars of £400,000 debentures, created March 16th, and secured by trust deed dated March 28th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital and land, buildings, and premises in West Ham and Liverpool. Trustees: J. S. Cockburn, J. Ferguson, Sir Henry C. Mance, Kt., C.I.E., and Hon. S. E. Marsham.

Willans & Robinson, Ltd.—Debenture dated April 28th, 1916, to secure £20,000 (ranking *pari passu* with a debenture £40,000 issued in December, 1911), charged on the company's undertaking and property, present and future, including uncalled capital, subject to prior charge. Holders: G. H. D. Coates, Rugby, and W. C. Buckley, 71, Lombard Street, E.C.

Ernst Hildebrandt, Ltd. (112,286).—Capital, £5,000 in £1 shares. Return dated March 16th, 1916. All shares taken up; £1 per share called up on 4,002 shares; £4,002 paid; £998 considered as paid. Mortgages and charges: Nil.

W. T. Glover & Co., Ltd. (56,124).—Capital, £214,850 in £1 shares (100,000 pref.). Return dated April 24th, 1916. 100,000 pref. and 114,850 ord. shares taken up; £1 per share called up on 67,000 pref. and 50,000 ord. shares; £117,000 paid; £97,850 considered as paid on 33,000 pref. and 64,850 ord. Mortgages and charges: £192,800.

CITY NOTES

General Electric Co. (U.S.A.)

The following particulars appear in the income account of this company for 1915, as published in the *American Electrical Review and Western Electrician*:—

	1915.	1914.
Sales billed	$85,522,070	$90,467,692
Costs, including operating maintenance depreciation charges	76,898,183	81,496,728
Profit	8,623,887	8,970,963
Interest and sundry revenue	2,129,266	1,570,431
Income from securities	1,554,843	1,313,989
Total income	12,307,996	11,855,383
Debenture interest	570,086	567,556
Net profit	11,737,910	11,287,827
Dividends	8,129,919	8,142,867
Surplus	3,607,992	3,145,060
Previous surplus	20,084,879	16,939,819
Profit and loss surplus	23,692,871	20,084,879

The net profit was equal to 11.56 per cent. earned on $101,510,600 capital stock, against 11.12 per cent. earned on $101,485,700 stock in 1914.

In his remarks to stockholders, Chairman C. H. Coffin said that the value of orders received by the company for electrical apparatus and devices in the past year was $98,385,891, an increase of $14,637,370, or 17 per cent. over those of 1914. This increase was largely due to the general revival of business in the latter part of the year. "These figures are exclusive of orders for special war munitions, which amounted to $33,980,000 during 1915. These have been so restricted as to interfere as little as possible with the regular product of the company. The percentage of profit from these orders will probably be less than that of the average of the company's output. The amount of sales billed was $85,522,000, a decrease of $4,945,621, or 6 per cent." The number of employés engaged in the factories and offices, and in those of subsidiary companies at the end of 1915 was about 60,000. The company has followed its customary practice in writing off against income account its total expenditures in 1915 for patents, applications for and licences under patents, and other outlays relating thereto, amounting to $838,455. The patent account is carried at $1, as in previous years. Stocks, bonds, and other securities are carried at a valuation of $32,916,593, of which $19,687,965 represents securities of subsidiary companies, and $13,228,628 those of public utility and other companies. Current accounts and notes receivable are carried at $19,619,215. Sales of several small factories substantially offset the manufacturing floor space added in 1915; and plant expenditures amounting to $4,485,068 were chiefly for improvements in existing construction and equipment, and the purchase of special tools and machinery which are subject to a high rate of depreciation. Because of the nature of these expenditures, and on account of the liquidation of the book value of the factories sold, the reduction in the plant account for the year was $5,985,068.

German Electrical Companies.

The Concordia Elektrizitats Ges., of Dusseldorf, which is now associated with the Berlin-Hagen Accumulator Co., records net profits of £8,600 for 1915, as compared with £12,000 in 1914. It is intended to pay a dividend of 7½ per cent., as against 10 per cent. in the previous year.

The Berliner Elektrische Bahnen, whose share capital of £300,000 is held almost entirely by the City of Berlin, propose to pay a dividend of 1 per cent. for 1915, as in the previous year. The directors state that they hope soon to be in possession of new motor tramcars in order to enter into competition with the Grand Berlin Tramways.

The report of *Korting & Mathiesen, of Leutsch, near Liepsig* (arc lamps and electricity meter works) states that Army contracts were only carried out to a limited extent in 1915, but activity in all departments was satisfactory, and the turnover was greater than that in the preceding year. After providing for depreciation, the net profits are returned at £10,500, as compared with £9,200 in 1914, and the dividend at 5 per cent. is the same rate as in the previous twelve months.

The Elektrizitats Lieferungs Ges., of Berlin, after reporting that the development of the supply industry in 1915 was hampered by the unfavourable situation of the times, states that the production of the works owned by the company, and of others in which it is also interested, increased by 3,240,000 KW.-hrs. to 55,672,000 KW.-hrs. As net profits, the accounts indicate the sum of £169,000, as contrasted with £179,000 in the previous year, and the dividend in contemplation is 10 per cent., as in 1914.

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The accounts of the *Bergmann Elektrizitats Werke A.G., of Berlin*, show gross profits amounting to £1,061,000 for 1915, as compared with £555,000 in the previous year. After deducting general expenses and interest charges, and setting aside £313,000 for depreciation, as against £158,000 in 1914, the net profits are returned at £573,000, as contrasted with £198,000. It is proposed to pay a dividend of 10 per cent., as compared with 5 per cent. in 1914, to place £50,000 to a goods reserve account, £200,000 to the war and war tax reserve account, and £2,500 to the benevolent funds, and to carry £19,000 forward to 1916.

French Electrical Companies.

The Compagnie d'Electricité de Limoges earned gross profits amounting to £31,000 in 1915, and net profits of £20,000. It has been decided to pay a dividend of 6 per cent. on the ordinary shares and set aside certain sums for the renewal of batteries, redemption of loans, &c.

The Société Francaise des Electrodes has declared a dividend at the rate of 16s. per share out of net profits amounting to £12,700 in 1915. It was mentioned at the recent general meeting that, notwithstanding the scarcity of labour, more satisfactory results could be expected for the current year.

The Union Electrique, whose revenue experienced a large decline in 1914-15 as compared with the preceding year, reports gross profits of £22,000, as against £36,000 in 1913-14. After defraying general expenses and financial charges, the net profits of £192 have been carried forward, this result contrasting with a dividend of 2 per cent. which was paid for 1913-14.

The Compagnie l'Energie Electrique du Sud-Ouest reports a large increase in the receipts in 1915, and net profits and balance forward amounting to £52,000. A dividend at the rate of 5 per cent., or £1 per share, has been declared. During the year extensions of the works were undertaken in order to cope with the growing demand, and an investigation is being made with a view to the utilisation of two new falls on the Dordogne, between Tuilere and the Mauzac barrage.

The Compagnie Francaise Thomson-Houston reports a gross revenue of £301,000 for 1915, as compared with £302,000 in the previous year, of which £209,000 and £204,000 were derived from manufacturing and sales in the two years respectively, and the balance from investments. After meeting general expenses, financial charges, and placing £72,000 to the depreciation fund, the net profits and balance forward are returned at £127,000, or practically the same as in 1914. It is intended to distribute £1 per share on the ordinary capital, being the same rate as in 1914.

Calcutta Electric Supply Corporation, Ltd.

At the annual meeting held on May 11th, the Chairman (Mr. P. V. Luke, C.I.E.) said that the capital expenditure during 1915 was £122,344, compared with £61,443 in 1914, the increase being chiefly on account of a new 6,000-kw. turbo set installed at Cossipore; the mains laid in connection with the supply of current to the docks of the Calcutta Port Commissioners; switchgear for the new sub-stations; and the ordinary expansion of the business. The total generation costs increased by £4,906, mainly owing to the larger quantity of coal used, 5½ million additional units having been generated. Revenue expenditure was practically the same. Revenue from sale of current showed a satisfactory increase of £24,404. Meter rents were reduced by one-half last July. The war tax of 50 per cent. on excess profits affected, or would affect, them seriously, although their excess profits were accounted for entirely by the growing expansion of the business, and were in no way due to the war. On the contrary, the business was adversely affected by the greatly increased cost of materials and transport. If their additional profits were in any way due to the war no exception could be taken, but on a business in a state of development it fell with a severity which hardly appeared equitable. There was no desire on their part to make a grievance of having to assist in the prosecution of the war. They had carried forward a much larger sum than usual in order to provide for the tax, which had now been increased to 60 per cent. Another matter of importance was the increase in the ordinary income-tax, which in India had been more than doubled, being raised from 5 pies in the rupee to 12 pies, or one anna; while the English income-tax would be for the current year 4s. 6d. in the £, and they had to pay both the Indian and the English tax. Moreover, an *ad valorem* import duty, on goods imported into India, had been imposed, which would affect them in the current year to the extent of 7½ per cent. on cables and 2½ per cent. on machinery. At the last two annual meetings he had alluded to their intentions to make certain reductions in the charges to their consumers in Calcutta. Consistent with their duty to their shareholders, they had ever before them the desire to make the supply of electrical energy as cheap as possible, and it was their intention to persevere in that direction. Their average dividend on the total subscribed capital had been 7 per cent., and considering the class of business it could not be argued that they had made undue exactions from the public. In setting aside large sums for reserve and depreciation they had been guided by figures well recognised in similar undertakings in this country, and these were by no means excessive, in fact, probably the opposite. As much as 77 per cent. of their reserve had been derived from premiums on shares issued and interest on investments. In regard to superseded plant, they had spent, roughly, £500,000 in bringing the undertaking up to date. This had necessitated laying aside a large amount of machinery which, though not worn out, was none the less uneconomical for their purposes. Had that plant served its full life the original cost would have been written off against depreciation, but not having served its full life the book value was still quite a large figure, larger than what they would sell it for. They had disposed of a considerable quantity of it, and the difference must be made good out of revenue. They had decided to spread the liquidation of that debt over several years, during which period additional sums, over and above what was required to cover current depreciation, must be set aside before the Corporation could be as generous as it might otherwise be to either its consumers or its shareholders. Therefore the reductions in charges to the public in Calcutta had been as liberal as the position of the Corporation justified. The chairman proceeded to show in detail that the aggregate result of several reductions in 1914 and 1915 in charges amounted to £22,000 per annum. He replied effectively to letters which appeared in the Calcutta Press on the matter of the charges to the public. Considering the unsettled state of the war and its consequences, they had acted toward consumers as liberally as circumstances permitted. Though the war had not affected them in Calcutta so detrimentally as it had done similar undertakings in England, it had not been without its sinister influence. The speaker proceeded to show how prominent members of the staff and others were assisting in the war, the difficulty in obtaining the services of suitable men from England, and the difficulty, almost impossibility, of getting any new plant from English factories. They were fortunate in getting delivery, though belated, of a 6,000-kw. turbo set ordered in December, 1914, from the British Thomson-Houston Co., Ltd., and in having it safely erected in Calcutta. In order to ensure the certainty of a supply of direct current for the auxiliary plant and the station lighting in case of any accident in future which might cause a complete breakdown on the H.T. side, a secondary battery had, as a special safeguard, been erected at Cossipore, which had cost, including the switchgear, £3,800. All the pumps, both for air and water circulation, are driven by D.C. motors, and will be kept running by this battery. This will enable the station to be started up again much more quickly, and in the case of a comparatively insignificant failure of the D.C. supply at Cossipore, the battery would probably prevent a total shut-down. The construction of four new sub-stations, badly needed to meet the expansion of business, was put in hand during the year, and one was started up in December. A ten years' contract had been made with the Port Commissioners for a supply of current to the docks. The great distance of the docks from the Cossipore station had involved a large expenditure of capital in mains, which had to be duplicated by different routes so as to ensure a safe supply. Several inquiries received for large extensions pointed to a considerable access of business after the war. There was a further improvement in regard to units unaccounted for. The bonus scheme distribution to the staff in India was £1,629, as against £1,406 in 1914.

Chesham Electric Light and Power Co., Ltd.

The profit for 1915 after paying all charges, including interest on debentures and temporary loans, but exclusive of depreciation, was £1,563. After deducting £500 for depreciation and £152 for proportion of costs connected with the debenture issue, and adding £1,958 brought forward, there is an available balance of £2,870. A dividend of 4 per cent. absorbs £[illegible], and £2,270 is to be carried forward. The gross earnings, exclusive of profits on wiring, have shown a steady increase for the past five years; for 1915 they were £6,315, against £5,085 in 1914. Extensions at Berkhampstead and Amersham had been further proceeded with. The capital expenditure during 1915 was £4,767. The heavier load had necessitated plant, &c., additions at Chesham, which had been fully warranted by the reduction in the cost of the electricity supplied. The bankers' loan had been increased to £4,000, leaving £1,000 still at the company's disposal. It is proposed to write off the remainder of the cost of the debenture issue by six annual instalments of £151. Units generated, 712,641; units sold, 618,067.

Callender's Cable and Construction Co., Ltd.

For the year 1915 there is a balance at the credit of profit and loss of £113,267, plus £163,169 brought forward, making £276,436. From this are deducted: interest on debenture stock, £13,500; preference dividend £10,000; depreciation of buildings, plant and machinery, £10,335; depreciation of office furniture, £254. It is proposed to pay a dividend on the ordinary shares at the rate of 10 per cent. per annum, less income-tax, being 10s. per share; a bonus of 5s. per share and a special bonus of 5s. per share, both less income-tax; and £207,347 is to be carried forward. The year's operations have been carried on under exceptional difficulties as to men, materials, and transport, and the directors are pleased to submit a report which shows such satisfactory results. The company has been a controlled establishment since August last. No firm in the electrical industry has rendered more effective service to the nation. The ordinary home trade has consequently been much interfered with, but it has been possible to carry out some municipal and other contracts in connection with munition work, and also to satisfy to some extent

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the demands of the old and valued customers of the firm. The shortage of shipping has seriously interfered with the delivery of orders for overseas customers, but in spite of this, good work has been done in several of the Colonies, and in some of the neutral countries, which will, it is hoped, be of considerable service after the war. It has been necessary to rearrange many of the departments of the factory, so as to adjust them to the new conditions. There have been difficulties in doing this, but the arrangements have now been made in a satisfactory manner, and the works at Erith and at Leigh are fully and most usefully employed. Substantial additions to the plant and machinery at Erith and at Leigh have been necessary, and further additions are being made. The Anchor Cable Co., Ltd., whose operations are so closely interwoven with those of this company, has also been able to show satisfactory accounts of its year's working. The Leigh factory has been running for many months continuously day and night on work on behalf of this company. Both at Erith and at Leigh great difficulty has been experienced in regard to labour, owing to the drain on the available supply for the direct manufacture of munitions, and the large number of the workmen and staff who have joined the Colours. At the Anchor works women have to a large extent taken the place of men, and arrangements are now being made at Erith for the employment of female labour upon an effective basis. Annual meeting: May 25th.

Eastern Extension, Australasia, and China Telegraph Co., Ltd.

The report for 1915 states that the gross receipts amounted to £950,030, against £819,583 for the previous year. The working expenses, including £51,312 for maintenance of cables, absorb £386,672, against £364,978, leaving £563,358, plus £31,371 brought forward. £30,096 is required for interest on mortgage debenture stock and £85,817 for income-tax payable in England and excess profits duty. Three interim dividends of 1½ per cent. each have been paid, and £200,000 has been credited to the general reserve fund. The directors now recommend a final dividend of 2½ per cent., with a bonus of 2 per cent., making 8 per cent., free of tax, for the year, carrying forward £38,816. In addition to the £200,000 above referred to, the general reserve fund has been credited with £40,912 in connection with the closing and disposal of the Banjoewangie-Roebuck Bay cable owing to the establishment of improved means of communication with Australia making it unnecessary to continue the maintenance of this cable. On the other hand (says the *Financial Times*), the fund has been debited with £74,685 for partial cable renewals carried out during the year, £11,382 representing the loss incurred on the sale of investments and £25,000 as a further provision on account of investment fluctuations, bringing the total provision against depreciation up to £225,000. An agreement has been concluded with the Australian Commonwealth Government enabling the company to deal direct with the public in Melbourne, as at Sydney, Adelaide, and Perth, and an office has been opened by the company for the reception and delivery of telegrams in Melbourne.

Eastern Telegraph Co., Ltd.

During the year ended December, 1915, the revenue was £2,104,431, less £655,888 ordinary expenses, and £202,609 for expenditure relating to maintenance of cables and other expenses, leaving £1,245,934, plus £32,742 brought forward. After providing for income-tax payable in England and excess profits duty, interest on mortgage debenture stock, and preference dividends, the balance is £821,638, out of which £460,000 has been placed to the general reserve, £10,000 to insurance of war risk at stations fund, and £5,000 to insurance of goods in transit fund. A final dividend on the ordinary stock of 2½ per cent. and a bonus of 2 per cent. make a total of 8 per cent., free of income-tax, for 1915, and £26,638 is to be carried forward. The general reserve fund has been charged with £204,880 in respect of the new Aden-Colombo cable and other special expenditure, and with £125,000 as a further provision on account of investment fluctuations. At the annual meeting on May 24th shareholders will be asked to approve the payment of the directors' remuneration free of income-tax.

Kidderminster and District Electric Lighting & Traction Co., Ltd.—During 1915 the capital expenditure was £309. The net receipts of the lighting undertaking were £4,561, plus £3,471 dividends received in respect of investments, and £219 brought forward. After deducting administration and general expenses, interest on temporary loans and debenture stock, and providing £500 for renewals, there remains £3,708. Of this, there is to be put to reserve £750, to dividend on cumulative preference shares £1,500, and there is carried forward £1,458. The profit on the working of the tramways company, after providing for renewals, is £2,439, plus £163 brought forward. There has been put to reserve £500, a dividend at the rate of 3½ per cent. absorbs £2,002, and £100 is carried forward.

Stock Exchange Notice.—The Committee has ordered the undermentioned to be quoted in the Official List:—

South Metropolitan Electric Light & Power Co., Ltd.—Further issue of 45,926 six per cent. cumulative second preference shares of £1 each, fully paid, Nos. 350,001 to 395,926.

Craigpark Electric Cable Co., Ltd.—At the annual meeting, in Glasgow, the Chairman said that the year's working had been satisfactory taking everything into consideration. They had been somewhat handicapped by shortness of labour and difficulty in getting delivery of material. They could have done more business but for these circumstances. There had been a big rise in the price of copper, but at present they were fairly well off with regard to purchases. He moved the payment of a dividend of 6 per cent. on both preference and ordinary shares, and, Prof. MAGNUS MACLEAN seconding, the report was unanimously adopted.

West Coast of America Telegraph Co., Ltd.—The gross receipts during 1915 were £65,475, as against £61,129 in 1914. The working expenses were £46,215, as compared with £43,054. After deducting £477 for excess profits duty, the revenue account shows a balance of £18,782, plus £1,994 brought forward, making £20,777. £6,000 has been paid for interest on the 4 per cent. debentures, £800 provided for the interest on the 4 per cent. income bonds, £5,000 transferred to the general reserve fund, and £6,000 to the provision on account of investment fluctuations, leaving £2,977 to be carried forward.

South Metropolitan Electric Light & Power Co., Ltd.—There is being offered to the holders of the shares and debenture stock for subscription, £30,000 4½ per cent. first mortgage debenture stock at £85. The issue is necessary owing to the continuous expansion of the business; the stock will rank *pari passu* with the other 4½ per cent. debenture stock, and it is repayable at par on July 1st, 1931, or earlier on six months' notice at £110. Allowing for redemption, the return at the price of issue is about 6 per cent. per annum. The Treasury raises no objection to the issue.

Birmingham District Power & Traction Co., Ltd.—The total revenue for 1915 was £101,909. Surplus, after providing £9,000 for renewals, £58,738. The directors recommend placing to reserve £5,000, a dividend on the preferred ordinary shares at the rate of 4½ per cent., carrying forward £2,551.—*Financial Times.*

Babcock & Wilcox, Ltd.—Speaking at the annual meeting on May 9th, Mr. J. DEWRANCE said that considering the enormous changes that had taken place since the last meeting, the balance sheet must be a source of great satisfaction. In pre-war days they made boilers, cranes, and conveyors; these were now cast aside, and they were making anything for which their factory was suitable without any stint of labour.

Kalgoorlie Electric Power & Lighting Corporation, Ltd.—The report for 1915 states that the average profit of previous years has been maintained. A further £7,000 has been added to the debenture redemption fund, bringing that item up to £14,000, and, after writing off £6,500 for depreciation and paying debenture interest, the balance carried forward is £1,139.—*Financial Times.*

Submarine Cables Trust, Ltd.—The revenue for the year ended April 15th was £25,489, and the expenses were £1,509, leaving £23,979. After providing £15,843 to meet payment of the coupons, £8,109 has been transferred to the redemption fund, leaving £77 to be carried forward.

Anglo-Argentine Tramways Co., Ltd.—The gross receipts for 1915 were £2,709,616, a decrease of £141,380. The expenditure was reduced by £94,256. No dividend on the ordinary shares is recommended. The credit balance of £91,120 is to be carried forward.

United River Plate Telephone Co., Ltd.—The directors recommend a final dividend of 5 per cent. on the ordinary shares, making 8 per cent. for the year 1915, free of income tax, carrying forward £6,234.

Victoria Falls & Transvaal Power Co.—The financial Press states that the net earnings (including those of the Rand Mines Power Supply Co.) for the quarter ended March 31st amounted to £192,874.

British Electric Traction Co., Ltd.—The directors, according to a financial daily, recommend a dividend of 3 per cent. on the new ordinary stock for the year ended March 31st.

Capital Reduced.—*British Uralite Co.* (1908), *Ltd.*—The Chancery Court last week sanctioned the reduction of capital already referred to here.

Melbourne Electric Supply Co., Ltd.—Interim dividend, 5 per cent., free of tax, on the ordinary stock.

STOCKS AND SHARES.

TUESDAY EVENING.

One of the principal features in the Stock Exchange market this week is the influence exerted over securities, particularly those of the best class, by the removal of the minimum prices from the pre-ordinary stocks in the Home Railway market. These have been protected in this way, of course, since the Stock Exchange re-opened, last January twelvemonth, and there was considerable speculation in advance as to whether

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the freeing this market from the restriction of minimum prices might not drive a blow at other gilt-edged securities.

So far, however, no harm has been done to any of the gilt-edged departments; and the extension of the arena of high-class issues which the development entails has been accomplished without any disturbance to other existing values. Prices in the Home Railway market have fallen from 10 to 20 points, the movement being accompanied, oddly enough, by advances in the ordinary stocks of this market, for which the explanation is adduced that trustees of deceased accounts will now be able to sell prior-charge Home Rails instead of being compelled to limit their realisations to the junior securities.

The railway stocks with which we are more particularly concerned in these columns, to which the minimum prices have applied hitherto, are as follows:—

Stock.	Price. Minimum.	Now.	Fall.
Metropolitan 3½ per cent. debenture	83¼	65	18¼
Metropolitan 3½ per cent. "A"	82¼	64	18¼
District 4 per cent. Prior Lien	92	74	18
London Electric 4 per cent. debenture ...	85	74	11
Central London 4 per cent. debenture ...	93	75	18
Central London 4½ per cent. preference ...	99¾	78	21¾
Metropolitan 3½ per cent. preference	77½	64	13½
Metropolitan 3½ per cent. "A"	74¼	64	10¼
Metropolitan convertible preference	74¼	63	11¼

The quotations in the second column—that is to say, those now current—are to some extent nominal even yet, because business is still a little cautious of returning to this market. Holders of the stocks argue that they have perforce kept them for so long that they may as well retain them a little longer, in the expectation of buyers giving more than the figures quoted above. Whether they will be right to refrain from selling, if they really wish to get rid of the stocks, seems to us a little doubtful, unless they are prepared to keep them for some time after the conclusion of peace.

Generally speaking, the best-class debentures have fallen to a level at which they pay 5 per cent. on the money: upon this platform, of course, they stand equal with the Exchequer Bonds of 1920. The preferences are approximately valued by the market upon a 5¼ per cent. basis of yield; and it will be observed that the returns from the stocks, given in our list above, conform roughly to this scale.

With Daylight Saving so close at hand, it would certainly not have been surprising to find most of the electric lighting shares lower on the week. As a matter of fact, however, the only falls are those of ¼ in County of London and in Westminster ordinary shares; while Cities are actually better at 12. There is, perhaps, less reason for dulness in Counties than in almost any other share throughout the list, since the company derives so substantial a part of its profit from supply of current for power that it should be less hit than its peers by the Daylight Saving Bill. The City of London is another concern with a big business amongst power consumers. Edison & Swan of both classes have further receded, their recent dramatic rises being too swift to last; as it is, however, the prices stand substantially higher than they did a month ago.

Anglo-Argentine Tramways continue to give way, and the first preference have dropped to 3½, at which they show a yield of 7⅛ per cent. on the money. Brazil Tractions regained the loss of the previous week, moving up to 56½ in consequence of a recovery in the Rio rate of exchange to a shade above 1s. The principal rises in this section, however, stand to the credit of the British Columbia Electric Railway group, where the deferred is 5 points, the preference 4 and the preferred stock 1 point to the good. Traffics of late show comfortable evidence of amendment, and there is a well-founded impression that the severity of the competition endured for some time past has slackened noticeably of late.

The news from Mexico is scarcely so good just recently, and those who declared themselves buyers of Mexican utilities are exhibiting some little hesitation when a seller comes along. The nominal prices of the securities, however, are unchanged. The Carranzist Government is said to have prohibited the export of silver from any of the Mexican mines, from which the inference is obvious that it is desired to place the terribly depreciated paper currency upon a better basis. This, however unjust to the silver-producing mines of the country, might turn out to be a bull point for the industrial concerns; though, as vigorous protests have been lodged against the proposed prohibition, it may come to nothing after all.

Telegraph stocks and shares are strong, the only exception being West India and Panama ordinary, which have dropped 3/16 on the passing of the dividend. The Eastern Extension report shows splendid results, net profit coming out at £563,000, and the carry-forward of £38,800 being £7,500 more than was brought into the accounts. Anglo-Americans are good, the preferred hardening to par. Globes continued their improvement on the increase in the dividend. In the manufacturing group, Telegraph Constructions gained 10s., and India-Rubbers half as much.

Projectiles, at 20s. for the 1s. shares, are the main feature of strength amongst the armament group. The rubber market is calmer again; business is remarkably quiet in contrast to the rush before Easter. The Commodity market is something of a dark horse at the moment, but share prices are maintained with a good deal of firmness, and buyers from the provinces have begun to re-assert their confidence.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1914.	Dividend 1915.	Price May 16, 1916.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	6⅝	—	£7 8 2
Charing Cross Ordinary	5	5	8¼	—	7 13 10
do. do. do. 4½ Pref.	4½	4½	8¾	—	6 18 6
Chelsea	5	4	8¼	—	6 8 1
City of London	9	8	12	+ ⅛	6 13 4
do. do. 6 per cent. Pref.	6	6	10½	—	5 14 3
County of London	7	7	13½	— ¼	6 15 7
do. 6 per cent. Pref.	6	6	1 1/16	—	5 14 3
Kensington Ordinary	9	7	5	—	7 0 0
London Electric	4	3	1⅛	—	7 6 4
do. do. 6 per cent. Pref.	6	6	4½	—	7 1 2
Metropolitan	3¼	3	⅛	—	6 6 4
do. 4½ per cent. Pref.	4½	4½	3	—	7 10 0
St. James' and Pall Mall	10	8	6	—	6 13 4
South London	5	5	2⅞	—	8 13 10
South Metropolitan Pref.	7	7	1 1/16	—	6 14 0
Westminster Ordinary	9	7	5½	— ¼	6 1 9

Telegraphs and Telephones.

	Dividend 1914.	Dividend 1915.	Price	Rise or fall this week.	Yield p.c.
Anglo-Am. Tel. Pref.	6	6	100 xd	+ ½	6 0 0
do. Def.	30/-	33/6	21⅛	+ ⅛	7 13 0
Chile Telephone	8	8	6½	—	6 8 0
Cuba Sub. Ord.	5	5	7½	—	6 13 4
Eastern Extension	7	8	14½	—	*5 12 4
Eastern Tel. Ord.	7	8	14¼	—	*5 11 1
Globe Tel. and T. Ord.	6	7	12½	+ ½	*5 14 3
do. Pref.	6	6	10½	—	5 17 5
Great Northern Tel.	22	22	34⅛ xd	—	6 0 7
Indo-European	13	13	49	—	6 13 8
Marconi	10	—	2 7/16	—	4 11 4
New York Tel. 4½	4½	4½	100½	—	4 9 4
Oriental Telephone Ord.	10	10	1 3/16	—	5 10 4
United R. Plate Tel.	8	—	6 1/16	+ 1/16	*6 13 0
West India and Pan.	1	Nil	⅛	— 1/16	9 6 1
Western Telegraph	7	8	14½	—	*5 12 4

Home Rails.

Central London, Ord. Assented	4	4	67½	—	5 18 6
Metropolitan	1½	1	25½	—	3 18 6
do. District	Nil	Nil	19	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	1⅛	—	Nil
do. do. "A"	Nil	Nil	5/6	—	Nil
do. do. Income	6	6	87	+1½	*6 18 0

Foreign Trams, &c.

Adelaide Sup. 6 per cent. Pref.	6	6	4¾	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½	5½	3½	— ½	7 17 3
do. 2nd Pref.	5½	5½	3½	—	8 9 2
do. 5 Deb.	5	5	78	—	6 8 2
Brazil Tractions	4	4	56½	+1½	7 1 6
Bombay Electric Pref.	6	6	10⅝	—	5 15 8
British Columbia Elec. Rly. Pfce.	5	5	50	+¼	9 9 8
do. do. Preferred	—	Nil	40	+1	Nil
do. do. Deferred	—	Nil	38	+5	Nil
do. do. Deb.	4½	4½	63	—	6 17 1
Mexico Trams 5 per cent. Bonds	—	Nil	41	—	Nil
do. 6 per cent. Bonds	—	Nil	85	—	Nil
Mexican Light Common	Nil	Nil	30	—	Nil
do. Pref.	Nil	Nil	82	—	Nil
do. 1st Bonds	Nil	Nil	41	—	—

Manufacturing Companies.

	Dividend 1914.	Price		
Babcock & Wilcox	14	2⅜	—	5 14 3
British Aluminium Ord.	5	22/- xd	—	6 7 3
British Insulated Ord.	15	10½	—	7 2 10
British Westinghouse Pref.	7½	44/-	+ 1/-	6 16 6
Callenders	15	11½	—	6 10 5
do. 5 Pref.	5	4½	—	5 17 8
Castner-Kellner	20	14 1/16	—	6 1 3
Edison & Swan, £3 paid	Nil	11/-	— 6d.	Nil
do. do. fully paid	Nil	1⅛	— ⅛	Nil
do. do. 5 per cent. Deb.	5	57	—	* 15 *
Electric Construction	6	16/6	—	7 5 5
Gen. Elec. Pref.	6	9⅜	—	6 4 *
Henley	20	14⅜	—	*6 13 0
do. 4½ Pref.	4½	4	—	5 12 *
India-Rubber	10	10½	+ ½	*9 10 6
Telegraph Con.	20	87	+ ½	*6 16 0

* Dividends paid free of income-tax.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month. £		No. of weeks.	Total to date. £		Route miles open.	Inc.
Blackpool-Fleetw'd	April 29	2,668	+ 183	17	6,728	+ 55	8	..
Bristol (Trams)	„ 28	19,921	+ 879	17	77,283	+ 3,592	30·6	..
Cork	„ 27	1,813	— 90	17	7,642	— 12	54·25	..
*Dublin	„ 14	12,071	—1,212	15	87,416	+ 3,402	9·89	..
Hastings	„ 28	4,081	+ 679	..	..	+ 273	19·8	..
Lancashire United	„ 16	7,227	+ 707	17	27,847	+ 1,731	42	..
Llandudno-Col. Bay	„ 28	1,331	+ 69	21½	4,584	+ 153	6·5	..
Tyneside	„ 22	2,114	— 151	16	7,888	— 314	11	..
Anglo-Argentine	„ 22	201,146	- 9,685	17	813,468	— 2,933	..	..
Auckland	„ 7	20,767	+ 551	40½	210,704	+ 3,558	25·42	1·66
Calcutta	„ 22	17,694	+1,160	17	..	+ 449	..	..
Kalgoorlie, W.A.	Feb.	2,248	..	.	4,484	..	..	..
Madras	April 30	4,211	+ 280	17	16,764	+ 1,560	..	..
Montevideo	April	28,997	+2,211	26	187,419	+12,764	..	..
Dublin-Lucan Rly.	April 28	564	+ 7	17	2,030	— 154	7	..

* Two weeks.

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THE ELECTRICITY SUPPLY OF GREAT BRITAIN.

This subject was discussed at a meeting of the Manchester Local Section of the Institution of Electrical Engineers, the discussion being opened by Mr. J. A. Robertson, who said that the present position of the electricity supply business in this country called for serious consideration in view of the steps which would have to be taken at the end of the war to re-organise and re-establish our national industries. The restrictions placed by the Local Government Board last year on new capital expenditure, coupled with the largely increased output of energy for war munition purposes, had reduced the reserve plant capacity in most central stations to a margin which would have been considered totally inadequate in normal times; the problem of utilising to the very best advantage the existing plant in central stations was, therefore, one that should receive the immediate and careful attention of all interested in electricity supply. The most serious difficulty with which central stations had had to cope during the last year had been the high price and the shortage of fuel supplies. The Prices of Coal (Limitation) Act, passed in July, 1915, conferred an immediate benefit in restricting the inflated prices which were then demanded, but the intention of the Act was not being fulfilled, and large quantities of coal were being sold at prices considerably above the maximum increase of 4s. per ton. The existing conditions called for thorough investigation, and, if found necessary, the Act should be amended to carry out the intention of Parliament. Indirectly, the difficulties under which central stations had been operating would do much good. Manufacturers who were still generating from private plants, or using steam or gas power, had found their power costs increasing by 30 to 40 per cent., while the central-station consumer had not been called upon to pay more than 10 or 15 per cent. increase in the rates for electricity. They had, therefore, the unique position of manufacturers applying for power supplies who were previously convinced they could produce more cheaply with their own plants, while central-station engineers were refusing applications for supply which no amount of canvassing could formerly obtain. The ultimate effect was bound to be beneficial to the electrical industry, and the time was, therefore, opportune to consider steps for improving and strengthening their position after the war. In the paper read by Mr. Williams at the Institution in London, they had Dr. Ferranti's splendid idea for centralising electricity supply put into the form of a concrete proposal. Mr. Williams believed that the time had arrived when a national scheme of bulk supply from large central stations might be introduced which would gradually supersede the inefficient, and in some cases obsolete, stations now in operation. All central-station engineers would agree that centralisation was desirable, but there were certain stages of development to be passed and difficulties to be overcome which were overlooked in the paper. The technical difficulties could not be set aside, particularly the differences in periodicities in various districts.

The present Government control of electricity undertakings by three departments was unsatisfactory, but the proposal to set up a Board which would operate electrical undertakings on such a large scale, and to give the Board powers now exercised by three Government departments, was open to severe criticism. He thought, also, that to place the control of a district comprising, say, the Midlands or the North-West of England, in the hands of one engineer-manager would not commend itself either to engineers or local authorities. The scheme did not propose to interfere with existing undertakings, but simply to set up a trading concern selling electricity in bulk. The power companies had been trying to do this for years, and had made little headway because they found in most cases that bulk supply could not be given to central stations at a price which would pay the standing charges on the necessary cables, converting and transforming plant, and also the standing charges on the superseded generating plant. Again, the Central Board would have no powers to compel a local authority to shut down its generating station, or to fix the price which the existing authorities were to charge for energy. A local authority might, therefore, continue to operate its own plant, and even to pay its extensions out of revenue, or it could purchase energy from the State system in bulk, and resell it at prices which were deliberately fixed high to ensure large profits for the benefit of the district rates. In either case, the object of a bulk supply scheme, *i.e.*, the provision of cheaper electricity for all industrial and domestic purposes, would be defeated. State ownership might be the *ultimate* solution of the all-electric problem, but they would be faced with an enormous difficulty probably in a few months, or, at most, in a year or two, to meet the demand for a cheap power supply which was vitally essential for increasing the productive capacity of manufacturers after the war. Their task for the present was to ascertain what steps could be taken to utilise their *existing* facilities to the fullest extent, taking care only to make extensions or adopt methods which could be worked in as part of a larger scheme, when the time was ripe for it.

The policy of linking up existing undertakings, which had been adopted in one or two London boroughs, would have to be seriously considered. The country for electrical purposes divided itself into eleven areas, which represented the important industrial and coal-mining districts. In each of these districts, the existing central stations could be linked up at a moderate cost. Later on, it would be a simple matter to supply the network thus formed from one or two large modern stations. About 220 generating stations out of a total of 364 in the whole country would be included in those areas. Most of the remainder were in residential districts, and it would not be profitable to connect them to any system of high-tension networks.

As an instance of what linking-up might do, the Manchester district was a striking example. There were situated within the Manchester area 15 generating stations with an aggregate generating capacity of 170,000 kw. Nine of these stations were generating three-phase energy at 50 periods, and there were no technical difficulties to prevent them being linked up immediately. The stations would act as reserves to each other, and the aggregate demand could be increased by 30 to 40 per cent. with perfect safety.

Hitherto, the chief obstacle to co-operation between existing authorities had been local jealousy, but if machinery was put in motion to combine these authorities for a common object this jealousy would probably disappear.

He proposed the formation of a joint board for each district, consisting of representatives elected by the supply authorities, along with a certain number of independent members appointed from the local manufacturers, who were, after all, the parties most interested in the question of cheap power supply.

As the joint board would require to raise capital, Parliamentary powers would be necessary, which might be limited at first to the raising of capital for the consolidation of existing undertakings. The powers might be enlarged later to include the extension of existing undertakings and the building of new stations. By this means they would obtain uniformity in administration, and other benefits, such as standardisation of rates for supply, would naturally follow.

It was not suggested that this proposal would provide a complete solution to the problem, but it would, at least, prove more workable than any nationalising scheme could possibly be at this stage; it could be put into operation with the minimum of cost, and, what was more important at present, with the minimum delay.

He agreed with the suggestion that the powers now vested in the Local Government Board, the Board of Trade, and the Home Office should be combined in a Central Electricity Board. This Board, which would be mainly composed of electrical engineering experts, would be the sanctioning authority for loans, and would, therefore, be able to exercise technical supervision over the proposals of the district boards.

There was another question closely bound up with the centralisation of electricity supply which, unless dealt with on national lines, would prove a serious hindrance to the object aimed at. Oil fuel might be left out of account while they were dependent on foreign markets for supplies. They were, therefore, absolutely dependent for the production of power on the supply of coal. Coal getting and coal distribution were an outstanding example of their haphazard methods in dealing with matters of vital importance. The colliery owner was left free to extract the coal, and to sell it to the highest bidder, even though he were the agent of a foreign Government not too friendly to this country. There was no attempt to grade or classify coal from particular districts for industrial purposes. Prices varied within wide limits, and at one time they were threatened with interruption of supplies through strikes, while at another stocks were held up in order artificially to inflate prices. The time had arrived when a Commission should be appointed by the Government to report on the national supply of fuel with the object of utilising it to the best advantage. The question of transport should also be dealt with, so that they would not witness the anomaly of coals being shipped from Newcastle to Manchester district, whilst collieries within a 20-mile radius of Manchester were actually sending consignments of coal to Newcastle for export. The Limitation of Prices Act would require to be strengthened and compulsory arbitration introduced to prevent an interruption of coal supplies through strikes. To avoid such strikes some form of profit-sharing might be established which would give the worker a direct interest in the concern for which he worked.

These proposals might seem somewhat daring, but if they were to make good the wastage caused by the war and to retain their commercial supremacy, the problem must be dealt with on broad lines. The ideal to aim at was to convert their natural resources, fuel and labour, into power, light, and heat, so as to achieve the highest individual and national efficiency.

If the war caused them to scrap their old methods and to reorganise existing systems with the view of attaining higher standards, the enormous sacrifices which it had entailed would not have been in vain.

Mr. J. S. Highfield said that one of the reasons for the success of electricity supply undertakings was the possibility of working with less coal than the individual manufacturer. He thought it was a mistake originally to grant powers to public companies with terminable concessions, as during the last few years preceding the termination it would be difficult to raise capital for so short a period, and they would not invest their reserve funds freely in the business because of

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the doubt as to what they would get for the undertaking when it was sold. When the Power Acts were granted in 1900, that fault in the original legislation was realised, and power companies were formed without compulsory purchase clauses. Even without such a Board as had been suggested, a great deal might be done with regard to linking up, so that the small stations should not be unnecessarily extended. The electrical industry in this matter had suffered from professional jealousy; there had not been that assistance given between managers of supply authorities which would have made connections possible. He had not much belief in Government control, because it was not possible to alter human nature by legislation. The war was going to do a lot for them, and it was making people see that the success of one's neighbour was in a very large measure one's own success.

Ald. W. Walker said that in principle the linking-up of stations would be a good thing for the community; when, however, details came to be discussed the human element entered into the matter. When dealing with representatives of public bodies and directors of private companies, with their professional and technical staffs, one immediately found that each took a conflicting view as to which was the main concern. At present they were handicapped by having to go to Parliament for permission before a step could be taken to improve the conditions in a given area. There ought to be some body to whom an appeal could be made, who would consider these questions solely on their merits, and not with sentimental or political motives.

Mr. A. E. McKenzie said that in Manchester the price of gas had been increased approximately 24 per cent. in the last twelve months, as against 10 per cent. to 15 per cent. for electricity. Mr. Robertson's suggestion that the proposed Board should fix the selling price would involve considerable difficulty, as each municipality had its own ideas as to the amount that the electricity department should contribute to the rates. The Manchester electricity department had for some years contributed a sum of £30,000 per annum in relief of the rates. If it were proposed that the department should be State controlled, he was sure the inhabitants of the city would offer great opposition to the scheme, unless this rate aid was continued. Great economies would be effected if the linking-up of stations was brought about; it was absurd that municipal boundaries should be insurmountable barriers against such a scheme. Professional jealousy also tended against its adoption. It had been done in several London boroughs, with very great saving. In Lancashire it could easily be arranged by the engineers of the various undertakings, and undoubtedly good would result.

Mr. S. J. Watson thought that one of the great difficulties of a Joint Board would be that of finance. He suggested that the capital might be found partly by municipal bodies and partly by private enterprise. A further step might be taken to appoint representatives from the local Boards to a Central Board in London, which should possess very wide powers. Not the least matter which such a board would have to deal with would be the conservation of coal supply. It would have power to stop the establishment of any further small generating stations, and also to consider the advisability of continuing existing stations or forcing them to take a supply from some other larger undertaking in the district. When Chairman of the Manchester Section, some five or six years ago, he went carefully into the question of linking-up the different stations, and found that if all the supply undertakings within an 8 or 10-mile radius of the city were coupled up, it would set at liberty for use spare plant to the value of approximately half a million of money. He agreed with Mr. Highfield on the question of perpetuity of tenure; if an order was limited, higher prices must be charged than would be the case if the time was unlimited, owing to the uncertainty as to what would happen at the end of the term.

Mr. C. C. Atchison agreed that there should be a Central Electricity Board in London, but its functions should be mainly in the direction of finance and general guidance. There should be some standardisation of systems throughout the whole country; at the present time systems were very varied, and it would be difficult to link up the stations in certain areas owing to the difference in frequencies, and so on. With regard to the profits from municipal stations, he thought that the ratepayers were entitled to a reasonable return from their trading undertakings, but not to the extent some of them had contributed in the past. The friction which might exist between undertakings in connection with the linking-up of systems did not, in his opinion, arise from engineers, but was purely a question of local councils. No doubt in the future it would be necessary to link up certain stations, and the engineers were quite willing to consider such a scheme with interchange of supplies regulated in a manner like the railway clearing-house.

Mr. J. H. Wood thought the time was ripe to consider the question of linking up. This could be done without a Board, by a meeting of the different authorities. Many of the smaller undertakings had found it necessary to limit their undertakings because they could not enter upon any additional capital expenditure until there was some revenue from the capital already expended. Many consumers were lost in this manner. With regard to coal supplies, a Board on the lines suggested by Mr. Robertson could control both prices and quality. He suggested that a Board might regulate the amount to be paid for labour.

Mr. R. Blackmore thought there was no good reason why the suggested Board should be formed. It had not yet been shown that super-stations could generate more cheaply than a medium-sized station. Linking-up was good, but it was not necessary to bring in Parliament to do it. Tramways had already been linked up, and electricity stations could be linked up similarly.

Mr. J. D. Paton said that engineers should not confine themselves to pure technical electrical engineering, but study mining engineering, in order to deal with the waste coal and future supplies of coal for electric power. They had millions of tons of waste coal which yielded 40 or 50 gallons of oil to the ton, but the colliery owners could not produce this material till it was demanded. The coal which was now estimated as valuable coal would in the near future be relegated to a position of secondary importance. Coal fired for a thermal value only would become a thing of the past, and take a secondary place to coal which would yield a high oil and by-product return.

Mr. Robertson agreed that the high price of coal was a good thing for electricity undertakings for the time being, and even if it continued, but a broader view should be taken. To re-establish their position after the war in the world of commerce, they must have cheap power, and therefore cheap fuel. It was just because of the human element that it would be necessary, in his opinion, to go to Parliament to obtain powers to over-ride those local councils which might not be prepared to come voluntarily into a local linking-up scheme. He had not proposed that uniform prices should be charged in one district or in one undertaking; he had simply said the Local Board should be the authority that would fix the prices for each area or portion of an area. He thought that was a very necessary thing, because if they were introducing a bulk supply to a group, one local authority might fix prices without any reference to the actual cost, or the actual value to the consumer. He did not think an electricity undertaking existed for the purpose of making money to be handed over to the ratepayers who were not possible consumers of electricity, and who would never be called upon to make good any deficiency that might arise. Any surplus or profits should be transferred to the reserve fund, and so prevent the possibility of the ratepayers being asked to make good any deficiency. The linking-up arrangement he suggested was only a temporary one, to meet the difficulty. His own view was that the powers possessed by these Boards should go much further later on, and would ultimately result, he believed, in the nationalisation both of generation and distribution.

AMERICA AND EXPORT TRADE DEVELOPMENT.

In the proceedings of the last annual convention of the National Commercial Gas Association of America, there appears a report of an address by Dr. E. E. Pratt, Chief of the Bureau of Foreign and Domestic Commerce of the U.S. Department of Commerce, on the subject of export trade development. He said that at the outbreak of the war much was said about America's exceptional opportunities for securing export trade, but he believed that many such statements were unduly optimistic, being made by persons who were inclined to take an exaggerated view of the possible expansion in the foreign field.

One assertion, however—and it might be regarded, after all, as the fundamental one—was absolutely true. The disturbed conditions in Europe did, and still do, give American manufacturers an altogether unusual opening for the building up of foreign trade. But the expectation of immediate returns, of getting a great number of cash orders in foreign countries, was ill-judged and failed, very naturally, of realisation. There was ground for the belief that many exporters thought they had only to go to South America, to Australia, to South Africa, to Japan or China, and pick up the orders overlooked or left behind by the countries that had become involved in the great military conflagration. Such a view was hardly justified. The European war broke up so completely the machinery of the world's traffic and the world's credit that it was impossible for many months to get orders in foreign countries. It was impossible for many months to get the cash for orders that had been taken before or during that time. The chief advantage derivable by American manufacturers from the unprecedented situation that confronted them at the beginning of the war was the chance to lay a solid foundation for future business. That was still true. The opportunity was not so much an affair of present profit as of earnest, judicious building toward a goal which, while it was clearly discernible, could not be grasped at once. And when this end was finally reached, the accomplishment would be valuable and important just in proportion as the preliminary work had been systematic and well done.

The American manufacturer had, in some ways, been slow to seize the advantage that conditions now afforded. Many were hesitating; they were waiting to see what someone else could do; they were reluctant to extend the necessary credit facilities. But, on the other hand, there were many enterprising, far-sighted manufacturers who had gone into the

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foreign markets with vigour at this time. They might not all be taking orders; but they were gradually, surely, paving the way for future trade. He knew one manufacturer who had sent out his salesmen (his business diplomats, they might more properly call them) for the purpose of establishing on secure foundations the business in these foreign countries. He knew of manufacturers who had planned extended campaigns for from one to five or ten years—not with the idea of getting immediate sales or of making marked conquests next year, or the year after, but, rather, of attaining an eventual position that would ensure the coming of a notable volume of business into their hands. Some of them might not realise the increase of American trade with the countries that were entirely outside the war zone. They were enjoying, of course, an augmented trade with the neutral European, as well as with the allied nations. There might not, however, be an adequate comprehension of the way in which U.S. trade with South America, for example, had increased. Comparing the four months—June, July, August, and September, of 1913—with the same four months of 1915, U.S. trade with South America had increased 21.5 per cent. That must be regarded as a considerable increase in a large volume of trade. "Our trade with Central America has, unfortunately, not increased. Our trade with Canada has actually decreased by almost 9 per cent. Our trade with British South Africa has increased 12 per cent. Our trade with Asia has increased 50 per cent., and our trade with Australia has increased by the astonishing amount of 77 per cent. These figures convey, more emphatically than any long analysis, a sense of what has happened in the markets that are not in the zone of military operations."

He did not wish to be understood as discouraging the hopes that had been aroused with reference to the Latin American field, but it seemed worth pointing out that there were markets in other countries that were of equal or greater importance. After all, in all of Latin America, including Mexico and the West Indies, there were 75 million people. But in certain other parts of the world there were tremendous populations—populations capable of absorbing vast quantities of goods. Passing over South Africa and Australia, with populations of 6,000,000 and 5,000,000 respectively, he spoke first of India. India had 315,000,000 people. Its imports in 1913-14 amounted to the total of $594,517,000, of which the United States furnished only $15,542,000. The value of American products consumed annually in India was less than 4 cents per capita. India had been characterised by a recent writer as "the treasure sink," and to an American commercial traveller it seemed like "a bottomless pit, into which supplies may be sent in an endless stream."

The East Indies had 40,000,000 people; Japan had 53,000,000; China had 350,000,000; and last, but by no means least, Russia had 170,000,000. Some of them were thinking that the people of those countries had not the purchasing power of the South Americans. If an individual average were taken, that was indisputable; but the fact should, nevertheless, be stressed that, in the aggregate, countries like India and China had a genuinely enormous purchasing power. In Australia—a field that in many discussions received comparatively scant attention—the average man bought about 50 dollars' worth of goods from the United States every year.

Russia, in his opinion, was perhaps the most promising market to which American manufacturers could just now look forward. It was a great, but largely undeveloped country. In all Russia there were now only about 46 thousand miles of railways; within the next few years, thousands of miles would be built. Only 20 per cent. of the large cities of Russia had either electric or gas plants. Only a small proportion had such public improvements as sewage and water systems. Russian mines, forests, and mineral resources were relatively undeveloped at the present time.

During the last few years Russia had been importing annually, from all the countries of the world, an average of $600,000,000 worth of goods. About half that amount, or $300,000,000, had in the past been sold by Germany. They might decide for themselves whether, after the termination of hostilities, such an amount of goods would continue to be taken from Germany into Russia. Present indications pointed to the probability that the trade would be divided between England and the United States on the west and Japan on the east. A tremendous amount of goods had been flowing from the United States *through* Germany into Russia. Germany, in fact, had acted as the middleman for most of U.S. Russian trade.

Dr. Pratt next glanced briefly at the methods of entering these markets. To one essential principle they might adhere, and that was that foreign was not basically different from domestic trade. They might reasonably expect to succeed abroad if they employed there the same fundamental principles that they had used in the successful development of their business in the United States. To illustrate this, they might cite an example. 'Suppose an American manufacturer located in New England were about to develop a new market on the Pacific coast. What would he do? Probably his first move would be to go there himself, looking over the field personally, formulating his impressions of it, determining whether there was likely to be a market. Then, quite probably, he would send out his sales manager for the purpose of acquainting himself with the sales methods of his competitors, and with the idea of testing out the market and ascertaining exactly what kind of products should go there. In the event that he represented a large corporation, he would send there skilled business investigators, in order that they might actually go to the consumers, find out what competing products were marketed, and gather together the many facts that a large manufacturer would desire before embarking on an undertaking of that kind. He would then be likely to set aside a small advertising appropriation, not so much with the idea of getting immediate business as of seeing whether the market would respond to methods he had used before—whether, in short, his goods would "go." After satisfying himself on these preliminary points, he would send out his salesmen. Most manufacturers would scarcely expect a group of salesmen in a new territory to show a profit at the end of their first trip. If they turned in profits at the end of a second or third trip, or even a fifth trip, the manufacturer would, in most cases, be satisfied. Later, headquarters, or a branch store or distributing warehouse, would be established in the locality, and finally, perhaps, a factory might be established. How did the same manufacturer approach the subject of foreign trade? He probably got together, in the first place, all obtainable books that had to do with the particular market that he contemplated entering. He sent to the Government for publications, and the Department of Commerce could, as a rule, supply him with interesting literature.

Writing to an American Consul, he might secure a list of all the persons in that district who would be likely to take his goods. His next step was to send out circular letters and catalogues of his goods—printed, perhaps, in English. As a result of these efforts, he might get an order. This he filled. Greatly elated at his success in the foreign field, it was quite probable that he might neglect altogether to look up the purchaser's credit rating—a thing he would not fail to do if he were shipping a bill of goods to Tacoma or San Francisco. Perhaps, finally, he became sufficiently resolute to send out a salesman; but almost invariably (and contrary to his usual custom) he would expect that salesman to show a profit at the end of his first trip.

"We have all heard men say: 'There is nothing in this foreign-trade game. I have tried it. I sent out a salesman, and he made no profits, and I am done with it. I am convinced there is nothing in it.' That is emphatically *not* the way to work up a business in a foreign market. The manufacturer who does business on such principles abroad will fail just as surely as the man whose methods I have previously outlined is certain to succeed in the domestic field. Let me repeat, therefore, the fact that, after all, the same businesslike principles are applicable to the foreign trade as to the trade at home."

Certain modifications were, of course, necessary, but, from the standpoint of general policy, these were of relatively small consequence. A few surface conditions presented new problems; a few obstacles or handicaps must be surmounted; but these things were a matter of detail. In South America, as had frequently been stated, travelling salesmen must possess the qualities of courtesy and politeness; business transactions there rested, in a large measure, on a basis of personal friendship and esteem. And, in addition, the methods were more leisurely; breeziness, hustle, a determination to make a quick sale must yield in those countries to the practice of quietly deferring to the wishes of the buyer. Adjustments, adaptations, must be made in minor matters such as these; the successful exporter and the successful salesman must show a willingness to conform. "But is not the same true, in a less degree, perhaps, of the United States? There are, I think, some sales managers here. Is it not true that you have to do business in different ways in different parts of the United States? Is it not necessary to use different sales methods in New York and in Chicago, in San Francisco and in New Orleans? Before passing on to another phase of commercial life, let me reiterate my conviction that, in so far as your domestic trade methods are sound, logical, and well-considered, they will need no material alterations when brought to bear upon the foreign field."

With respect to co-operative marketing for export, there was really not much that could be said, since information on the subject was more or less limited. The German cartels had been pointed out from time to time as an example of what they ought to do. He thought, however, that there was some misunderstanding as to precisely what the cartel was and what the cartels in Germany were actually doing. As a matter of fact, these were organisations (perhaps the word "pool" would more nearly express their character) of independent manufacturers and, strange as it might seem, of independent consumers. A large proportion of the German cartels were organisations of consumers and not of producers. These had been brought into existence by conditions growing out of the producers' organisations; they therefore found in Germany a peculiar situation, in which organisations of producers were opposing similar organisations of consumers. Some of the German cartels were very loose associations. Some of them merely controlled the conditions of sale; some controlled certain other market conditions; some actually fixed prices; others fixed the proportion of profit or the proportion of the market that was to be allotted to various producers belonging to that cartel.

Only a few of the German cartels had any definite foreign-trade policy, and where such a policy existed it was, in many cases, not well developed. "I think I am justified in saying that Germany has succeeded in foreign trade, not because of her peculiar organisation of industry, not because of the pre-

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valence of cartels, but rather because every German manufacturer who goes in for foreign trade brings to that field an energy and perseverance that compel results. He gets all the facts together and then, with his knowledge to guide him, markets his goods in essentially the same way as in Germany."

Dr. Pratt next referred to the work of the Bureau of Foreign and Domestic Commerce in helping American manufacturers in their efforts to win such trade. The nation got information from a number of sources: First, from the Consuls, of whom there were about 400; second, from the commercial agents, of whom there were about 20. These latter were experts on certain commodities, such, for instance, as boots and shoes, or electrical apparatus, or gas appliances. Then, in the third place, they got information from the commercial attachés, a new service which had been in existence about a year. The information obtained from all these sources was brought together, systematised, and co-ordinated in Washington at the Bureau of Foreign and Domestic Commerce, whence it was disseminated by correspondence, through their publications, and by means of their district offices, which were located in eight cities. In addition to these eight district offices, the Bureau had co-operating branches in the chambers of commerce in five other cities.

In regard to the commercial attachés, there were ten of these trade diplomats, with headquarters at London, Paris, The Hague (the man assigned to Berlin is temporarily at The Hague), Petrograd, Peking, Melbourne, Santiago, Lima, Rio de Janeiro, and Buenos Aires. These men did not, in any way, duplicate the work of the consuls. The consuls had a comparatively restricted district and were burdened with a tremendous amount of routine work. The attaché, on the contrary, had jurisdiction over an entire country—sometimes two or three, or even five, countries—and his business was to attend to the more general problems, the things that concerned the country as a whole rather than the minute, local features that concerned only a particular district. For example, their commercial attaché at Rio de Janeiro had given almost his entire time to a careful study of the tariff situation. Their commercial attaché in Petrograd had given a portion of his time, among other activities of promotion and investigation, to getting out embargoed goods. Their commercial attaché at The Hague had given practically his entire time to facilitating the movement of goods, so far as possible, in and out of Holland and Germany. Their commercial attaché at Peking, China, had done a number of things, especially in the way of getting Americans appointed as special advisers to China on such subjects as cotton mills, agriculture, or similar economic matters. Perhaps the most interesting achievement of any of their men was that of their commercial attaché at Paris. "We received an invitation from the King of Spain, coming to us through the Department of State and asking that a commercial man be sent to Madrid. The King desired a conference and exchange of views with respect to commercial relations between Spain and the United States. Our commercial attaché was therefore sent from Paris. In the course of his conversation with the King of Spain, he mentioned to His Majesty the existence of a transport tax on coal—a tax that placed American coal at a serious disadvantage as compared with English coal and, in fact, practically kept our coal out of the Spanish market. His Majesty was much interested and asked many questions. Three weeks later the transport tax on coal was abolished by Royal Decree, and there is now a market in Spain for approximately 3,000,000 tons of American coal a year."

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The I.E.E. and a Current Commercial Problem.

It is always very gratifying when the Institution take under their ægis a commercial problem. Their latest essay in this direction had been taken on the recent issue of the Board of Trade circular asking gas and electric light companies to get their consumers to reduce lighting consumptions by 10 per cent. Thereupon, the Institution duly convened a meeting of the engineers of the supply undertakings. We are sorry, however, to have to criticise their method, even at this preliminary stage. The whole question is a commercial one, and, surely, the commercial side should have been adequately represented. Instead of this, it appears to have been composed of the station and other engineers, despite the fact that the Board of Trade letter does not raise any engineering point but one of policy. History in the past has shown that for such questions to be dealt with by station engineers is to invite trouble. It has not yet been made public what corporate action has been decided upon, but one may be pretty certain that the engineers have been "drawn." We must remember that they are up against very strategic opponents.

I should, incidentally, like to know whether those who are responsible for calling this meeting have taken the trouble to ascertain whether the Department of the Board of Trade who are directly responsible for electric supply undertakings (and the proper performance by them of their statutory obligations) had been consulted on this letter, and whether such department had given their support. Or, as the alternative, whether the letter in question emanated from some one or other department in the Board of Trade whose interests are entirely alien to the electric supply section, and who, acting independently, are trying thus adroitly to "draw" the industry. It is to be hoped that the engineers had not allowed their innocency to be traded on.

The letter from the Board of Trade may be regarded as a kind of knot in the stretched rope of tug-of-war. On the one side there are the electric supply and gas companies, and on the further side there is, one may surmise, a very astute body of colliery owners and others who have everything to gain by decreasing home consumption (which is under "limited" prices) and increasing the export consumption (which can command fancy prices).

With regard to the Board of Trade circular itself, this has already met with full criticism in the electrical and gas Press. One can only regret that on one of the few occasions when the Board of Trade has woke up from its Rip Van Winkle somnolence its activity should not have been better considered. Anyhow, we await with interest the result of the Institution meeting.

Policy.

Justice to Inventors.

I would like to endorse the very opportune letter written by "Fair Play" and inserted in your issue of May 5th. Unfortunately, inventors cannot hope for any immediate assistance from our Government. The immediate question arising, therefore, is: "What is the best course to adopt at the moment?" I would suggest three initial steps:—

1. That every inventor whose British patents are adversely affected by the war should, either directly or through the medium of his patent agent, pay his patent renewal fees under vigorous protest.
2. That inventors should bring their grievance to the notice of their respective trade associations.
3. That trade associations should be invited to co-operate on the subject, and when a fitting time arises they should present a concrete proposal to the Government.

For my part, I have already adopted suggestions (1) and (2), and shall be glad to further joint action and to interest my trade association if the suggestion meets with general approval. In the meantime, inventors are indebted to you, Sir, for allowing this subject to be ventilated in your valued columns.

Inventor.

The Pronunciation of "Ljungström."

I think it would interest a few of us readers of the REVIEW if we had the English pronunciation of the word "Ljungström" as applied to the turbo of that make.

James A. Burns.

Magheramorne, *May 13th*, 1916

[We sincerely sympathise with our correspondent, and have made inquiries; it is difficult to convey the result to our readers in print, but we understand that a fair approximation to the Swedish pronunciation is given by "Yoongstrerm." The *English* pronunciation seems to be a matter of personal taste.—EDS. ELEC. REV.]

The I.E.E. Election.

May I be allowed to say that my sentiments on the matter are identical with those of your correspondent of last week, though I am afraid the course he adopted with his ballot paper may have invalidated it.

Think of a number of years, say, 20. Then can anyone deny that in that long period there would be many more than 20 fresh men to select from; men who deserved and who could act up to the highest position in the Institution?

The Council and the Local Sections seem chiefly to blame in not giving us a new President.

Speaking of Local Sections reminds me that I was once a disgusted member of that at Manchester. It had far less "go" in it than the committee of any sort of club.

There were other things in the ballot paper that were not clear to me, but it showed in black and white that there was only one small body in the whole Institution that had the gumption to put forward an outside candidate for the Council. I voted for him without hesitation.

We have recently been told, officially and numerically, how poor the response is when members are asked to indicate their wishes on voting papers sent them through the post. The conclusion one arrives at from this and other signs is that the majority of I.E.E. members are hopelessly indifferent to things. What else can be said of men who lack the *esprit de corps* to lift a pen, do a little thinking, write a word or two, and spend a halfpenny or a penny on a stamp?

The occasional grumblers (and I am one of them) seem to forget that by co-operation and procedure on regular lines, the carrying out of any desired "reform," if it really had much to recommend it, would be comparatively easy. So perhaps, after all, the Council is not so very much to blame.

W. Perren Maycock.

London, S.E., *May 14th*, 1916.

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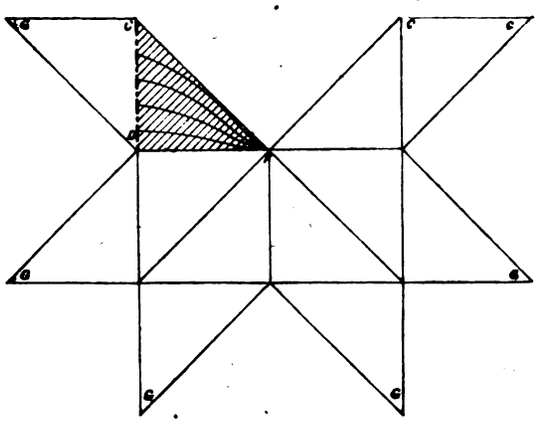
The Resistance of a Cube.

There is an error in the demonstration by Mr. Makower, "The Resistance of a Cube," which is not brought out in the communications of Mr. Carter and Mr. Smith in the issue of March 24th.

Mr. Makower is correct in stating that the conduction in the sides of the cube will be made up of six parallel circuits, each consisting of two triangles in series; but he errs in assuming that the stream lines in these triangles will be the same as when these triangles represent quarters of a square with electrodes at two opposite corners.

This may readily be shown by developing the surface of the cube out into a plane, as in the accompanying figure. F represents one electrode and G the other. F C D is one of the triangles referred to, and the stream lines shown are for the



case when it is part of a square. G C D is the triangle in series with it, and it will be noticed that this triangle is reversed with respect to the first. The result is that the line C D is no longer one of equipotential, and the stream lines will not follow the same course as in the case of the square. Hence the resistance cannot be computed on the basis of this analogy. The result is approximately correct, but is not exact.

Of course, it is necessary to consider an electrode with appreciable size, but this may be taken the same for both square and cube.

M. G. Lloyd.

Chicago, U.S.A., *April 21st*, 1916.

Daylight Saving.

In your first editorial on this subject you referred to having received protests from Mr. Willett and myself against your antagonistic attitude to this measure, and with regard to mine, you expressed astonishment "that one whose profession it is to propagate accurate time service should lend his aid to the destruction of that ideal." I trust, therefore, that you will permit me to reply to the more important points in your two articles.

Greenwich mean time fixes the minutes and seconds only. They remain permanent and universal. I yield to none in my pride in the fountain head of the world's time-keeping, and it was left to me to protest against our lamentable failure to take any share in the work of organising international wireless time service, an undertaking which our country was most competent to perform. Daylight saving takes nothing from the prestige, utility, or permanence of Greenwich mean time, which is the world-wide standard for minutes and seconds. But the position of the hour-hands is variable, is, in fact, already different for each of the 24-hour zones, is fixed by every country for the convenience of its inhabitants, and may be moved backwards or forwards at will to secure the greatest good for the greatest number. A forward movement in the spring is demanded in latitudes like ours, where the inertia of winter habits results in our sleeping many hours behind blinds drawn to keep out the sunlight.

In your current issue you say that the original proposal was optional, and the present one compulsory. There was no more option in the Daylight Saving Bill of 1911 than in to-day's Summer Time Bill. In both the option is with the individual, who may, if he likes, refuse to conform. It is obvious that few would be so eccentric or stubborn as to exercise this option to their own detriment and vast inconvenience.

Why should we feel this to be "a voluntary self-deception and a slur upon our moral strength" any more than the daily clock alteration on an Atlantic liner? The cause is similar, and the object desired is identical. Owing to a change in the hours of daylight relatively to the human time-table, we get out of phase with the sun, and a correction must be made. The one is measured by latitude, due to a change of seasons, and the other is measured by longitude, due to a change in our position.

Denounce, if you like, a calendar based upon hours of uniform length, but unless and until you are prepared to revert to the Roman method of "temporary" hours, *i.e.*, hours of varying length (and, incidentally, to give up the measurement of time, yea, even astronomy itself as an exact science) your only alternative is to pass a Summer Time Bill.

I cannot conceive of any other means whereby man can adopt the estimable habits of the lower creation and vary his time-table from winter to summer *with the unanimity demanded by modern civilisation*. If you have an alternative we look to you to suggest it rather than to indulge in purely destructive criticism, which, fortunately, cannot now destroy.

It will be no easy task for my diminished staff to alter 5,000 clocks in London alone next Saturday night, but I think it is to the credit of the electrical profession that it has contributed a method by which it can be done comparatively simply and with precision.

F. Hope-Jones, M.I.E.E.

London, E.C., *May 15th*, 1916.

TRADE STATISTICS OF ITALY.

The following statement, showing the imports of electrical and similar goods into Italy during the year 1914, is extracted from the recently-issued trade statistics. The figures for 1913 are added for purposes of comparison, and notes of any increases or decreases are given.

	1913. Lire.	1914. Lire.	Inc. or dec. Lire.
Boilers.—			
From France	23,000	17,000	– 6,000
,, Germany	231,000	195,000	– 36,000
,, Great Britain ...	1,077,000	1,142,000	+ 65,000
,, Switzerland ...	146,000	2,000	– 144,000
,, Other countries ...	41,000	16,000	– 25,000
Total	1,518,000	1,372,000	– 146,000
Copper, brass, or bronze wire more than ½ mm. diameter.—			
From France	908,000	941,000	+ 33,000
,, Germany	1,003,000	1,055,000	+ 52,000
,, Great Britain ...	7,000	9,000	+ 2,000
,, United States ...	—	184,000	+ 184,000
,, Other countries ...	49,000	18,000	– 31,000
Total	1,967,000	2,207,000	+ 240,000
Copper, brass, or bronze wire of ½ mm. diameter or less.—			
From Germany	353,000	219,000	– 134,000
,, France	89,000	36,000	– 53,000
,, Other countries ...	45,000*	1,000	– 44,000
Total	487,000	256,000	– 231,000
* Great Britain, 43,000.			
Electrical apparatus.—			
From Germany	3,978,000	3,251,000	– 727,000
,, Great Britain ...	145,000	162,000	+ 17,000
,, Switzerland ...	330,000	308,000	– 22,000
,, United States ...	369,000	397,000	+ 28,000
,, Other countries ...	165,000	105,000	– 60,000
Total	4,987,000	4,223,000	– 764,000
Steam engines, stationary, without boilers.—			
From Belgium	137,000	1,000	– 136,000
,, Germany	646,000	287,000	– 359,000
,, Great Britain ...	802,000	512,000	– 290,000
,, Switzerland ...	4,000	18,000	+ 14,000
,, United States ...	86,000	116,000	+ 30,000
,, Sweden	3,000	—	– 3,000
,, Other countries ...	77,000	31,000	– 46,000
Total	1,755,000	965,000	– 790,000
Steam engines, semi-stationary (with boilers), hot-air motors, compressed air, gas, petrol, &c.—			
From France	150,000	80,000	– 70,000
,, Germany	1,401,000	2,023,000	+ 622,000
,, Great Britain ...	1,779,000	951,000	– 828,000
,, Switzerland ...	329,000	191,000	– 138,000
,, United States ...	150,000	240,000	+ 90,000
,, Other countries ...	165,000	422,000	+ 257,000
Total	3,974,000	3,907,000	– 67,000
Dynamo-electric machines weighing more than 1,000 kg.—			
From Austria-Hungary ...	398,000	166,000	– 232,000
,, France	177,000	99,000	– 78,000
,, Germany	2,937,000	5,564,000	+ 2,627,000
,, Great Britain ...	428,000	172,000	– 256,000
,, Switzerland ...	178,000	489,000	+ 311,000
,, United States ...	56,000	68,000	+ 12,000
,, Belgium	24,000	104,000	+ 80,000
,, Other countries ...	94,000	53,000	– 41,000
Total	4,292,000	6,715,000	+ 2,423,000

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	1913. Lire.	1914. Lire.	Inc. or dec. Lire.
Arc lamps.—			
From Germany	220,000	101,000	– 119,000
,, Austria-Hungary ...	5,000	2,000	– 3,000
,, Great Britain ...	2,000	4,000	+ 2,000
,, France	19,000	9,000	– 10,000
,, United States ...	1,000	4,000	+ 3,000
,, Other countries ...	2,000	—	– 2,000
Total	249,000	120,000	– 129,000
Dynamo-electric machines weighing 1,000 kg. or less.—			
From Austria-Hungary ...	636,000	225,000	– 411,000
,, France	132,000	97,000	– 35,000
,, Germany	2,689,000	2,093,000	– 596,000
,, Great Britain ...	322,000	336,000	+ 14,000
,, Switzerland ...	161,000	251,000	+ 90,000
,, United States ...	131,000	322,000	+ 191,000
,, Other countries ...	28,000	43,000	+ 16,000
Total	4,099,000	3,367,000	– 732,000
Electric transformers.—			
From Austria-Hungary ...	911,000	1,638,000	+ 727,000
,, France	36,000	46,000	+ 10,000
,, Germany	1,816,000	2,439,000	+ 623,000
,, Great Britain ...	33,000	38,000	+ 5,000
,, Switzerland ...	279,000	416,000	+ 137,000
,, United States ...	180,000	340,000	+ 160,000
,, Other countries ...	1,000	1,000	—
Total	3,256,000	4,918,000	+ 1,662,000
Parts of dynamo-electric machines and of transformers.—			
From France	168,000	111,000	– 57,000
,, Germany	975,000	580,000	– 395,000
,, Great Britain ...	194,000	183,000	– 11,000
,, United States ...	60,000	120,000	+ 60,000
,, Switzerland ...	49,000	112,000	+ 63,000
,, Other countries ...	407,000	55,000	– 352,000
Total	1,853,000	1,161,000	– 692,000
Electric lamps, incandescent.—			
From Austria-Hungary ...	2,362,000	2,672,000	+ 310,000
,, France	138,000	131,000	– 7,000
,, Germany	5,486,000	3,863,000	– 1,623,000
,, Great Britain ...	8,000	57,000	+ 49,000
,, Switzerland ...	141,000	159,000	+ 18,000
,, Netherlands ...	921,000	465,000	– 456,000
,, Other countries ...	36,000	58,000	+ 22,000
Total	9,092,000	7,405,000	– 1,687,000
Carbons of all kinds for electro-technical purposes.—			
From Austria-Hungary ...	133,000	121,000	– 12,000
,, Germany	666,000	1,290,000	+ 624,000
,, France	86,000	155,000	+ 69,000
,, Switzerland ...	41,000	9,000	– 32,000
,, United States ...	50,000	43,000	– 7,000
,, Other countries ...	4,000	2,000	– 2,000
Total	980,000	1,620,000	+ 640,000
Accumulators and metal parts.—			
From Germany	33,000	32,000	– 1,000
,, Great Britain ...	10,000	13,000	+ 3,000
,, France	80,000	8,000	– 72,000
,, Other countries ...	8,000	28,000*	+ 20,000
Total	131,000	81,000	– 50,000

* United States, 28,000 lire.

The classes of electrical and allied goods, in which Italy is making most progress as an exporter, are shown in the following comparative figures of her exports (special trade) in 1913 and 1914 :—

	1913. Lire.	1914. Lire.	Inc. or dec. Lire.
Dynamo-electric machines weighing 1,000 k.g. or less:—			
To Argentine Republic ...	730,000	664,000	– 66,000
,, France	332,000	207,000	– 125,000
,, Brazil	201,000	22,000	– 179,000
,, Austria-Hungary ...	69,000	48,000	– 21,000
,, Other countries ...	714,000	614,000	– 100,000
Total	2,046,000	1,555,000	– 491,000
Copper, brass or bronze wire more than ½ mm. diameter.—			
To India and Ceylon ...	426,000	213,000	– 213,000
,, Tripoli	79,000	54,000	– 25,000
,, Egypt	16,000	5,000	– 11,000
,, Other countries ...	40,000	68,000	+ 28,000
Total	561,000	340,000	– 221,000
Steam engines, stationary, without boilers.—			
To Argentine Republic ...	124,000	136,000	+ 12,000
,, Spain	109,000	—	– 109,000
,, Tunis	5,000	80,000	+ 75,000
,, Russia	41,000	—	– 41,000
,, Turkey	50,000	112,000	+ 62,000
,, Other countries ...	213,000	119,000	– 94,000
Total	542,000	507,000	– 35,000

	1913. Lire.	1914. Lire.	Inc. or dec. Lire.
Boilers (including multitubular).—			
To Argentine Republic ...	163,000	192,000	+ 29,000
,, Tunis	13,000	16,000	+ 3,000
,, Tripoli	28,000	11,000	– 17,000
,, Brazil	40,000	21,000	+ 19,000
,, Chile	14,000	—	– 14,000
,, Egypt	163,000	177,000	+ 14,000
,, Other countries ...	24,000	93,000	+ 69,000
Total	445,000	510,000	+ 65,000
Steam engines, semi-stationary, with boilers.—			
To Argentine Republic ...	990,000	2,650,000	+ 1,660,000
,, Tripoli	312,000	85,000	– 227,000
,, Roumania	167,000	126,000	– 41,000
,, Egypt	792,000	352,000	– 440,000
,, France	59,000	5,000	– 54,000
,, Russia	594,000	63,000	– 531,000
,, Great Britain	328,000	18,000	– 310,000
,, Spain	349,000	163,000	– 186,000
,, Turkey	234,000	3,000	– 231,000
,, Other countries ...	933,000	590,000	– 343,000
Total	4,758,000	4,055,000	– 703,000

N.B.—25 lire = £1.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 165, High Holborn, London, W.C., and at Liverpool and Bradford.

6,181. "Arc-lamp reflectors." H. LEVY & H. STREET. May 1st.
6,184. "Methods of attaching telephone receivers to the head." F. G. BAILY. May 1st.
6,185. "Apparatus for detecting vibrations." F. G. BAILY. May 1st.
6,196. "Electric generating systems." J. H. C. BOYD. May 1st.
6,234. "Electric firing circuits for guns, mines, torpedoes, &c." J. SOUTHERN. May 2nd.
6,238. "Miners' electric safety lamps." T. THOMAS. May 2nd.
6,241. "Electric hand lamps." S. FILDES. May 2nd.
6,243. "Electric hand lamps." S. FILDES. May 2nd.
6,244. "Plug for telephone switchboards, &c." P. P. CRAVEN. May 2nd.
6,249. "Reversing controller for petrol-electric cars, &c." W. A. STEVENS. May 2nd.
6,255. "Transformers." W. H. WILSON. May 2nd.
6,256. "Aerial conductors for wireless signalling, &c." J. HETTIGER. May 2nd.
6,257. "Adapting socket for attaching electric shades and lamps combined to lampholders." T. CRACKNELL. May 2nd.
6,258. "Combined electric switches and plug couplings." J. B. McINDOE. May 2nd.
6,260. "Troughing or trays for electric conductors, conduits, pipes, &c." J. H. COLLIE. May 2nd.
6,269. "Electrical selectors or impulse responders." L. C. BYGRAVE AND RELAY AUTOMATIC TELEPHONE CO. May 2nd.
6,274. "Electric batteries." G. F. A. STONE. May 2nd.
6,275. "Electric batteries." G. F. A. STONE. May 2nd.
6,288. "Method of making and maintaining electrical communication in the field." T. H. CLARKSON-JONES. May 2nd.
6,292. "Systems of control." BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO. May 2nd. (U.S.A., May 4th, 1915.)
6,302. "Electric flashlight batteries." J. W. MANDER. May 3rd.
6,315. "Sparking plugs and manufacture of the same." H. W. CLARKE AND T. CROSBEE & SONS. May 3rd.
6,326. "Electrical measuring apparatus for indicating depth of liquids in tanks, &c." G. B. BURROWS & J. PLUMMER. May 3rd.
6,328. "Automatic telephone systems." W. A. BURRELL. May 3rd.
6,329. "Telegraphic transmission devices." R. D'ANTONIO. May 3rd.
6,339. "Automatic switches or cut-outs for use in charging batteries from dynamos, &c." A. A. PRICE. May 3rd.
6,355. "Telegraphic transmitters and relays." A. ORLING & ORLING'S TELEGRAPH INSTRUMENTS SYNDICATE. May 3rd.
6,378. "Timer or interruptor for magneto." C. MESSERSCHMIDT. May 4th. (U.S.A., October 12th, 1915.)
6,379. "Magneto." C. MESSERSCHMIDT. May 4th. (U.S.A., June 29th, 1915.)
6,393. "Automatic chain-grate, &c., stokers." LONDON ELECTRIC SUPPLY CORPORATION. May 4th.
6,404. "Electrical regulators." C. F. KETTERING. May 4th. (U.S.A., July 26th, 1915.)
6,405. "Systems of electrical generation." C. F. KETTERING & W. A. CHRYST. May 4th. (U.S.A., October 27th, 1915.)
6,406. "Ignition systems." C. F. KETTERING. May 4th. (U.S.A., August 30th, 1915.)
6,407. "Engine starting systems." C. F. KETTERING & W. A. CHRYST. May 4th. (U.S.A., October 11th, 1915.)
6,467. "Dynamo-electric machines." J. W. HOWARD. May 5th.
6,476. "Vibrating make-and-break devices or electric signalling." A. C. BROWN. May 5th.
6,483. "X-ray apparatus." C. E. CAMPBELL. May 5th. (U.S.A., August 7th, 1915.)
6,491. "Telephone systems." W. H. GRINSTEAD & E. A. LAIDLAW. May 5th.
6,516. "Production of sine-wave and like smoothly varying electromotive forces." C. E. HAY. May 5th.
6,517. "Systems of telegraphy." C. E. HAY. May 5th.
6,530. "Electrically-propelled vehicles." C. J. SPENCER. May 6th.
6,541. "Electro-magnetic relays." SIEMENS & HALSKE AKT. GES. May 6th. (Germany, June 22nd, 1915.)
6,551. "Electric lampholders." C. G. M. BENNETT. May 6th.

PUBLISHED SPECIFICATIONS.

1915.

4,263. AIR-COOLED TANKS FOR ELECTRICAL APPARATUS. Babcock & Wilcox, Ltd. (Babcock & Wilcox Co.). March 18th.
5,630. MOUNTING OF ELECTRIC OSCILLATORS FOR SUBMARINE SOUND SIGNALLING. W. J. Mellersh-Jackson (Submarine Signal Co.). April 14th.
5,723. MAGNETO-ELECTRIC MACHINES. P. A. Bentley. April 16th.

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THE INTERCONNECTION OF ELECTRICITY SUPPLY UNDERTAKINGS.

WE have followed with the keenest interest the recent discussions at the Institution of Electrical Engineers on the proposals put forward by Mr. Ernest T. Williams for the reorganisation of electricity supply in this country, on the bases of centralisation, co-operation, and interconnection, and have cordially welcomed the new spirit which seems to be stirring the dry bones of this exceedingly important branch of the industry. Hitherto, to judge by the actual course of events, the watchword of most undertakers of electricity supply, whether company or municipal, and of most engineers connected with them—but, happily, not all—has been "every man for himself"; the petty jealousies of municipalities and of supply engineers were freely blamed in the Manchester discussion for the failure to secure co-operative working between them, although the fact was clearly recognised that very great advantages could be derived from a policy of interconnection of systems and genuine co-operation, particularly in such densely inhabited industrial areas as those of South Lancashire, Yorkshire, and Birmingham. But there was ample evidence that the national importance of the matter, the changed conditions, and the general awakening of the nation to the imperative necessity of placing efficiency and economy above all minor and local considerations, were bringing about a new attitude of mind towards such questions, and that the time was ripe for action.

We were, therefore, intensely pleased to receive from the Board of Trade a copy of a letter which it has addressed, under date May 25th, to all electric supply undertakings in the United Kingdom, in the following terms:—

The Central Coal and Coke Supplies Committee have had under consideration the increasing difficulty in providing for the supply of coal to important consumers, and have advised the Board of Trade that in view of the possibility of a serious shortage in the near future every practicable economy in consumption should be adopted without delay.

In this connection the Board desire to call attention to the very considerable saving that can be effected by the adoption of arrangements for interconnection and joint working of electric supply undertakings, including interconnection with stations supplying tramways and railways.

The Board are aware of the difficulties involved at the present time, particularly in regard to labour and materials, but they are advised that in many cases the necessary arrangements could be made at once, and they wish, therefore, to urge upon electric supply undertakers the necessity in the national interest of taking immediate steps to avail themselves to the fullest possible extent of the powers which exist for the purpose.

Any application which may be made to the Board of Trade for their approval of such arrangements under the powers conferred on them by the Electric Lighting Act, 1909 (Section 4. Sub-section 3) and the London Electric Supply Acts, 1908 and 1910, will receive their immediate attention.

The Board are prepared to assist as far as possible in cases where difficulty is experienced in securing the agreement of all the parties interested in any proposed scheme, or in arranging the terms and conditions under which it shall be carried out.

The importance of this step can hardly be exaggerated, not only in its bearing upon the conditions which exist in war-time, but also in its effect upon the whole future of electrical engineering in this country. We heartily congratulate the Board upon its prompt action, and upon the intention, which is plainly manifest, to follow up the policy suggested. We would gladly see it go further, and obtain com-

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pulsory powers to enable the Board not merely to "urge upon electric supply undertakers the necessity in the national interest of taking immediate steps," but also to ensure the adoption of its suggestion. This is no time for coaxing and wheedling; what the nation is crying out for is government with a firm hand. We have seen the lamentable results of the former policy in only too many instances; we have seen also how readily and willingly the nation complies with an order backed up with energy and decision. To be effective during the war, the policy of interconnection must be put into force *at once*.

The immediate benefits to be derived from this course chiefly consist in economy of fuel, the expressed purpose of the Board, and the release of stand-by plant to cope with the increased demand for power. These features may at first sight appear to be somewhat conflicting, but a little consideration will show that the small and inefficient power stations can be utilised as a reserve to the large stations equipped with modern economical plant; the latter will be able to supply a greatly increased demand, and yet show a great reduction in the aggregate consumption of fuel. No interference with local management of the distribution of electrical energy is necessary, at any rate for the present, and we feel sure that station engineers, a most patriotic body of men, will heartily support a movement which is shown to be of advantage to the nation, while their private interests can readily be safeguarded, if they feel it to be necessary. We trust that no time will be lost in pressing on with a proposal which we believe to be of the first importance to the nation, to the electrical engineering industry, and to every consumer of light, heat, and power throughout this country.

The Future in Russia.

In discussing the future of trade in Russia we have on several occasions expressed the opinion that Germany's influence in that and other markets would wane as the financial difficulties within the Central Empires developed, rendering necessary or politic the disposal of securities in electrical and other engineering undertakings. Of course, whether the weakening would be temporary or permanent would depend to some extent upon the ability of German interests to re-purchase the securities after the war, and upon whether they were transferred to friendly hands in neutral lands as a matter of war convenience. Present indications do not suggest that such ability will be very substantial, but there are certain signs that transfers are being made.

Another very important point to which we have also already alluded several times is the need for engineering industrial development in Russia, by Russians, and by nations which are now their Allies. Engineers, at all events, have long recognised that Russia would have been able to withstand the German and Austrian offensive last year with even greater brilliance and effect—indeed, the war might never have come at all—if she had been more advanced as an engineering and industrial nation. We may judge from the many utterances that have been made by responsible statesmen, scientists, engineers, and industrial authorities in Russia, that this aspect of the situation is as keenly appreciated there as it is here. They have a land of vast resources, and they desire to release it from the strangling grip of the Teuton.

Both of the foregoing matters are referred to in a very businesslike interview which "Sergius," of the *Daily Chronicle*, has had with Mr. A. Protopopoff, the vice-president of the Russian Duma, who, we are told, is looked upon as the future Russian Minister of Trade and Commerce. His great desire seems to be to revolutionise the whole of Russian trade—if he succeeds in revolutionising only a part of it he will have done much to open the way for the development of closer relations with British finance, industry, and commerce. He recognises the need of British capital, says that the desired guarantees and facilities that our capitalists require will be forthcoming, flouts the opinions of those Russian economists who blindly demand a complete control over the capital, and who want only Russian engineers and workmen to be employed, leaving the English capitalist merely a dividend. Mr. Protopopoff says: "Give us English Engineers, English managers, and even English skilled workmen. We will learn from them. We are going to open wide our doors to Allied capital . . . and see that such conditions are created . . . as will facilitate the turnover of capital." Railways will be required on an extensive scale; gold, iron, and coal mining industries clamour for development, and after the war "we shall build up new industries and develop the old ones, and thus emancipate ourselves." It may be that in the readjustment of affairs, when the war is ended, there will not be very much capital free for such purposes immediately. But Mr. Protopopoff will, as time passes, and as the position comes to be tackled, see that finance is but part of the huge problem, and British manufactures will be wanted by the million sterling if the German yoke is to be flung off. His sympathies, we are sure from other comments made in the interview referred to, will lead him to advocate the facilitation of British trade quite as enthusiastically as he now argues for British finance, which is promised a fair return, "perhaps many times greater than the profit on . . . manufactured goods." He praises highly the efforts of his friend, Prince Shahovsky, the present Russian Minister of Trade and Commerce, to bring about closer business relations between the two countries, urges the organising of visits of British business men and experts to Russia, and the setting up of an Official Information Bureau. He is careful to warn British manufacturers and capitalists against throwing themselves haphazardly into Russian enterprises, and in this he is but preaching what we have ourselves long advocated, a policy of unity and co-operation in a strong effort on the part of British electrical and engineering manufacturers to build up a thoroughly sound organisation equal to the immense possibilities of the situation. All efforts to this end may not be as free from set-backs as we might desire, and some appear to be delayed because we are lamentably short of the right type of men to carry these operations through with experience and authority. We trust, however, that some of the financial minds of the British Empire have their attention fixed upon the concessions, electrical and other, the hold upon which Germany is now being driven to loosen. These may be regarded in many cases as key concessions to fit and turn the lock of industry.

German Realisation of Foreign Securities.

In connection with what we have stated above, we are informed that a movement is in progress in Germany in the direction of taking advantage of the opportunity afforded by the present rate of exchange for disposing of securities held in undertakings in neutral countries, whilst, at the same time, these countries are exhibiting a greater desire to nationalise electrical works. Among the recent transfers may be mentioned the sale by the Frankfort Lahmeyer Co. of its Wangen electricity works in Switzerland for a sum of about 9,000,000 fcs. (£360,000), and the disposal by the Berlin Electrical Undertakings Co. of shares for 1,136,800 crowns in the Christiania tramways; it is stated that the transaction yielded a good profit, which could not have been obtained in normal times. A further opera-

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tion of considerable magnitude relates to the Nuremberg Schuckert Co., which, as stated last week, has succeeded in transferring to a Norwegian syndicate, for a cash payment, its large holding of shares in the Aktieselskabet Hafslund. These, again, are said to have been sold at a large profit, and they represent a total value of about £720,000.

Rubber.

THE rubber market has been of late rather severely depressed, not because of any material deterioration in the outlook as to the future outlet for the commodity, but chiefly in consequence of the fact that the export trade has been seriously handicapped by the difficulties experienced in the way of getting permits for shipment to neutrals, more particularly the United States. There is as yet no indication of any material improvement in that direction, and this naturally continues to prejudice the general demand to an extent which must be expected to keep the warehouse stocks on this side in rather unwieldy proportions. It seems unfortunate that the progress of the industry should be so much hampered by the action of the authorities, the reason for this not being quite clear, although it is suggested that demands for permits were at one time forced to a degree which tended to make the authorities more circumspect, possibly partly because of the persistent tightness of shipping. These adverse conditions are clearly reflected in the Board of Trade Returns for the past month, showing a very big falling off in the quantities dispatched to the United States, the total against the previous year marking a deficit of over 4,300 tons, while it is well under the tonnage accounted for in the same month two years ago. The exports to allied countries were fairly well maintained. As compared with the large shrinkage in the exports, the decrease in the imports was comparatively small and due to a falling off in the shipments from the Near East, probably on account of freight scarcity. The result, therefore, has been an inevitable swelling of the stocks, the existence of which is obviously making itself felt, the home stocks being considerably larger than for some years past. There is no mistaking the fact that export buyers have now still to contend with many difficulties as regards freightage and licences, and until these drawbacks are to some extent remedied, it is hardly likely that the position of spot rubber will mend to any appreciable extent, although arrivals look like being smaller for some time. The total shipped during last month from the Federated Malay States was, according to official returns, only 3,904 tons, against 4,429 tons for the previous month, and 2,777 tons for April last year. The aggregate for the four months amounts to 18,011 tons, which is an increase of about 5,000 tons against last year, and almost double the returns for the same period two years ago. The tendency of prices for weeks past has been most irregular, the depression in spot and near rubber down to 2s. 9d. per lb. (from which a temporary rally ensued of about 3s. per lb.) contrasting sharply with the comparative firmness which has characterised forward rubber, the latter having been invariably maintained at a fair premium due to a well-sustained demand which, however, has been chiefly met by dealers. The estates are apparently still reluctant to take advantage of this satisfactory feature. Dealers have thus been tempted to increase their operations while repurchasing on the spot at a discount some of the rubber sold short forward. For the time being, consumers confine their purchases to near requirements, so that the market is largely in the hands of dealers. The backward attitude of producers has come in for some criticism, for the prices obtainable for forward delivery seem attractive enough. The course of the market to some extent depends on the proportion of the quantities reaching this side unsold.

LABOUR AND INDUSTRY.

FOR some years prior to the outbreak of Germany's war upon Civilisation we were deeply absorbed in the domestic questions which were constantly arising in consequence of the progress of British Democracy. Those to whom it falls to write the history of those days will probably record against us that we were so much involved in embittered controversy, and so angrily engaged in internecine struggles, that we were, as to the majority of us, allowed to remain oblivious to the terrible danger that was gathering force, lifting its ugly head, and hardening its mailed fist, in readiness for the great spring forward, striking the blow which should give Germany World Domination. The Enemy happily was unable accurately to estimate the British character and the Oneness of Heart of our Empire, or to foresee the ability of the Allies to act in so grand a spirit of unity and fortitude against the Terror of Europe. The guardian of the Law who enters to interfere in the domestic differences between husband and wife knows from long experience that he is inviting the combined attentions of both parties, who put aside their own comparatively trifling differences in order to visit the full force of their vengeance upon the intruder. Such, in the main, has been the penalty incurred by Germany from the combined forces of British Capital and Labour. At the appointed Day the vast forces of Prussian militarism were let loose with thirst for blood and lust and plunder. Husband and wife flew at the new-comer, their common interests deciding that his intentions were more dangerous than were the internal grievances which brought about the domestic blows. It has been an exhausting struggle extending over nearly two years, but the intruder is kept at bay, and if only the combined effort can be maintained he will be sorry for the intrusion before long—indeed some reports suggest that there is a very deep sorrow already, and that much would be given by Germany and Austria, by Turkey and by Bulgaria, could they see reasonable justification for hopes that they will ever return to the highly favoured state in which they existed before the first shell was fired in August, 1914.

The British and Allied determination, as grim as it is unalterably fixed, is that they never shall so return.

But when the aggressor has been beaten to his knees and permanently defeated, shall we celebrate the Peace by a renewal of our old quarrels between Capital and Labour? We trust not, after all the sacrifice that has been mutually borne by both classes on the fields of blood and slaughter; yet we shall still be a British Democracy—the war has not wiped that out of the national character; our relations will still be those of master and man; and whatever developments may take place altering parties and party politics, there will still be motives and ambitions, purposes and objects, bringing different classes and different minds into conflict. We wish we could agree with those who think that the life and death of the trenches are to have a subduing and a soothing influence which will outlast the very serious difficulties of demobilisation. There are millions for whom the only "trench" during these two years has been the factory at Home, and amongst these a "high wages habit" has been established; and hundreds of thousands, either through disablement or death, or the liking for open-air life, will never return to factory life.

We need to remember that for many years prior to the war the workers were struggling and fighting periodically in individual trades—almost incessantly if we consider all trades together—for concessions from employers, from Capital and from Industry. During the war these workers have been told almost to the point of weariness that they by their efforts are winning the war quite as much as the men with the fighting Forces. Is it to be supposed that they will forget that fact after the war when they renew their claims? Already the Voice of Labour has been letting us know in very clear tones that the fruit of former struggles, what are termed the rights of the worker, the better wages, the shorter hours, the improved conditions, must not be filched from them as a result of the war. Have they not had the definite promises of responsible legislators that they shall not be so robbed? The inevitable economic consequences of the war, the inability of industry to carry all the burdens that it is

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sought to impose, the effects of supply and demand upon employment, these and other factors may exert an influence in connection with the fulfilment of those promises when the time comes. But with all the softening influences and all the promises of ministers, human weaknesses will remain, and we shall be guilty of the gravest of errors if we count too much upon the approach of an Industrial Utopia after we are at Peace again, especially remembering that during the last two years, when we have been fighting for our lives against the enemy, there have been frequent rumblings of discontent in Labour circles, and disgraceful unwillingness in some parts of the country to rise to the occasion and increase the output of munitions of war and of ships. Even during the last few weeks our newspapers have been reporting disaffection in many trades, and everybody knows that Labour's eyes have recently been turned somewhat longingly in the direction of Australia and New Zealand, where wages are higher, where pensions are larger and are paid at an earlier age than here. One Labour spokesman has declared that if Labour swallows the Australian policy of Protection it will want these compensations in return. Other Labour men hold that they cannot have such rewards unless the economic position is rectified along Protective lines.

We have, of course, no desire to exaggerate the possibilities of the situation, but manufacturers' associations have not been slow to recognise the importance of facing the Labour problem as far in advance of demobilisation as is practicable. The Government has its committees studying the question, and Labour, through its organisations, is engaged very seriously formulating proposals for securing the position of the working classes after the war. We give below some of the proposals that have been advanced, as we think it most necessary that those interested in industry should keep themselves informed respecting the policies, principles, and aspirations to which certain sections of the workers have announced adherence.

In April the following programme was adopted by what is called the Triple Labour Alliance; this Alliance consists of the Miners' Federation of Great Britain, the National Union of Railwaymen, and the Transport Workers' Federation:—

1. That any departure from Trade Union practices which have been made to accelerate production and distribution shall terminate upon the resumption of peace.

2. That all workers, whether men or women, who have been employed as substitutes shall be on their disemployment, provided with other work at the standard living rates or with full maintenance by the State.

3. That the Government be urged to arrange for the demobilisation of all those who have joined for the duration of the war in such a manner as shall lead to their gradual absorption into their civil occupations.

4. That all men desiring to do so shall be granted extended furlough on full Army pay and separation and billeting allowances in order to recuperate themselves at the end of the war.

5. That a registration bureau be set up with management powers half of which shall be Trade Union representatives appointed by the various Trade Unions with full executive power, in order to deal with the transition stage, and that men who had severed their connection with the Army who cannot procure employment shall be insured full employment by the State.

It will be observed that this Alliance is a very strong one, composed of organisations representing millions of workers whose occupation is vitally necessary for the maintenance of the industrial and ordinary life of the Kingdom. In (1), it sets up a claim for what has been promised under pressure of the most exceptional circumstances. Yet the fact remains that those who gave the promise on behalf of the nation have been loud in their condemnation of trade union practices because they meant limitation of output in the critical periods of war when we have been fighting for our lives and when the maximum effort of the nation was essential. Those who have studied such industrial questions in peace time during the past 10 or 20 years, and feel some anxiety in regard to the industrial conditions that will follow the war, realise that deliberate limitation of output—in other words, "trade union practices"—is as heavy a millstone round the neck of manufacturing industry for peace-time development as it proved to be in the production of munitions of war. It is profoundly hoped that Labour will have seen the error of its ways for itself—we are all learning lessons in practical experience in these trying days, and Labour, ready as it may be to fight for what it may call its "rights," must be induced to learn the seriousness of its responsibilities in relation to after-the-war production. Items No. 2 to No. 5 in this programme present demands which, of course, do not err on the side of modesty; there is apparently no bottom to the Empire purse! But these are points for the discussion of which the time is hardly ripe. The problem of demobilisation will call for anxious thought from the entire nation—from legislators, from industrial employers, and from labour organisations. To a large extent whatever after-war burdens are imposed will become a tax on industry, and the worker needs to learn that the burdens of industry must inevitably in the long run be passed on to the worker in some form or other, perhaps as unemployment consequent upon restricted business in some trades. At the moment we are not called upon to discuss these demands further; authorities have been appointed to investigate the prospective situation, and their findings will give us a basis for discussion in due course. It is announced that while the big combined organisation referred to has formulated the proposals given above, in other labour circles there is a disposition to investigate separately before adopting a programme. For instance, it is stated that a number of Trade Union leaders have appointed a Special Joint Labour Committee to report on labour problems after the war. It will consist of the following members, representing the organisations named:—

Trade Union Congress.—**H. Gosling, W. Thorne, M.P., and C. W. Bowerman, M.P.**

Labour Party.—**G. J. Wardle, M.P., J. R. Clynes, M.P., and J. R. MacDonald, M.P.**

Workers' National Committee.—**Robert Smillie, A. Bellamy, and Sidney Webb.**

General Federation of Trade Unions.—**Three members not yet appointed.**

Everything is to be gained by the most exhaustive study of the problems by Labour, especially if while the war lasts, it can bring to its deliberations some of that spirit of the trenches about which we hear so much. It is to be hoped that in such deliberations the questions will not be viewed short-sightedly. The rights and the best interests of Labour will be more permanently safeguarded if the problems of national industry and trade, and their bearing upon employment and unemployment, are carefully and sympathetically studied as a whole. Labour and Capital both need to take a long view in the critical inquiries and negotiations that should lead on to reasonable compromises in the interests of the entire Empire. To advance extravagant demands without due regard to the question of national trade policy, and to the need for protecting ourselves in some way or other against the outside aggressor, if and when he resumes his characteristic trading methods, will be a hindrance to peaceful and satisfactory inquiry.

We are sympathetically drawn by some parts of the programme of the British Workers' National League, whose recent magnificent initiatory meeting at Queen's Hall was addressed by Mr. W. M. Hughes, the Prime Minister of Australia. The avowed objects of this League are:—

1. The application of the War's emphatic lessons (1) that Competition and Private Profit-Seeking lead to Waste, Inefficiency, Fraud, and National Disunion; and (2) that the full Expansion and National Use of National Resources in Peace or War absolutely depend on the National Control of Vital Industries under the joint management of administrative and manual workers in the interests of the whole nation.

2. The establishment on a democratic basis of defences adequate to the Empire's security, by the recognition of every citizen's duty to defend the life of the State. This naturally involves the State's reciprocal duty to guarantee the citizen's right to live—that is, the right to work at a full living wage.

3. The Federation of the British Free States under a governing council, representing all portions of the Empire, for the direction of Imperial and Foreign policy.

4. The modification of our international commercial policy, with a view to the political and economic defence of the British States and their Allies.

5. Educational reform on a national scale to secure greater technical efficiency combined with more democratic general access to knowledge.

6. Drastic agricultural reform to secure the full scientific development of the land in the national interest, with especial regard to the employment of ex-soldiers and sailors.

7. The realisation of free democratic government based on Universal Adult Suffrage, instead of the actual Government by caucus and money-power.

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We do not propose to comment upon all the planks in this platform—they do not fall immediately within our industrial scope; but No. 4, relating to the future commercial policy of the British States and their Allies, was the one point upon which the speakers were unanimously emphatic, and the one which the vast audience vociferously cheered again and again. Making full allowance for all the glamour that would be cast around the proceedings by the presence of a Labour Prime Minister from the Antipodes, who had come Home to strike a definite note when so many other voices were weak or silent, we have to say that the definiteness and strength of the speeches of Labour men left no room for doubt about their enthusiasm for an Imperial Labour policy such as Mr. Hughes has been urging all along. To our mind, so far as British Labour Trade policy is concerned, the speech of the chairman, Mr. Hodge, M.P., was as important as that of Mr. Hughes. In brief, both of them recognised that the workman cannot expect to secure higher wages and to realise the ideals of a healthy and virile population unless the manufacturer "knows where he stands." It will help us to understand the importance of this movement, in relation to those of other Labour sections which condemn anything in the nature of an economic war with Germany, if we give the names of the men who are more prominently associated with the League:

Chairman.—A. M. Thompson.
Hon. Sec. and Treasurer.—Victor Fisher.
[To whom all communications should be addressed at 22, Buckingham Street, Adelphi, W.C.]
Assistant Hon. Sec.—Irene Fisher.
Chairman Organisation Committee.—J. A. Seddon.
Vice-Presidents.—Right Hon. W. Abraham, P.C., M.P., Right Hon. W. Crooks, P.C., M.P., Charles Duncan, M.P., John Hodge, M.P., James O'Grady, M.P., C. B. Stanton, M.P., Stephen Walsh, M.P., A. Wilkie, M.P., H. G. Wells.

The Queen's Hall meeting is to be followed by similar big gatherings organised by the League; these are to be held in different centres of the provinces, stimulating or focusing the opinion of Labour.

(*To be continued.*)

G.E.C. CADET CORPS.

In most of the large and industrial concerns in the country considerable numbers of youths, between the ages of 15 and 18 years, are employed. Many of them have been Boy Scouts, and, if they are given the requisite encouragement, they will take an active part in making themselves fit for military service when they reach the legal age for enlistment. It is, however, desirable that the encouragement take the form of practical support from their employers, and undoubtedly much good work can be done to establish an active Cadet Corps among the youth of manufacturing undertakings and commercial houses. We learn that Mr. H. Hirst, the chairman of the General Electric Co., Ltd., has instituted the G.E.C. Cadet Corps (attached to the Sussex Yeomanry), which has now been on an active footing for nearly two months, and which, we hear, is already at "full strength."

The uniform and equipment, comprising khaki tunics, breeches, caps, belts, haversacks and puttees, have been supplied to the Corps by the company without charge. What might have proved an insuperable difficulty in the formation of the Corps has thus been removed by the generosity of the company.

The first Corps is commanded by Captain E. A. Joyce, who has on his staff First Lieut. A. V. Cannon, and Second Lieut. W. F. Arnold. We reproduce a portrait of these officers herewith. This Cadet Company is attached to the First Cadet Battalion of the Sussex Yeomanry and is 112 strong, consisting of two platoons. Khaki uniform is worn, and both officers and "men" are recognised by the War Office.

The training is given in accordance with the 1914 Infantry Training Regulations, and we understand that the Corps, although it has been in existence a comparatively short time, is already displaying marked ability. We gather that the cadets are put through a regular course of shooting once a week at the 10 target range at the Cripplegate Institute. Squad and Company drill is undertaken on Friday evenings at the Institute, and on Saturdays the Corps, by permission of the Inner Temple Gardens' Association, drill in the Temple Gardens, which should prove an ideal ground for the purpose. It will be seen, therefore, that the movement is proceeding upon "regular" lines, and that the training will be of immense value as preparatory work to that which will be undertaken when the Cadets come to be called up.

OFFICERS OF THE G.E.C. CADET CORPS.

THE G.E.C. CADET CORPS.

More than ordinary interest attaches to the Corps, because it has been brought into existence by the help of the management of the General Electric Co., who inform us that not only is the training of immense value in developing the physique of the lads, but it contributes considerably towards increased efficiency in business by making them take a greater interest in themselves, by accustoming them to discipline, by improving their manners, and last, but not least, by the establishment among them of *esprit de corps*.

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NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Small Humphrey Type Pumps.

We illustrate herewith (fig. 1) an interesting development of the Humphrey gas pump, which, as our readers will remember, was originally designed to deal with water in bulk quantities, to meet the requirements of waterworks and for similar duties.

The new-type of pump has been developed for small uses, which are, of course, much more numerous than the large ones, and at present two sizes, with power cylinders of 3 in. and 6 in. diameter respectively, are made. The new pumps work on a two-stroke cycle

The power cylinder at the top contains a piston, with the piston rod projecting through the top cover and attached to a heavy metal crosshead, circular in shape (shown resting on the cylinder head in our view). This crosshead is connected by side rods to a lower crosshead, which in turn is connected to the pump bucket in the pump at the lower end. The power cylinder has a mechanically operated exhaust valve at its lower end, and, part-way

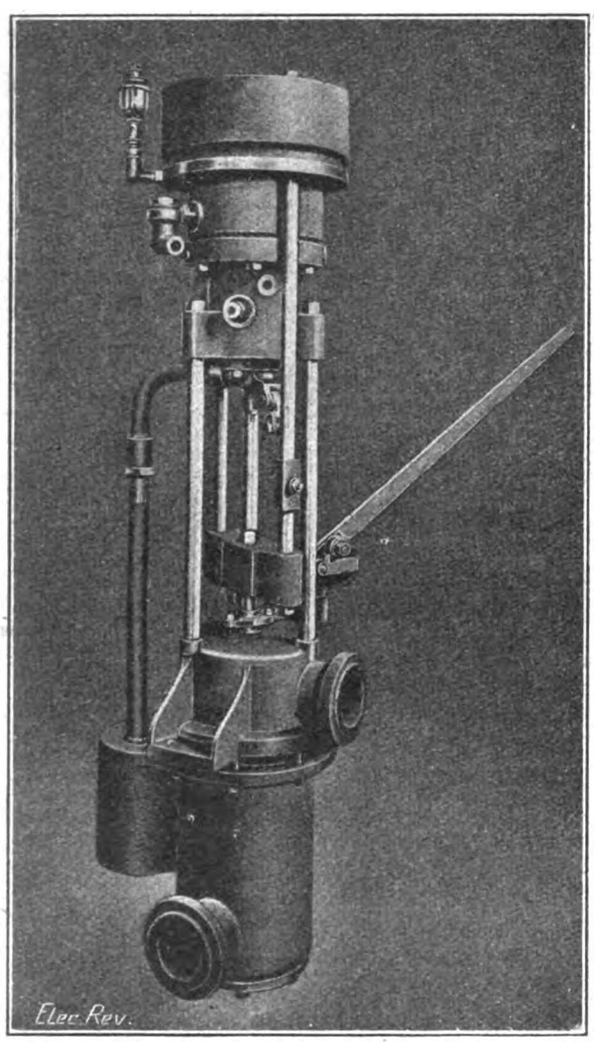

FIG. 1.—HUMPHREY GAS PUMP.

up, a row of gas and air inlet ports. Assuming the piston to be at the bottom of its stroke, with a compressed gas charge below, on ignition of the charge, the piston, with the crossheads, &c., and pump bucket, is forced up—the bucket forcing out the water above it and drawing in fresh water beneath through a foot valve.

In the power cylinder the upstroke of the piston has compressed a charge of gas and air in the cylinder top and mixing chamber with which the ports communicate. The piston overruns the ports and the compressed charge then enters the cylinder, assisting to drive out the burnt gases through the exhaust valve which has opened in the meantime. The exhaust valve closes and the piston with the weighty parts connected to it falls, compressing the new charge again ready for the next stroke.

It will be noted that the pump movements are gas-cushioned, but as a precaution a corrugated rubber pad is placed on the cylinder head to cushion the falling crosshead if necessary.

The explosive charge is ignited electrically, but under some circumstances the charge may ignite itself; if pre-ignition should occur it would only shorten the working stroke of the pump.

The water ends are made in various sizes to suit the quantity of water to be pumped, which becomes less as the head increases. For instance, the 3-in. pump output varies from 9,200 gals. per hour at 8 ft. head to 575 gallons at 172 ft.: the 6-in. pump output varies from 46,800 gallons an hour at 12 ft. head, to 1,500 gallons at 500 ft. The 3-in. pump weighs 350 lb. and the 6-in. 1,630 lb. the former consuming approximately 20 cb. ft. of gas or ¼ pint of petrol an hour.

"Holdfast" Lamp Guards.

The L.P.S. ELECTRICAL CO., of 18, Adam Street, Strand, W.C., are introducing the patent lamp guard—the "Holdfast"—for glow lamps, shown in fig. 3, consisting of a clamping collar, forming a rigid guard to the socket, from which is suspended a wire cage containing an internal spiral-spring cushion fixing the position of the lamp bulb. Between cushion and guard there is a 1-in. clearance which not only protects the lamp from jars, but keeps it at a safe distance from anything combustible. A special trap lock prevents the unauthorised removal of the lamp. These guards have been in use 11 years and are guaranteed; they are designed for all lamp sizes from small carbon to 1,000-watt pear-shaped metal-filament lamps.

"Verilux" Glass.

"Verilux" is a new three-ply glass, which has recently been placed on the market by The GENERAL ELECTRIC CO., LTD., of London, designed to produce, in combination with tungsten lamps, a close and permanent approximation to daylight. The inmost layer of the glass is a colour-straining medium, the next is a diffusing medium, and the outside layer is of clear glass to provide the necessary "body" or strength. Light transmitted through this glass emerges as a precise imitation of daylight, and is free from glare. There is no restriction on the shape or dimensions of the globes made for this purpose, but the best results are obtained with the deep bowl or the spherical types (fig. 4), which ensure that practically all the rays are transmitted through the glass.

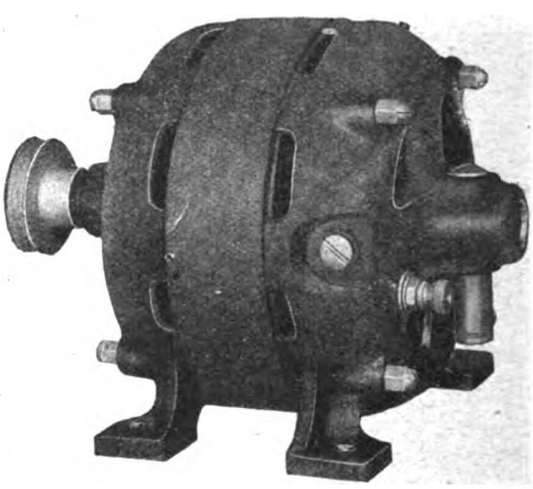

FIG. 2.—B.T.H. ¼-H.P. MOTOR.

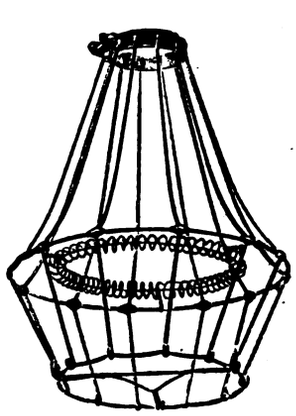

FIG. 3.—"HOLDFAST" LAMP GUARD.

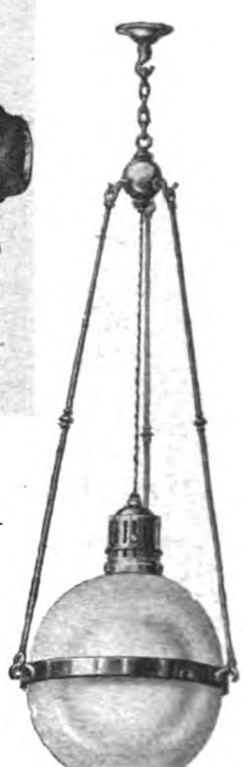

FIG. 4.—PENDANT FITTED WITH SPHERICAL "VERILUX" GLASSWARE.

Owing to the high efficiency of the Osram and Osram-Atmos type lamps, the loss due to absorption by this glass is, for all practical purposes, unimportant, but in any case the commercial value of artificial daylight is so high that a slightly lower efficiency will not affect the popularity of the "Verilux" glass. There are many industries which, for want of such an invention, can be carried on for only a few hours each day during the winter months; the number and variety of such industries is much greater than most people imagine. In domestic and office lighting there is also a field which is worth cultivating.

Small-Power Motors.

The BRITISH THOMSON-HOUSTON CO., LTD., of Rugby, has put on the market a series of motors of very small powers, for which the qualities of cheapness, efficiency, and reliability are claimed. One of them is illustrated in fig. 2; it will be noticed that the field-magnet consists of steel laminations, riveted together, and forming the main frame of the motor, to which the malleable-iron end-shields are bolted. The latter contain the bearings and brushes; the bearings are fitted with grease cups on the underside, arranged for wick lubrication. The figure shows a D.C. motor (type S.D.,

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½-H.P., 110 volts), but single-phase motors are also made, very similar in appearance and construction; the sizes range from $\frac{1}{200}$ to ½ H.P., at 110 and 220 volts, 50 cycles A.C. and D.C. The D.C. machines of type S.D., up to $\frac{1}{10}$ H.P., are shunt-wound, larger sizes compound-wound. From $\frac{1}{200}$ to $\frac{1}{5}$ H.P., both A.C. and D.C. motors are designed with series characteristics, and have commutators; the A.C. motors, type S.A., from $\frac{1}{50}$ to ½ H.P., are of the split-phase induction type, with the primary winding on the rotor, and the secondary on the stator; at full speed the starting winding is automatically cut out of circuit. Carbon brushes are used in all cases, with fixed holders.

Small Shell Inspection Lamp.

Messrs. Ward & Goldstone, of Sampson Works, Salford, Manchester, are placing on the market a small type of shell inspection lamp specially designed for inspecting small shell interiors. A feature of the lamp is that the guard protecting the bulb is only ¾ in. in diameter; a proportionately small bulb is used and is energised from a dry battery, the handle being fitted with a push contact so that current is not wasted when the lamp is not in use.

A long length of flexible is provided connected to the battery; the firm's "Volex" 4-volt batteries give from 80 to 250 hours for intermittent use.

LEGAL.

Hill *v.* John Lysaght, Ltd.

In the King's Bench Division, on May 16th and 17th, Mr. Justice Bray and a special jury heard an action brought by Albert Edward Hill, an electrical fitter, against John Lysaght, Ltd., London and Bristol, to recover damages for personal injuries sustained, as it was alleged, through the alleged negligence of a servant of the defendants, who are a firm of ironmasters and engineering contractors. The defendants denied the alleged negligence.

Mr. Vachell K.C., and Mr. S. Duncan were for the plantiff, and the defendants were represented by Mr. Clavell Salter, K.C., and Mr. Raynor Goddard.

The case for the plaintiff was that the defendants in July, 1915, were engaged on certain Government constructional work in the eastern counties in connection with a large shed with galvanised iron sides 300 ft. long, 100 ft. broad, and 50 ft. high, the work being very urgent. The task of putting in an electrical installation was in the hands of the firm of G. E. Taylor & Co., and it was by this firm that the plaintiff was actually employed. The plaintiff was employed running metal tubes over the building, electrical wires, and fixing fuseboards. While he was thus engaged working on a high scaffolding, an employé of the defendants, who was higher up, dropped a heavy bolt which struck the plaintiff on the left forearm with great violence, causing a lacerated wound. He suffered from this for a long time and also from nervous troubles consequent on the injury and shock. The plaintiff gave evidence to bear out these statements, and denied that he was warned on behalf of the defendants against working on the electrical fittings while the men were working on the iron girders above. Other employés of Taylor & Co., who were engaged with the plaintiff, deposed that no warning was given by any of defendants' men as to danger overhead.

Archibald Lowe, the foreman of Taylor & Co., said he always warned his men to look out for others above them, and he had on occasions found his men working elsewhere if they found the ironworkers were too close.

Mr. Clavell Salter, K.C., submitted that there was no evidence of negligence against the defendants.

Mr. Justice Bray said that the case was "very near the line," and he would hear the evidence called on behalf of the defence.

Mr. Salter, K.C., in opening the defence, said that the employés of Taylor & Co. were continually warned by the defendants' foreman of the danger of working beneath the men engaged on the iron work, but all the warnings were disregarded. Work of this character was necessarily dangerous, and the dropping of bolts, tools, &c., occurred without negligence. The evidence showed that the plaintiff was not bound to work at this spot; and Taylor's men were continually warned of the danger of working under the men on the ironwork. He asked the jury to say that the claim against the defendants was unfounded, and that the real liability lay on the plaintiff's employers, Taylor & Co., or the insurance company by whom they were insured.

Mr. Geo. Carpenter, defendants' foreman, gave evidence, and, in the result, the jury returned a verdict for the defendants, for whom judgment was entered, with costs.

Knowles *v.* Electrolytic Plating Apparatus Co., Ltd.

On May 18th, the Lord Chief Justice, Lord Justice Warrington, and Mr. Justice Lush, heard an appeal respecting the sale of a quantity of nickel anodes for electro-plating. The appeal was from a decision of Mr. Justice Bailhache, at Birmingham Assizes, and the parties to the proceedings were Mr. J. W. Knowles, of Oldbury, and the Electrolytic Plating Apparatus Co., Ltd., of Birmingham.

Mr. Maddocks, for Mr. Knowles, explained that Messrs. Shaws, Ltd., of Willenhall, sold a number of nickel anodes to Messrs. A. S. Smith & Sons, of Walsall, and they resold them to the Electrolytic Plating Co. The last-named firm sent, at the request of Messrs. Smith, a cheque for £105 to Messrs. Shaws, and the cheque passed to Mr. Knowles, a debenture-holder of Messrs. Shaws. The Electrolytic Co., finding, as they alleged, that the anodes were of no value, stopped the cheque. Mr. Knowles at once took legal proceedings on the cheque, alleging that having received value for the money the Electrolytic Co. could not legally stop the cheque. The Electrolytic Co., however, counterclaimed for breach of contract with regard to the anodes, but Mr. Knowles contended that having received the articles from A. S. Smith & Sons, the remedy of the Electrolytic Co. was against that firm and not against him or Shaws, Ltd., at all. Mr. Justice Bailhache held for Mr. Knowles on the counterclaim by the Electrolytic Co., and for the last-named company on the claim by Mr. Knowles. Consequently, both parties appealed.

Their Lordships, on Friday, dismissed both appeals, with costs. The Lord Chief Justice said that to succeed Mr. Knowles would have to show that Shaws, Ltd., supplied nickel anodes, whereas it seemed a fact that what they sold to Messrs. Smith was scrap nickel. Consequently, the Electrolytic Co. did not receive value, and were entitled to stop the cheque. On the other hand, to succeed in their counterclaim against Shaws for alleged breach of warranty, the Electrolytic Co. would have to prove that Messrs. Smiths bought the nickel as their agents. Seeing that it was a well-known fact that the Electrolytic Co. could only use anodes containing not less than 96 per cent. of nickel, it seemed improbable that Messrs. Smiths, had they acted as agents for the Electrolytic Co., would have bought for their principals scrap nickel containing 91 per cent. of nickel. Consequently, Messrs. Shaws could not be sued by the Electrolytic Co. for breach of warranty.

Scobie *v.* L.C.C.

Before Mr. Justice Bray, in the King's Bench Division, on May 18th, a special jury awarded Private Stewart Homer Scobie, a Canadian soldier, £500 damages against the London County Council. Plantiff, formerly a horse trainer at Saskatchewan, joined the Canadian Expeditionary Force, and was wounded in France. On October 11th, 1915, just before midnight, while crossing the Kennington Road, he was knocked down by one of the defendants' tramway cars, receiving such injuries that his right arm had to be amputated.

Munitions Cases.

An important ruling was given at a sitting of the Oldham Munitions Tribunal last week. A firm of electrical instrument makers charged an employé with having failed to work regularly and diligently on April 19th and following days. On April 18th the man applied for a leaving certificate, so that he could return to the mill, but his application was unsuccessful. He had not been back to his work since. The man now said he had not been at his work since April 5th, and had been out of work the full six weeks allowed under the Act before he could take another situation. The Chairman (Mr. James Hodgson) consulted with the assessors, and then announced that, in this case, an important point had been raised as to whether a man who left his employment with no intention of returning, was liable to a penalty, in addition to the punishment he voluntarily incurred by the loss of six weeks' wages. It was a point of law, and, accepting the man's statement that he had not worked since April 5th, he held that there had been no infringement of Rule 2, because he was not working on April 19th, the date on which he was charged with having failed to work regularly and diligently. No further penalty could be enforced, or the man would be penalised twice for the same offence. The case was therefore dismissed.

At the same Tribunal an electrical firm charged a youth with having neglected his work. It was stated that the foreman had had nothing but trouble with the youth, and what the latter really wanted was to leave his work and go into the Army. The firm could not commend his conduct, but believing that discipline would do him a great deal of good they were prepared to let him go into the Army. The youth now stated frankly that he had been asking the foreman for months if he would allow him to join the Army, but he had always refused. He was willing to join now. The firm's representative said the youth's conduct had been such that they would not be able to offer him a situation after the war, nor could they guarantee the allowance which they usually paid to dependents. The case was withdrawn, and the youth was sent off with the good wishes of the chairman of the Tribunal and also of the firm's representative.

A Peculiar Line Trouble.—The operator in a sub-station connected with a long-transmission line recently noticed that his lightning arresters were discharging regularly at short intervals. Since it was a clear day, and there was apparently no trouble on the line, he was at a loss to know the cause of the disturbance. The line was, however, inspected, and after going out from the station a distance of 19 miles, it was found that the galvanised-iron ground wire above the line had slacked off and was swinging in the wind. Every few minutes it would swing over within spitting distance of the line and cause a surge which resulted in the discharge through the lightning arresters in the sub-station 19 miles away. This is one example of the peculiar ways in which surges may manifest themselves, and travel along the line.—*Electrical World.*

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SERVICE BRANCHES FROM EXTRA-HIGH-TENSION CIRCUITS.

By D. M. MACLEOD, M.I.E.E.

(*Abstract of paper read before* The Institution of Electrical Engineers *at Glasgow.*)

With the rapid growth and development of power supply from central stations generating and delivering alternating current, the problem of an efficient and economical mains lay-out has become of paramount importance. Every method must be tried to reduce to a minimum the outlay involved in feeder and network extensions, compatible with reliability of supply.

The ring-main system of distribution possesses undoubted advantages, one of the most important being that supply can be maintained to all consumers even though a fault should occur at one point on the ring circuits. To achieve the best results from this method of distribution it is essential that some system of balanced protective gear should be installed.

When a supply is required for a large power consumer, there is seldom any question as to its being obtained from or incorporated with the nearest available ring main, even should the consumer's works be situated some distance therefrom, as the importance of the supply on the commercial as well as on the engineering side is such as to justify the capital expenditure involved in looping-in the ring-main circuit and providing the necessary sub-station and balanced protective equipment.

In some cases, however, a comparatively small supply for an isolated works may be all that is required, or the return to be expected is totally inadequate to justify the heavy outlay that would be entailed in looping-in the ring-main cables. Under these circumstances the supply authority requires to exhaust every possible economical method of distribution in order to fulfil its obligations and ensure, at the same time, an adequate return on the capital employed.

In a number of cases the power supply required is too small to justify the cost of even a single branch with switch-house and consumer's sub-station equipment. Such cases can often be met, however, by the installation in lieu of the switch-house of an extra-high-pressure junction box; this course has been successfully adopted by the author during the past eight years.

The following table gives some indication as to percentage cost of various methods of delivering a supply of, say, 100 kw. to a point distant, let us assume, one mile from the line of route of a ring-main cable, it being understood that the point of supply is so far removed from any transforming station that a low-tension service line is not considered to be economically practicable.

(*a*) Cost of looping-in ring-main cable, auxiliary cables, and consumer's sub-station equipment 100
(*b*) Cost of laying branch cable and auxiliary cables, building and equipping switch-house, and equipping consumer's sub-station 64
(*c*) Cost of laying branch cable and auxiliary cables, link box, and equipping consumer's sub-station 53

The percentages are calculated for underground cables in each case. In the case of (*a*), overhead transmission is not admissible, as the expense of a double line built in accordance with Board of Trade requirements and accepted modern practice would show to very little advantage compared with underground cables laid in a common trench. Overhead transmission is, however, often quite admissible in the case of (*b*) and (*c*), and if adopted would make the percentage cost of these two methods still more favourable.

These figures show at once the economy in first cost in using branch services controlled from an extra-high-tension link box at the point of junction. The results achieved with these boxes have been uniformly successful.

Specifications and preliminary sketches clearly defining the functions and conditions to be met, were submitted in 1907 to the principal manufacturing firms throughout this country. At that time the application of link boxes to 11,000-volt circuits was considered to be so daring that one or two firms declined to tender. Fortunately, however, Messrs. Siemens Bros. submitted a design which clearly fulfilled all the requirements of the case, and which provided, in the author's opinion, a reasonable margin of safety both as to the insulation of the current-carrying parts and as to the safety of the operator. The design submitted was, subject to a few modifications, the one finally adopted by the power company with which the author is connected.

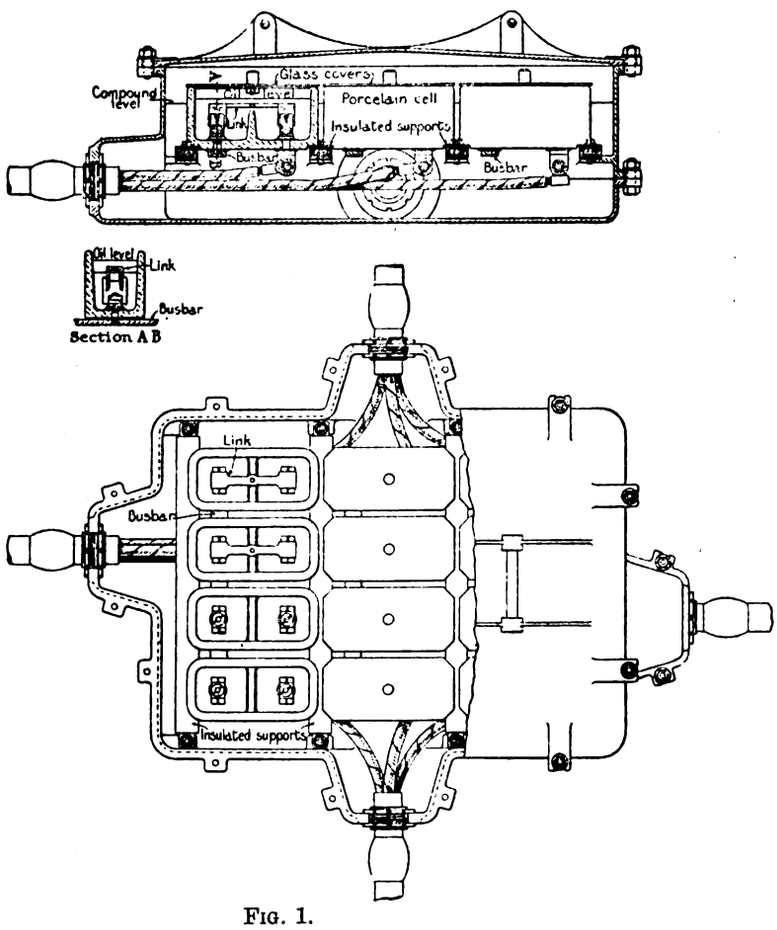

Fig. 1.

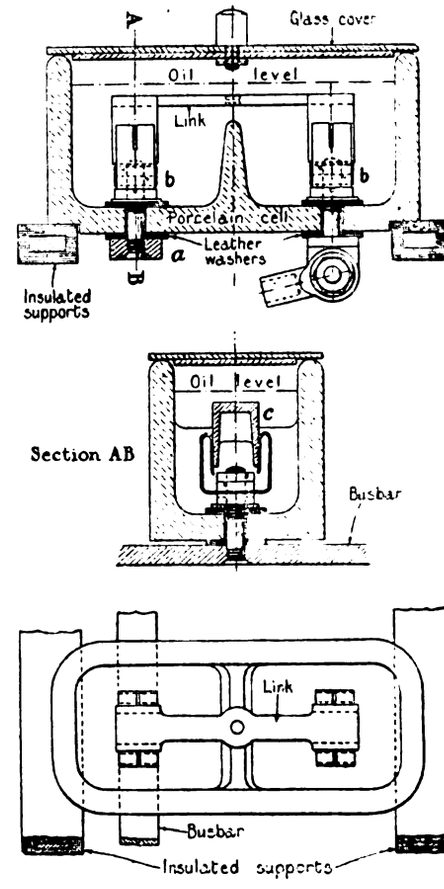

Fig. 2.

The general arrangement of the link box is shown in fig. 1. Each main and service cable is brought into the box in such a manner as to leave no doubt in the mind of the operator as to its identity. This very important feature is frequently overlooked in link-box design. All disconnecting boxes should embody in their design their own diagram of connections, thus leaving no doubt as to the route and purpose of each cable entering them.

The link box consists essentially of a rectangular cast-iron box in three portions, so arranged as to facilitate assembling and jointing. The internal fittings consist of a number of porcelain cells, one for each cable core. Details of one of these cells are shown in fig. 2. Through the bottom of the cell pass two studs, one of which is in metallic contact with a bus-bar (*a*), and the other is directly connected with one of the cores of the cable. To these studs are attached two main contacts, *b b*, and these again are connected together by means of a removable link *c*. The porcelain cell is of a suitable depth to provide for the link being immersed in oil. Each cell is provided with a glass cover, and in the centre of

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each link is a screwed hole into which the operating rod is screwed for the removal or insertion of a link. These cells are assembled in groups corresponding to the number of phases, and they are embedded in the box compound with which the greater portion of the cast-iron box is filled.

Referring to the cast-iron box itself, the bottom joint passes through the main cable glands, and the faces are machined and fitted throughout. This arrangement provides the maximum of accessibility, in that it allows of all the cable cores being set into position and jointed up before the box is finally assembled, and when this is done nothing remains but carefully to wipe the lead of the cable to the brass glands of the box.

The complete jointing of one of these boxes occupies too much time to permit of all the work being done at the site. Obviously the ring circuit would require to remain open all the time this work was being carried through, and that being so, the risk has to be taken of another section of the main opening under fault conditions, thus endangering supply to a more or less extensive area. This difficulty is got over by jointing into the link box short lengths of cable of the required sectional area. After assembly the box is transported *en bloc* to the required site, where two or more cable jointers make the requisite straight joints in the minimum of time.

These boxes are not intended to break load, but simply to disconnect a line under pressure. In one or two cases of emergency a connection has been both broken and made under load, but the carrying out of this operation demands a cool head and a steady hand, the flash and noise when the circuit is either made or broken under these conditions being considerable.

Special care has in all cases to be taken to eliminate any traces of moisture inside the box, and this is done by means of an exterior vessel containing calcium chloride. This vessel is directly connected with the box by means of a short piece of screwed tubing, so that the chemical can be renewed when required without the necessity of opening the box cover.

In the construction of the box chamber, every care must be taken to exclude surface or drainage water. The chamber therefore usually consists of a shallow pit built of 9-in. brickwork on a 6-in. bed of concrete, this brickwork being surrounded by a 4½-in. brick wall so placed as to leave a space of 1 in. or more between the two walls. This intervening space is filled with bitumen run in hot, and thus ensures a perfectly dry chamber under all climatic conditions. Care has also to be exercised to exclude moisture when opening the box, particularly in damp weather, this operation being carried out under a jointer's tent.

It has been found in practice to be quite feasible to take branch services off sections of cable controlled with balanced protective gear. At first sight it might appear that the taking off of such intermediate services would disturb the static balance in the current-transformer secondary circuits. Theoretically this is undoubtedly the case, but when it is borne in mind that in actual practice the relays employed in connection with a balanced protective system are usually set for operating on a fault current of from 60 to 200 amperes, it will at once be apparent that there is an ample margin within which it is possible to give a branch supply without materially impairing the efficiency of the protective system. Nevertheless, it has been found necessary to install a no-volt release at the supply or consumer's end of such service branches, as otherwise the static balance is liable to be disturbed in the event of any sudden fluctuation of voltage, caused, for example, by a fault on the external circuit.

Supplies given off these service branches are subject to the disadvantage that they are liable to temporary interruption if a fault should occur on that portion of the ring-main circuit off which the branch is tapped. This is, however, not a serious objection, as it is a simple matter to test out, disconnect the faulty section, and restore supply over the sound portion of the ring-main section. Obviously, it is in this connection that the disconnecting links are of special value.

It will be readily understood that in a widely scattered industrial area the field for such devices is fairly extensive. Branches are often extended from time to time for miles, continuing from one point of supply to another, until in the ultimate course of development it is found practicable to reconnect the far end either with another similar branch or with another point on the ring circuit, the branch ultimately becoming part of a subsidiary ring. The original box is then withdrawn and a switch-house substituted in its place. With development carried out in such a manner, it is possible to make each extension on a minimum of capital outlay, the supply network by a process of steady growth being extended over a wider area to the mutual advantage of the industrial community and the supply authority.

One of the chief sources of reliability is simplicity, and the author is a confessed advocate of the single-branch service as the most direct method of securing reasonable freedom from failure for all classes of supplies, except those the magnitude or importance of which makes inclusion on a ring circuit imperative. All such service branches should, in every case, be laid complete with the necessary auxiliary cables for a telephone service and pilot wires, so as to permit of the steady development of the branch in the direction already indicated.

It is, of course, not contended that these link boxes are applicable in every instance, but it is undoubtedly the case that their use makes it possible to secure business which would otherwise be most difficult to negotiate.

A demand sometimes arises for small lighting and power supplies for farms or residential property along the route of overhead transmission lines. There is a growing tendency to make the granting of wayleave facilities, especially through residential estates, conditional upon the giving of a lighting supply to the owner's house. Where such a condition has been imposed it can be very readily met in the case of a low-tension transmission line, but in the case of an extra-high-tension transmission the solution is not so simple. The author has met the difficulty by using small pole-type transformers. The reliability of transformers of this type has been fairly well established. No effort should be spared to create and develop a demand for electrical energy on the part of the small power consumer. No scheme of electrical power distribution may be considered complete which finds no place in it for the small trader or the ambitious workman who desires to become his own master. Only by such means can an appropriate place be found for electricity in the service of man.

Discussion.

Mr. Mitchell said he was in complete agreement with the author; the taking of branches off high-tension loops was now recognised as quite good practice. The N.E. Coast system did not use these junction boxes, but a large proportion of the system was on 20,000 volts, and junction boxes would not be so satisfactory at that pressure as they were at 11,000 volts. In Glasgow, following the Clyde Valley Co.'s lead, they had used these junction boxes for some years. They had eight working and another was being put in, and they gave complete satisfaction. They had not had to open these boxes in an emergency during the whole time they had had them in use. In the diagram shown in the paper the positions of the bus-bars were in proper sequence, but he thought the bus-bars on phases one and three should be kept always to the outside of the box for the sake of getting longer bends on the cores to the cable terminal contacts, which would then be towards the inside of the box. With regard to the identification of the bus-bars, he had thought of fixing a piece of porcelain to each bus-bar which would project up through the compound, and so identify the bar; they had not found assembling in a workshop a great success. They could put down a box with all the tails laid out in a country road, but in a crowded thoroughfare this was not possible. They had always to contend with gas and water pipes, and when all the tails were connected they might have to thread underneath these conduits, which subjected the cables to severe strains. He did not quite agree with the author with regard to the time lost in assembling a box *in situ*. It was not necessary to interfere with the loop until they had got the tails laid out; they had the tails which would ultimately connect the loop laid alongside the main cable, and after everything was connected up it was easy to shut down the loop section and make these two joints, and all the time during which the section was dead was that necessary for making the joints. With regard to the earthing of the cables at the box, he thought it was most desirable that facilities should be provided so that that could be done. Say that a fault existed on the branch leading from the box. The links would be drawn in the box on that cable, but the bus-bars would be kept alive. After the faults had been located it was likely that a joint or joints would require to be made, and it was then desirable that the faulty cable should be earthed if possible in the box, and at the other end also. The jointer's mind was at rest if he knew the cable was earthed at both ends. He showed a very simple and safe device which enabled this earth connection to be made in the box. This was done by substituting for the lid of each cell another lid of porcelain with a fitting attached which when the lid was placed in position made contact with the cable terminal contact. The fitting was connected on the outside of the lid by a length of insulated conductor to an earthing stud on the side of the box. The use of this device made the identification of the bus-bars all the more important. Also, the cable terminal contacts must be got at when identifying the phases preparatory to making the joints, and this would be a dangerous proceeding with the bus-bars alive unless the tester was absolutely clear as to the position of the live terminals. The use of this earthing connection enabled the phasing to be carried out in perfect safety. As to the advantages of the use of calcium chloride, his firm had not used that, and had not, so far, had any trouble through not using it. He asked whether the author had had any trouble due to the covers of the cells being made of glass. They had found a number of the glass lids broken, due to temperature change, when they had gone back to the boxes some time after they had been put in place. He thought that in future the glass lid might be replaced with a porcelain lid.

Mr. Wm. Nairn said that when he first learned, five years ago, that such boxes were in use he considered that their operation would cause the staff grave concern, but during that period not a single failure had occurred. The author had stated his opinion that "all disconnecting boxes should embody in their design their own diagram of connections." There was no doubt that this was a point of paramount importance, not only in the design of junction boxes, but also in the switchgear lay-outs in the sub-stations. Stonework partitions between feeders should differ considerably from the stonework partitions between the phases of the same feeder;

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isolating links should be placed immediately over and under the oil switches they controlled; remote-control bodies should be arranged symmetrically opposite the oil switches, and generally the whole design should be arranged on its own diagram of connections, as the author pointed out.

The Chairman (Mr. D. A. Starr) said that in a diagram of Canadian transformers shown by Mr. Macleod, these were enclosed with housing around. He did not think there was any Board of Trade regulation which insisted on such enclosure. He had seen thousands of these transformers in Canada for pressures much higher than the 11,000 volts which was used by the Clyde Valley Co., and these transformers erected on poles had no cover or housing whatever.

Mr. J. K. Stothert recalled some experiences. In 1890 he had to do with laying mains for one or two towns; it was before the days of oil-immersed transformers. They put the transformers in street boxes, and had a good deal of trouble due to dampness. They got over a good deal of the difficulty by using receptables, and tried calcium chloride and caustic soda, ultimately preferring the latter. The heating of the transformers inside the box rendered it difficult to keep the joints intact, and the joints shown on the screen would never have done. They had to use thick flanges and good jointing material to keep the joints damp-proof. They put a special gauge inside to find out the pressure.

Mr. R. A. Brown asked the size of the pit and the containing box for these transformers.

Mr. H. T. Burton stated his conviction that the development of the H.T. service lay in the overhead link. When the inconsistencies both of our wayleave laws and out legislature were changed, the American system of lattice poles, overhead switching apparatus, and overhead transformers would be as common on our highways and railway lines as telephone lines were at present. Overhead transformers were in more common use in the South than in Scotland, and four years ago he supervised work on a 6,000-volt 50-K.V.A. transformer which was mounted on a four-membered pole without weather protection, and gave satisfactory service.

Mr. Macleod, in reply, said he would not like to put forward those boxes for use with 20,000 volts, though he had no doubt that it would be a comparatively easy matter to alter them to suit that pressure. He would adopt the apparatus Mr. Mitchell had brought forward in connection with his work. He had had no experience with the cracking of covers, and could only suggest that the two pieces of glass had been screwed up too tightly. As to the suggestion of the chairman that housing was unnecessary, his experience was that the white porcelain boxes proved too great a temptation to stone-throwing boys when left exposed. The protecting frame was 4 ft. square, and the box chamber was flush with the inside of the frame, the depth being 16 to 18 in. He would have no hestitation in putting in an equipment of pole switchgear provided he was satisfied on the point of design. His view of the Merz-Hunter protection as applied to overhead construction was that it was likely to cause more trouble than it would prevent. In the Merz-Hunter system, where they duplicated conductors they doubled their troubles by doubling their insulators. A common insulator was now being used to meet this objection.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Economy in the Use of Coal.

In your "Notes" of May 12th you refer to the letter issued by the Board of Trade to gas and electric lighting undertakings, calling for their assistance in reducing the household consumption of coal by 10 per cent.

Perhaps it has not occurred to the Board of Trade that a very considerable economy in fuel consumption can be effected by a general change-over from the use of gas to electrical energy for illuminating and power purposes.

The output of gas per ton of coal varies from 10,000 cu. ft. to 13,000 cu. ft., according to quality of coal and the retorts employed. A 66-C.P. burner will consume 4 cu. ft. of gas per hour, therefore one ton of coal will supply light, under the most favourable conditions of plant and fuel, to 3,250 66-C.P. burners.

By employing electricity as the lighting agent, under the best conditions of plant and fuel not more than 3 lb. of coal per unit of energy supplied need be consumed, therefore one ton of coal will produce 747 units of energy, or 747,000 watts, and 11,318 one-watt lamps of 66 C.P. each will give 3½ times the light obtainable from 3,250 66-C.P. gas burners; *i.e.*, by using gas for illuminating purposes 3½ tons of coal are used to every single ton necessary to produce an equivalent illumination by the use of electrical energy, by which 70 per cent. of fuel can be saved.

By using half-watt lamps the proportion of fuel consumed is one to seven.

But a greater field for economy presents itself in the use of power. 25 cu. ft. of gas per H.P. is a fairly moderate estimate for gas-engine consumption, compared with 746 watts by the use of electrical energy.

One ton of coal will yield 520 H.P.-hrs. by the use of gas and 1,000 H.P.-hrs. by the use of electricity, which shows a saving of approximately 50 per cent. in coal consumption.

Perhaps steps could be taken to bring these facts to the notice of the Board of Trade, with the assurance that every electrical engineer will readily assist the Government to bring about this enormous reduction in coal consumption provided the Government will assist the engineers in obtaining adequate supplies of fuel and machinery to achieve the desired object.

J. Horace Bowden,
Borough Electrical Engineer & Manager.

Electricity Works, Poplar, *May 16th*, 1916.

Faults in Bitumen Cables.

The opinion of others would be welcome on the following problem. About eight years ago three bitumen cables were drawn into a 3-in. earthenware duct, the conductors being .1 in., .1 in., .075 in. Voltage across outers 440 v., continuous current. The positive cables have given trouble, while the negatives have not. In one fault the bitumen had disappeared at the fault, on one side of the cable, for a distance of about 6 in., the copper being green and eaten through. The bitumen was in good condition in other parts, except that the braiding was gone in a few patches. The duct is damp, but not excessively so.

I will be glad to hear from others who have had similar faults as to whether trouble of this kind is liable to spread rapidly or whether it remains local Also, if it is a good thing to change the polarity of the cables, so that the positive becomes negative and *vice versa*. Will such a change prolong the life of the cables, or will it bring their life to a sudden termination?

Bitumen.

Decimal Coinage.

Like all who have an eye on England's future I, too, am intensely interested in the decimal question. But why need Mr. C. Thorkelin bother further about the decimal money system? The problem has been solved for some considerable time by those far-seeing people the Esperantists. Their seven-year-old system (recognised by the London Chamber of Commerce) is based on the "Speso," an imaginary coin whose international value is .05s., 1,000 speso = 1 spesmilo, the practical unit; which is equivalent to 2s., 2m., 2½f., and so forth. The method of pricing catalogues, estimates, &c., is easy in the extreme. The contractor simply quotes in spesmilo or decimal fractions thereof, and that figure is comprehensive in all countries.

May I here offer a tip to engineers who are receiving or sending money abroad? Let them send it through the International Esperanto Bank (it is connected with a big London bank, by the way), and their *bureau de change* losses will go down rapidly. This is not intended as a free advertisement for the bank in question, but a frank exposition of personal experience.

Herewith is enclosed a money table issued by the bank, giving the relative values of the spesmilo to various units of monetary systems throughout the world.

I give this information for what it is worth, and hope that others may taste of the benefits which I myself have enjoyed for several years.

I would gladly give inquirers any information or addresses of firms abroad who I know use the system.

Alfred Bridges.

20, Wilsons Road, Hammersmith,
London, W., *May 20th*, 1916.

[It is interesting to note that the unit adopted by the Esperantists corresponds with that which we have recommended in preference to the franc or mark, namely, 2s., one-tenth of £1.—Eds. Elec. Rev.]

WAR ITEMS.

Exemption Applications.—At Middleton, an electrician appealed for the exemption of two wiremen. One—an apprentice with a mother and sister partially dependent on him—also appealed on domestic grounds, but he was ordered to report. The other man was granted exemption conditional on his remaining in his present occupation.

At Ramsbottom (Lancs.), on May 18th, an appeal was made for a tramway depôt foreman, and it was stated that he had been employed at the depôt since the local tramway system was commenced. The cars would stop altogether, it was stated, if this man had to go. Exemption till August 1st was granted.

At Chipping Norton, the Recruiting Officer applied for the withdrawal of certificates of exemption held by Mr. W. H. Hellyar (37), manager of the local electricity works, granted under Regulation 48, sec. 6, para. 2B, and Geo. G. Bates (21),

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electrical worker with the electricity company. Asked how many men were employed before the war, Mr. Hellyar replied that the number varied from seven or eight down to five. He now had only one other man of experience with Bates, two apprentices, and a Belgian, who assisted. There should be at least two on each shift, but he was now running with only one. There was a lot of mains work he had not been able to touch; in fact, there was work in this respect to occupy two or three months. He was now working with the minimum staff to maintain the private supply of light, and he himself was doing the mains work besides his own. The Tribunal allowed Mr. Hellyar's certificate to remain, but granted the appeal as to Mr. Bates.

Kingston-on-Thames Tribunal has granted exemption until August 31st to the head of the electrical department of W. H. Gaze & Sons, Ltd., who is largely engaged in carrying out installations at various munitions factories.

Margate Tribunal has refused any exemption to a local electrician who claimed to be in a certified occupation.

At Newton Abbot, the Urban Electric Supply Co. applied for exemption for a stoker as being in a certified occupation. The manager said it was impossible to get another man in his place. On a month only being granted, the manager said he should appeal to the County Tribunal.

At Canterbury, Mr. H. E. Philpot, electrical engineer, applied for absolute exemption, and he was given a conditional certificate. He also applied for a wireman, Alfred Fassum, who is engaged on important electrical installations for the Government. Mr. Philpot said that he himself and Fassum had been scheduled for badges, but some delay had occurred in obtaining them. This case was deferred for a month in view of the badges arriving.

At Exeter, on May 16th, Wippell Bros. & Row, engineers, of High Street, appealed for A. E. Wilson, the only qualified electrician left with the firm. Out of the staff of 27, 15 have gone. Exemption was allowed until July 31st.

At Sutton (Surrey), an electrical engineer appealed for his 19-year-old apprentice, whose indentures expire on September 30th, and whose services he desired to retain in order to be able to complete contract work, eight employés having enlisted. The appeal failed.

Beddington and Wallington Tribunal has granted a local electrical engineer, aged 36, exemption until August 31st.

Nuneaton Corporation electricity department appealed for seven members of the staff. Three were temporarily exempted until September 30th; the others were given conditional exemption.

At Oxford, the Electric Light Co. appealed for exemption for Wm. Chas. Coates (26), stoker at the generating station for the public supply of electricity. It was stated that 16 out of the engineering staff of 40 had enlisted. Conditional exemption as being in a certified occupation was granted.

Messrs. Webster & Sons, electricians, Folkestone, have appealed for H. J. Vine, the only engineer left besides the foreman. Four months' conditional exemption was conceded.

Mr. J. W. Darby, an engineer at the Caterham electricity works, has been given conditional exemption. It was stated by the manager, Mr. Howard, that there were only two engineers to work the night and day shifts.

At Torquay, on May 16th, Mr. Nisbett, manager of the Tramway Co., appealed for the chief clerk of the traffic department and an electrical fitter. The latter, it was stated, had been taken away once and placed in Devonport Dockyard, but he was released on an appeal being made. The chief clerk was exempted until September 1st, and the fitter was given conditional exemption.

At the Hastings Tribunal an electric wireman and general electric repairer and an ironmonger's manager were claimed by their employer, who stated that he had tried at the Labour Exchange for other men; over 20, or more than half, of the staff had joined the Colours. The case of the wireman was adjourned for him to be medically examined, and the other was given two months' exemption.

At the Blackpool Tribunal, on May 18th, a discussion took place regarding the employment of four young single men at Blackpool Corporation electricity works. Mr. Dunkerley said Mr. Furness, the borough electrical engineer, had made a statement to him about the men, and had explained that an Inspector from the Ministry of Munitions had been down and made application for badges for them. It was practically certain they would get them, but they had not received them yet. It was decided to ask Mr. Furness to attend and make an explanation at the next meeting of the Tribunal.

At Chatham, on May 16th, the Chatham & District Tramways Co. applied for the exemption of three switchboard attendants and a car fitter. One switchboard attendant was given three months; the other claims were rejected.

Mr. Frank Bailey, electrician, in the employ of the Burnham (Somerset) Electric Supply Co., Ltd., has been given total exemption.

Before the North Devon Appeal Tribunal, on May 17th, Garnish & Lemon, of Barnstable, appealed for C. W. Cockram, electrician. It was stated that a war-serving badge had been obtained, but not yet received. It was claimed that the man was now under the Ministry of Munitions, and beyond the jurisdiction of the Tribunal. The case was adjourned *sine die* provided the badge is received.

The Middlesbrough Tribunal has refused exemption to Wilfrid Heal, electrician at the Grand Opera House, who pleaded that he had a wife, two children, a blind father and crippled mother dependent upon him.

At Oldham, an electrical engineer sought exemption for an electrician and wireman. Prior to the war 10 men were employed, and now there were three only, one of whom was over military age, and another had to report for service in July. Exemption until August was granted on business and domestic grounds. The same Tribunal granted exemption till July 1st to an electrical engineer and contractor with a partner. He urged that his business premises would have to be temporarily closed if he had to go. The employés of the firm had gone into the Army.

At the Walsall Tribunal, on Friday, an electrical instrument maker who applied for exemption, explained that he was engaged in making electrical instruments required by the Government. Before the war 75 per cent. of these instruments were made in Germany. His partner knew nothing about the electrical part of the business, and if he (applicant) had to go it would have to close down. In reply to questions, applicant said there was only one other firm engaged in making these particular instruments. Six months' exemption was granted, and the Chairman of the Tribunal observed that it was a trade which ought to be developed.

At Barnstaple, on May 17th, Mr. Frank Bickford, electrical engineer, applying for exemption, stated that he was responsible for the upkeep of over 140 H.P. motors at various factories, his business was solely dependent on his own energies, and the major portion of his capital was in the stock, while he had an extensive fitting business. The Military did not assent, on the ground that there were other electricians available in the town. It was decided that Mr. Bickford, who had been passed by a local doctor for garrison duty only, should be re-examined by the Army Medical Board.

At Rawtenstall, last week, an appeal was made by Mr. Stewart, tramways manager, for the exemption of a switchboard attendant who was unbadged. It was stated that 26 men, some in responsible positions, had left. A badge for this man had not been applied for, because it was thought he was under military age. He was in his present occupation before August last year. The appeal was allowed.

At the Grantown Tribunal, Mr. G. Anderson asked for the exemption of an electrician. Applicant had the contract for the lighting of the town, and the engineer had left with the Territorials at the outbreak of the war.

At the Kingston Tribunal, Messrs. Offer & Sons asked for the exemption of their works foreman, who had charge of all the electrical machinery, and was responsible for setting out the joinery work. He was practically the key of the shop. Exemption granted to August 31st.

At the Aldershot Tribunal, Mr. Vertue, electrical engineer, appealed on his own behalf on the ground that if his men were taken he could not carry on the business. His partner was wholly engaged under the Officer-in-Charge, Electric Light, Aldershot Command, and he could not receive any help from him. Applicant was granted exemption until August 15th. Mr. Vertue also applied on behalf of an employé, aged 32 years, Group 37, electric wireman and fitter, on the ground that if he were taken they could not carry on the business. They were the only firm of electrical engineers in the town, and were responsible to most of the biggest firms in the town engaged on Government work. Exemption until June 15th.

An appeal was made at Drolysden by Messrs. Ashworth and Hadwen for their assistant electrical engineer, Mr. F. Hargreaves. He was allowed until May 31st only.

At Winchester, a firm of electrical engineers appealed for the only wireman left, who does nothing but electrical work. Six months was granted.

A Surbiton electrical engineer who appealed for his apprentice, aged 19, said that he had lost all his men, and it was impossible to replace them owing to the high wages obtained in munition works. No exemption was allowed.

At Southwark, on Tuesday, Samuel Vousdon, of Ryan and Vousdon, porcelain and stoneware electrical insulator manufacturers, applied for exemption. He was an ironmonger's assistant before the war, but since the war began had started this business with his brother-in-law. The articles which he produced were made entirely in Germany before the war, and since they commenced business they had been inundated with orders for Government departments and private works. He was granted conditional exemption.

Substitutes in Germany.—The annual meeting of the Verein Deutscher Elektrotechniker, which is to be held at Frankfort-am-Main early next month, is to be mainly devoted to papers on the subject of "Substitutes for Scarce Electrical Engineering Materials, and on Experiences with such Substitutes." In connection with the gathering, an effort is being made to organise an exhibition of all the substitutes that have been brought into use since the commencement of the war, and in order to make it as complete as possible a general invitation to send specimens has been issued to all German electrical engineers.

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Dr. Rathenau.—On May 20th the "Times" mentioned the prospect of Dr. Rathenau, of the A.E.G., of Berlin, becoming Minister of Finance in place of Dr. Helfferich, but an Amsterdam report of the following day gives that appointment to Count von Roedern.

Controlled Works.—The number of works now controlled by the Ministry of Munitions is 3,577.

After-the-War Trade.—The "Times" states that the Council of the Association of Chambers of Commerce have passed a resolution expressing the opinion that the Board of Trade Committee on Textile Industries after the war is not sufficiently representative of the large producers.

It is stated that the President of the Board of Trade has appointed Mr. Henry Summers to be an additional member of the Committee recently appointed to consider the position after the war of the iron, steel, and engineering trades.

In the House of Commons Mr. Asquith said that according to his information he could not accept as proved the statement that quantities of goods were being made and stored in Germany and America for the purpose of being dumped in the United Kingdom at the end of the war. The Government's expert advisers failed to find any evidence of this. The question of trade policy after the war was receiving, and would continue to receive, the most careful consideration of the Government.—In reply to Mr. Hunt, who asked: "Can we have any assurance that millions of our own people will not be driven back to the starvation wages of pre-war days?" Mr. Asquith replied: "How can I give such an assurance?" To a later question by Mr. Hunt, asking for an assurance that we should have fair play in our own country and in the Colonies, the Press reports "No answer was given."

Speaking in the House of Commons, in the course of the debate on the second reading of the Finance Bill, Mr. Chamberlain said (according to the *Times* report) we were using up capital for the purposes of the war at a time when neutral countries, happily for themselves saved from the struggle, were making enormous profits at the expense of the belligerents, and were able out of their profits to reorganise, extend, and develop their business. He would not undertake to say what was the exact measure of agreement which might be evolved among the various parties as we set ourselves to the work of reconstruction after the war. He would be a rash man who would undertake to say what were the limits of possible agreement. But one thing was clear—we could not leave the work of reconstruction to chance. There was no section which would maintain that we could pursue after out experience of this war the policy of *laissez faire, laisser aller*. It was common ground among people who were widely divided in the old days that the Government must come in to help, organise, and support, to see that the pivotal industries of the country were to continue to exist, and that industries which were vital, as we had found out, to the country, should not again be allowed to be crushed out, but should be maintained at least in so far as any one of them could be shown to be necessary to the full life and vital strength of the nation. Speaking for himself, he was not at a time like this or in the future going to consider himself bound to the exact measures which he advocated before the war, nor even to a rigid policy which in the circumstances after the war he might not consider the best. It would be a much better thing to get a system which any one of them might regard as imperfect, but which might really form the basis of a national and Imperial policy for our political development hereafter. Any declaration of policy by the Government had better be made at the Paris Conference rather than now, before they had consulted with their Allies, or had their proposals before them. The representatives of the Government at that Conference would go there unbound by any rigid school of economic thought of the one kind or the other—unbound by any specific fiscal policy which they had adopted in this country in the past or which some of them had advocated, in order to see in what way their common interests might be best pursued and strengthened.

Prohibited Exports.—A supplement to the "Board of Trade Journal" for May 18th, which occupies over 100 pages, and is, therefore, larger than the normal issue of the "Journal" itself, brings together in convenient form the complete "Prohibitions of Export in Force in the United Kingdom and in Certain Allied and Neutral Countries." Export firms should find it of considerable assistance to them.

To be Wound Up.—The Board of Trade has ordered to be wound up, under the Trading with the Enemy Amendment Act:—

Isaria, Ltd., 208, Tower Bridge Road, London, S.E.—Dealers in electric meters, &c. Controller: G. S. Pitt, 140, Leadenhall Street, E.C.

Trading With the Enemy.—The "London Gazette" for May 19th contains further additions to the list of persons or bodies with whom trading is prohibited in Argentina, Brazil, Chile, Netherlands East Indies, Norway, Persia, Peru, and other countries.

Rhodes Scholarships.—It is announced that the trustees of the will of Cecil Rhodes intend to apply for a Bill in Parliament abolishing the Rhodes Scholarships at Oxford allotted to German subjects.

THE ELECTRICITY SUPPLY OF GREAT BRITAIN.

In his reply to the discussion in London on his paper, read before the INSTITUTION OF ELECTRICAL ENGINEERS (reported in the ELECTRICAL REVIEW of April 21st, p. 447), Mr. E. T. WILLIAMS, referring to Mr. Merz's remarks, said he thought the chief reasons why they had not made greater progress towards the ideal in electricity supply were that they had not considered the problem from the standpoint of the country as a whole, and had lacked a central organisation to translate theory into practice and co-ordinate effort. He was convinced that centralisation of plant was the ideal arrangement, and must come sooner or later. Mr. Merz's splendid achievements on the North-East Coast showed something of the possibilities of public electricity supply and the soundness of interconnected power stations with large units, enabling a saving in fuel of 30 to 60 per cent. to be effected. He had come to the conclusion that it was the basis of organisation that required solution, and they should not go to Parliament until they had secured the support of the electrical profession in general and the electricity supply industries in particular. Their densely populated manufacturing districts required large power stations at comparatively short distances apart, rendering interconnection easy and inexpensive; no district in the world, taken as a whole, offered so favourable a field for a cheap and efficient electricity supply, and the remarkable load factor attained on the North-East Coast was due to the interconnection of the stations in that area. In reply to Mr. Chattock, he did not agree with the nationalisation of electricity supply, knowing the disabilities under which Government departments worked. Small economies often meant the difference between success and failure, and it was fallacious to suppose that because a manufacturer's costs for power were only 1 per cent. of the total costs, it was of no importance to reduce the price of energy by 10 per cent. They should be independent of State finance; the proposed Electricity Board should raise money on the security of its assets for the erection of power stations, &c., and would work on a commercial footing, paying interest and sinking fund, but not operating for profit. Mr. Chattock's proposal to replace small stations by a bulk supply at once would raise powerful opposition to the scheme. Powers to grant wayleaves to electrical undertakers should be entrusted to the Board. If they could go to Parliament as a united profession, backed by municipalities and electricity supply companies, with a sound, straightforward proposal, he believed it would soon become law. In answer to Mr. Highfield, he had no intention of proposing to sacrifice the vested interests of either capitalists or engineers. By cheapening the cost of electricity, not only the public, but also the capitalist and engineer, would be benefited. In view of the difficulties incurred, their past achievements were truly remarkable, but the position of the industry was far from what it might be, as exemplified by the success of the North-East Coast system. If they could be sure that the requirements of the country could be met without the Board having operating powers, he would agree that it should be only a controlling board; and if this question of dual powers became an obstacle to agreement, it would be better to give way on the operating question for the sake of unity, and carry through the proposal for an electricity board with controlling powers only. But he believed the interests of present undertakers could be properly safeguarded in the Act of Parliament by which the Board would be created, and the Board could be prevented from operating in competition with any existing undertaking in that undertaker's area; if an undertaking misused its powers the Board could refer the matter to Parliament. If the Board had no operating powers it might mean a serious loss to present undertakers, as well as to agricultural districts which undertakers would not care to supply; moreover, the Board would be unable to carry out pioneer work in the direction of gas-fired boilers, recovery of by-products, &c. Parliamentary control would be ensured by the presence of a Member of Parliament on the Board, who would have to answer for the Board in Parliament; a Government official might possibly be added to the Board as a further link with Parliament. Mr. H. Faraday Proctor's energetic demand to "get a move on" was backed by a large number of electrical engineers. There was a call for action, and the sooner they made their demands known, the sooner the new era would commence. They should avoid widening the scope of the inquiry, and keep out any proposal with the word "Ministry" in it. He agreed with Mr. Wordingham that it was important to avoid Government operation in electricity supply; but Parliament would never put extensive powers into the hands of any other organisation than a Government department or a Public Board such as that which he proposed. He was absolutely opposed to anything that would deal unfairly with existing concerns. With regard to Mr. Roles's remarks, he had great sympathy with the interests that he mentioned, and knew it was useless to bring forward a scheme which could not be supported by electrical engineers while remaining loyal to their own interests. But he was satisfied that with extended areas for distribution and an increased demand due to lower costs, the importance of their undertakings would be much greater than at present, and the positions of the engineers would be strengthened and improved. He welcomed Mr. Roles's suggestion of endeavouring to bring into the scheme the smaller stations which would not form part of

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the ultimate scheme, in order to avoid the opposition of the engineers and committees or companies controlling them. The new electricity supply era would create such a large demand that consulting and supply engineers, manufacturers, and all connected with the electrical industry would find more openings, the engineers' status would improve, and their services would be at a premium. This home demand would react favourably on exports. On the other hand, if united action were not taken, after the war capital would not be attracted to extend electrical operations, and the electrical industries would be badly affected. The more efficiently and economically they organised the sooner the period of trade depression would be over. The Institution and the technical Press could render the greatest assistance by creating interest in the subject and focusing attention on the main issues, and the engineers of medium and small undertakings could educate their councils to advocate the proposed organisation. The trend of the discussion appeared to be favourable to a scheme on the basis of: interconnection of power stations for security of supply; reduction of costs; conservation of fuel; and co-ordination of control, and the opportunity had arisen to advance a cause of great national importance.

Replying to the discussion at Manchester (reported in the ELECTRICAL REVIEW of May 19th, p. 575), Mr. WILLIAMS pointed out that Mr. Robertson was mistaken in supposing that the proposed bulk supply system would be owned and operated by the State through a Central Board; the country was to be divided into six districts not for supply purposes, but for the purpose of control, an entirely different matter, and it was not proposed to place the control of any one of the districts in the hands of one engineer manager—the control would come under the Board as a whole. The engineer would manage only the property of the Board in his district, and not that of municipalities or companies. Any person, company, or body in the district could present its case directly to the Board if desired. The smaller generating plant would not be superseded until it had fulfilled its economic purpose—that is, until the cost of a bulk supply was less than that of running the plant and meeting the standing charges on it. The Board could withhold its approval for extensions or replacement of obsolete plant, where such a course would not be advantageous, but could not otherwise control the price charged for energy by local authorities or compel them to shut down existing stations. Contrary to Mr. Robertson's view, he held that this was the best possible time to deal with the problem. He welcomed Mr. Robertson's proposal to form subsidiary Boards, but urged the necessity of forming the Central Board first. In reply to Mr. Highfield, he thought it desirable that at no distant date municipalities which possessed powers to purchase the undertakings of companies should be called upon to adopt settled policies, so that there should be no period of uncertainty of tenure. The Board would probably discourage the taking-over of companies' powers by municipalities so long as a cheap supply of electricity was ensured. He did not agree with Ald. Walker that the cost of site was immaterial; no item of cost was immaterial. In reply to Mr. E. K. Scott, the members of the Board would be paid, and would be expected to devote the whole of their time to the work of the Board. If, as Mr. Roles suggested, the Home Office, Board of Trade, or Local Government Board opposed the scheme, the opposition would have to be met, and if it were insuperable he thought they ought to proceed with the Board with whatever powers they could obtain for it, and expand its powers later. He had had the subject of the paper under consideration for many years, and held that the inclusion of the many subsidiary matters touched upon in the discussion would create controversy and delay achievement. They should keep in mind the main issues, and deal with the subject in a businesslike manner. The agreement that something should be done somewhat on the lines suggested was more general than he had anticipated, and the profession would welcome energetic action on the part of the Council of the Institution.

BUSINESS NOTES.

Liquidations. — *Re* CEDES ELECTRIC TRACTION CO., LTD., 112, Great Portland Street, W. — The creditors and shareholders of this company (in liquidation) met on May 19th, at the Board of Trade Offices, Carey Street, W.C., when a statement of affairs was presented showing unsecured liabilities £44,826 and assets valued at £3,992, after deducting £4 000 to meet the claims of the debenture-holders. The deficiency as regards shareholders is estimated at £47,834. Mr. H. E. Burgess, Official Receiver, reported that the company was formed in 1910, most of the issued capital being held by the Austrian Daimler Motor Co., of Vienna. In 1911 an agreement was entered into, under which, in consideration of certain royalties, the Austrian company granted to this company the sole right to manufacture and sell their electrically-driven motor vehicles. In 1914 the financial position of the company became somewhat difficult, and an arrangement made for it and another business to be taken over by a new company was rendered abortive by the war. The company's business had been carried on at a loss throughout: in 1913 the books showed a loss of £7,000, in 1914 it was £7,395, and in 1915 it amounted to £14,000. The directors attributed the failure of the company to the fact that its resources were too limited to produce on a scale sufficiently large to be remunerative, but, the chairman added, there also appeared to have been some discord between the management in London and that in Vienna. A Receiver had been appointed on behalf of the debenture-holders, and the whole of the assets were in possession of that gentleman. The liquidation was left in the hands of the Official Receiver. Appended is a list of the principal unsecured creditors:—

Lancashire Brass Foundry	£30	Electro-Mechanical Brake Co., Ltd.	£23
Berham, T.	22	C. Churchill & Co., Ltd.	25
Dunlop Rubber Co.	105	Tramway and Railway World Publishing Co.	72
"Fi e"	86	Direction der Disconto Gesellschaft	39,231
Tudor Accumulator Co., Ltd.	189	Austrian Daimler Motor Co., Ltd.	2,589
Schenker & Co.	15	J. Sandell & Co.	16
Geo. Adams	19	British Insulated & Helsby Cables, Ltd.	48
Turner & Co.	13	W. P. Thompson	14
Marryatt & Place	16	Johnson & Phillips, Ltd.	750
The Electric Vehicle	12	J. Sankey & Co., Ltd.	102
,, London Electric Wire Co.	44	Cooper Bros. & Co.	97
Pickfords, Ltd.	12	Graham, Nicholson and Jones	91
T. Chatwin, Ltd.	17	Stamford Hill Palace Co., Ltd.	75
C. Macintosh & Co., Ltd.	21	North Metropolitan Electric Supply Co.	56
Hart Accumulator Co., Ltd	158		
Boynton, Dowsett & Co.	25		
Vickers, Ltd.	18		
C. W. Burton, Griffiths & Co., Ltd.	87		
Sachsenwerk Licht und Kraft A.G., Dresden	40		
Christopher Dodson, Ltd.	537		

GENERAL ELECTROLYTIC PARENT CO., LTD.—A meeting is called for June 20th, at Widnes, to hear an account of the winding up from the liquidator.

ACCESSORIES MANUFACTURING CO., LTD.—A meeting is to be held on June 30th, at 8, Queen Street, E.C., to hear an account of winding up from the liquidator, Mr. H. A. McCann.

UNIVERSAL CHEAP CABLES, LTD.—This company is winding up voluntarily with Mr. H. E. Oldham, 30, Bush Lane, E.C., as liquidator. Creditors must send particulars by June 20th.

M. & G. TRUCK AND ENGINEERING CO., LTD.—Creditors should send the usual particulars to the liquidator, Mr. C. Cooper, 30, Moorgate Street, E.C., by June 20th.

Bankruptcy Proceedings.—A. F. HAWDON, electrical engineer, Gosforth.—June 5th is the last day for sending proofs for dividend to Mr. C. Woollett, Official Receiver, 30, Mosley Street, Newcastle-on-Tyne.

STEEL BROS., electricians, &c., late of 206, East India Dock Road, E.—A sitting of the London Bankruptcy Court was appointed to be held on Tuesday before Mr. Registrar Linklater for this public examination. An order of adjudication had been made on May 8th, against Sidney Steel, trading as, or a partner in, the firm of Steel Bros. Mr. Egerton S. Grey, Official Receiver, reported that inquiries were proceedings with a view to ascertaining exactly who constituted the firm. The examination was adjourned.

Book Notices.—"Annales des Postes, Télégraphes et Téléphones." Vol. 5. No. 1. March, 1916. Paris: A. Dumas. Price 12 fr.

"Pole and Tower Lines for Electric Power Tranemission." By R. D. Coombs. London: Hill Publishing Co. Price 10s. 6d. net.

THE BRADSTREET CO., of London, E.C., have issued a pamphlet giving a summary of the failures in the United States and Canada in 1915, in comparison with those of previous years.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXV. No. 5. May, 1916. New York: The Institute. Price $1.

"The Principles of Apprentice Training." By A. P. M. Fleming and J. G. Pearce. London: Longmans, Green & Co. Price 3s. 6d. net.

Trade Announcements.—MESSRS. IKIN & EADS, LTD., announce that owing to the demand for their Quead electric fires, they have formed a separate company to control their electric heating department, which will be known in future as Quead, Ltd., 47-57, Marylebone Lane, London, W. Telephone: "Mayfair 3582."

Catalogues and Lists.—MESSRS. SCHOLEY & CO., LTD., 56, Victoria Street, London, S.W.—20-page illustrated pamphlet entitled "The Economical Production of Steam," and giving an account of the principal features of the Taylor mechanical stoker and the Copes feed-water regulator.

THE STENTOR ELECTRIC MANUFACTURING CO. (INC.), New York.—12-page pamphlet containing an illustrated description of the Stentor loud-speaking telephone equipment.

Private Arrangements.—B. T. GARDNER & CO., LTD., electrical engineers, 20, Bennett Street, Blackfriars.—A meeting of creditors was held on Monday, at Balfour House, E.C. The company had passed resolutions in favour of voluntary liquidation, and had appointed Mr. G. E. Corfield to act as liquidator. The statement of affairs presented showed liabilities of £199, and net assets of £22, or a deficiency of £177. Mr. Osborne stated that the company was formed a few years ago to take over the business which had previously been carried on by Mr. B. T. Gardner. A balance-sheet prepared in December, 1915, showed a loss on trading of £186. The business had since been continued, and further losses made. It was decided to confirm the liquidation of the company with Mr. Corfield as liquidator.

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LIGHTING AND POWER NOTES.

Argentina.—The electric power station and the public water supply service of the town of 25 de Mayo (Province of Buenos Aires) have been acquired by the Compania Americana de Luz y Traccion of Buenos Aires, whose president is Senor Juan Carosio.—*Review of the River Plate.*

Bury.—Price Increase.—It is proposed to increase the price of electric current for private and public lighting, and tramways by a further 5 per cent., and for power and heating by 10 per cent.

Canterbury.—Price Increase.—The T.C. has decided to advance the price of current for lighting by ½d. per unit. This is on account of the Daylight Saving Act. It is computed that the extra halfpenny will convert a prospective deficit of £200 into the customary profit of £600.

Continental.—Italy.—"The Utilisation of Hydraulic Power in Italy" was recently the theme of an interesting address by engineer Dal Buono, before the Associazione Elettrotecnica Italiana. In the view of the speaker, a new era is opening for Italy in this direction. Modern history had its start with the use of steam, and this occurred in countries rich in coal, whence their greater progress. Water-generated power had, however, many advantages, and estimates gave from 3 to 4 million H.P. as the Italian total available. This consumption might be considerably increased by the use of power by intermittent industries. The aggregate power of the installations actually at work was about 1 million H.P., and the equipments might be truly described as technically perfect. The problem of the transmission of energy to a distance, so far as Italy was concerned, might also be said to be completely solved in practice, it now being possible to transmit energy to a distance of from 400 to 500 km. But the utilisation of Italian power stations was far from being complete, so long as the plants were not used to their full capacity, and for the whole of the day—defects which might be remedied, on the one hand, by the use of storage reservoirs, and, on the other, by the creation of industries to utilise the surplus energy.

The extension of hydro-electric plants did not imply the elimination of the use of coal (of which some 10 million tons were imported yearly) for heating purposes, for which it was generally more suitable than electrical energy; but it was desirable to restrict its use as far as possible, as also to cultivate the national reserves of coal.

Of Italy's production of upwards of 1,600,000 H.P. of motive power, 40 per cent. was thermal in origin, but might be displaced by hydro-electric power, involving an appreciable saving in cost. The development of electric traction had hardly begun, some 348 km. only of the 16,000 km. in operation being electrified. The realisation of the Government scheme for the electrification of 2,000 km. more would call for about 300,000 H.P. Electric traction should also have a large development in connection with light railways and tramways. Furthermore, the electrochemical and metallurgical industries claimed attention with regard to the production of metal and the fixation of atmospheric nitrogen; the former as the base of all industry, and the latter as valuable for the development, in general, of agriculture, and, in particular, the intense cultivation of grain. An additional ½ million H.P. employed would give such life to the iron, brass and zinc industries as to render Italy independent of the foreigner, while providing nitrates in the quantity needed by Italian agriculture.—*L'Elettrotecnica.*

At a recent meeting in Turin an influential Committee was formed to foster the movement in favour of the utilisation of the water power available in the Province of Piedmont, in connection with the supply of electrical energy for lighting and power purposes.

Croydon.—Price Increase.—The T.C. has decided to add 10 per cent. to all accounts for lighting, heating and power supplies, as and from the June meter readings. A similar percentage is to be added to the public lighting account, and the tramways will be charged an increase of ¾d. per unit on all units above 10 millions. The Electricity Committee reported that, having regard to the loss (£3,600) on the past year's working of the undertaking, it had no alternative but to recommend the increase. Part of the loss, however, had been made up by the tramway department, thus reducing the loss on the year to approximately £800. There would probably be an increase of £6,000 in the cost of coal and materials during the current year, so that unless the charges were revised, there would be a large deficit at the end of the 12 months.

Dublin.—Damaged Arc Lamps.—At a meeting of the Electricity Supply Committee details were submitted of the damage caused to the arc lighting system during the recent insurrectionary troubles. Most of the damage was done, apparently, by rifle fire, and in the majority of instances the lamps were beyond repair. The total cost of making good this class of damage was estimated at £1,050. It was reported that the electric lighting accounts of consumers whose premises had been destroyed by fire amounted, for the past 12 months, to £8,072. A letter was read from the B. of T. asking that a notification be issued to consumers urging the necessity of economy in the use of electric light, as a reduction of the coal supply to the generating station at the Pigeon House might have to be made.

Fleetwood.—The Blackpool Building Trades Employers' Association has written to the Electricity Committee respecting the carrying out of private work by the employés in the electricity department. The Committee has decided to take no action in the matter.

Heston and Isleworth.—Suggested Price Increase.—The L.G.B. auditor in his report upon the electricity undertaking, states that the year's working, after allowing for all charges has resulted in a deficiency of £1,050, which, with £938 brought forward from the previous year, makes a total deficiency, at March 31st, 1916, of £1,988. The electrical engineer reported on the question of enforcing the minimum legal charge. The minimum statutory charge the Council was entitled to was 13s. 4d. per quarter, *i.e.*, 20 units at 8d. Last year they had 70 accounts under 6s. each. In view of a further decrease in the use of current consequent on the Daylight Saving scheme, the losses in revenue were likely to increase, and he suggested an entire revision of prices.

Heywood.—Year's Working.—There was a loss of £1,052 on the working of the Corporation electricity undertaking during the past year, including £112 disallowed by the L.G.B. some time ago. In the previous year there was a loss of £972.

Hornsey.—In the course of a report upon the question of a reduction in the quantity of electricity now being consumed in the darkened street lamps, the borough engineer stated, as regards arc lamps, of which there are 58, that the provision of small side-arm lights for post-midnight hours had enabled the arcs to be dispensed with. They used only 36 pairs of side-lights, in which the consumption of current per lamp had been reduced by one-half. The present cost of current consumed was £55 a year, as compared with £903 under normal conditions.

Hull.—Female Meter Readers.—The Corporation Electricity Committee has decided, on account of the depletion of the meter staff, to engage women meter readers at the same wages as paid to the men.

India.—On April 8th the Simla municipality took over the new generating plant. On the evening of the 19th the demand on the power station bus-bars was very nearly equal to the full installed capacity of the old plant, *i.e.*, 790 K.V.A.—*Indian Engineering.*

Keighley.—Revised Discounts.—The Electricity Committee has recommended the laying of a cable to the new hospital at Morton Banks, at a cost of £475. It is also proposed that as from April 1st the discount on accounts for electricity supplied otherwise than under sealed agreement be reduced from 5 to 2½ per cent.

London.—Bethnal Green.—The B.C. has decided to appoint Mr. H. W. Couzens as consulting engineer for its electricity undertaking until March, 1920, at an annual fee of 200 guineas plus 5 per cent. on capital expenditure.

Islington.—The B.C. proposes to apply to the L.C.C. for sanction to the borrowing of a further sum of £1,500 to cover the additional cost of mains, which was estimated in May, 1914, at £7,564, and subsequently revised at £9,076 in July last.

The City Corporation has been informed that the B. of T. has refused the application of the Charing Cross E. S. Co. for an increase in its charges for electricity of 10 per cent.

Rawtenstall.—Proposed Linking-Up Scheme.—At the meeting of the T.C. last week the borough electrical engineer reported that a scheme was being considered for linking up, where possible, the electric power stations in the Lancashire area with a view to economy and the placing of local authorities in a better position as regards electricity supply.

The T.C. has approved of draft agreement for the supply of electricity to Haslingden.

Ripon.—Proposed E.L. Scheme.—A movement has been started to form a syndicate for the supply of electric light to the city, and it has been decided to approach the Corporation to obtain its support in an application for lighting powers.

At the inaugural meeting Mr. Charles Pullan, of Bradford, explained a scheme pointing out that if the project was to materialise by the autumn of 1918, a move must be made now.

Mr. F. Stockton Gowland remarked upon the difficulty of raising the required capital locally.

Rochdale.—The dispute between Tyre Yarns, Ltd., and the Electricity Committee as to the interpretation of certain parts of the agreement between the two respecting the supply of current to the mills of Tyre Yarns, was again before the Committee last week. The firm has asked that the matter be referred to arbitration by the B. of T., and the Works Sub-Committee is to report on the request.

With reference to the proposal to borrow £10,000 for electricity works extensions, a deputation has been appointed by the Committee to interview officials of the L.G.B. on the matter.

Tottenham.—The North Metropolitan Electric Power Supply Co. is prepared to make an allowance to the U.D.C. of £139 in respect of public lamps not used during the past quarter. The General Purposes Committee is to ascertain whether this includes an allowance for the December quarter last.

Tynemouth.—The Electricity Committee has decided to adopt the revised wiring rules of the Institution of Electrical Engineers, and to request the local wiring contractors to conform thereto in future.

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West Ham.—LOAN SANCTION.—The L.G.B. has sanctioned the borrowing by the Corporation of the following amounts for the purposes of the electricity undertaking:—£3,000 for general mains and cables, £5,400 for feeder cables, £350 for switchgear, £300 for protection gear, £5,000 for sub-stations, transformers and switchgear, £450 for wet-air filter, and £3,000 for additional connection to water mains—£14,850 in all. The total amount applied for was £26,775, but the amounts granted were for the more urgent and important items. The offer of the makers of the suction ash-plant at the generating station for altering and replacing certain portions, is recommended for acceptance.

Willesden.—The North Metropolitan Electric Power Supply Co. has given notice of its intention to extend the mains from Taylor's Lane to Wood Green. The Electricity Committee has agreed to supply energy to Messrs. F. E. Barwick & Co. for a period of three years, and the L.G.B. has sanctioned the borrowing of £500 for this purpose. The Commissioners of Inland Revenue have agreed to a reduced assessment in respect of the accounts of the electricity undertaking for the year 1914-15, which will result in a saving of £104.

TRAMWAY and RAILWAY NOTES.

Australia.—An order made by the Victorian authorities authorises the Prahran-Malvern Tramways Trust to construct an electric tramway from Kew to Malvern.—*Board of Trade Journal.*

Belfast.—At a special meeting of the Tramways Committee held last week, it was intimated that 42 applications had been received for the post of general manager of the Corporation's tramway system.

Blackpool.—FEMALE LABOUR.—The Watch Committee was informed that the Blackpool, St. Anne's and Lytham Tramways Co. were proposing to employ women drivers; the Committee expressed its disapproval, holding that there were sufficient men over military age and discharged soldiers who were competent to do the work.

An exciting incident occurred last week on a Corporation car, when a controller was completely burnt out, and the staircase was also severely scorched by the flames before the trolley could be disconnected from the overhead wire.

Continental.—PORTUGAL.—The municipal authorities of Guimarães are authorised to contract a loan of about £70,000 to be devoted to certain public works, including the installation of an electric tramway system between Braga and Guimarães.—*Board of Trade Journal.*

SPAIN.—It is under consideration to employ electric traction for the express trains between Madrid and Valencia, whereby the journey will be made in five hours, with a single stop at Cuenca. The Madrid station will be underground, situated in the Calle de Montalban, fronting the Prado, on a site, however, already fixed upon by the Government to build the Ministerio de Marina. If this railway can be included among the secondary and strategic lines, its construction may be begun within a year, and in six years' time, says *Industria e Invenciones*, it will be in working order.

Dublin.—The tramway system is now running as usual; the rebuilding of Sackville Street, in which several important parts of the system run, including a couple of junctions and a terminus, may lead to some important changes of the system in that particular area.

East Ham.—FEMALE LABOUR.—The T.C. is recommended to authorise the tramway manager to employ women as car conductors in the event of his not being able otherwise to fill vacancies.

Huddersfield.—YEAR'S WORKING.—On the working of the Corporation tramways during the past year, there was a gross surplus of £63,229, and a net surplus of £13,014.

London.—WANDSWORTH.—The Town Clerk has been directed to call attention of the L.C.C. to the dangerous condition of the tramway rails in Upper Tooting Road, Tooting High Street and Garratt Lane.

Nottingham.—COLLISION.—On Saturday evening two cars on the Sherwood Rise section of the Corporation tramways came into collision, causing serious injury to one driver, while many of the 17 passengers received minor injuries. Both the car fronts were smashed, and much of the damage was due to broken glass falling amongst the passengers.

Salford. — ESTIMATED SURPLUSES. — Ald. Jenkins (chairman of the Finance Committee), in his annual statement on the coming financial year, said the Tramways Committee promised £18,000 in aid of the rates, or £4,000 less than during the past year, and the Electricity Committee promised £6,500, or £3,000 more than was promised twelve months ago.

Sheffield.—FEMALE DRIVERS.—At the Amalgamated Association of Tramway and Vehicle Workers' annual conference, a resolution was passed protesting against the employment of women drivers, the conference declaring that it would not allow it to come to pass except under the gravest national emergency.—*Sheffield Independent.*

U.S.A. — LARGE RAILWAY TURBINE SET. — Some further data concerning the 35,000-KW. turbine set for the South Boston station of the Boston Elevated Railway (to which we referred on page 398), appeared in a recent issue of the *Electric Railway Journal*. The set, which is to be built by the General Electric Co. (U.S.A.), is to operate on 200 lb. steam pressure and 200° F. superheat, and run at 1,500 R.P.M.; it will have a capacity of 42,500 KW. for two hours. The steam guarantee for the turbine at 200 lb., 1,500 R.P.M. and 1 in. back pressure, is as follows: 10,000 KW., 12·10 lb. per KW.-hour; 15,000 KW., 11·30 lb; 20,000 KW., 10·85 lb.; 25,000 KW., 10·65 lb.; 35,000 KW., 10·95 lb. For each 10 lb. per sq. in. increase or decrease in steam pressure the steam consumption is to decrease or increase by 1 per cent. from 185 lb. to 210 lb. per sq. in., and for each 10·5° increase or decrease in steam temperature between 175° and 225° F. superheat, the steam consumption will vary 0·5 per cent. At 2 in. absolute back pressure the guaranteed steam consumption per KW.-hour is as follows: 10,000 KW., 13·20 lb.; 15,000 KW., 12·30 lb.; 20,000 KW., 11·80 lb.; 25,000 KW., 11·60 lb.; 35,000 KW., 11·90 lb. An 18-in. steam pipe will be required for the unit, with a 10 ft. × 16 ft. exhaust. The generator will be a two-pole machine delivering 25-cycle three-phase energy at 13,200 volts pressure. Its guaranteed commercial efficiency is 97 per cent. at one-quarter load; 98·25 per cent. at half, 98·75 per cent. at three-quarter, and 99 per cent. at full load, not including friction and windage—roughly, 250 KW. With air at 40° C. the maximum armature temperature is not to exceed 100° C. at 35,000 KW. continuously, or 125° C. at 42,500 KW. for two hours. With full load 70,000 cb. ft. of air at 40° C. per min. will be required for ventilation.

York.—FEMALE DRIVERS.—At a meeting of the Electricity and Tramways Committee last week, it was reported that in view of the extension of the system, it would be necessary to engage from six to eight female drivers. A motion that no women drivers should be employed was not seconded, and the recommendation will come before the City Council. Female conductors have been employed for some time, but the male staff has been considerably perturbed over the proposal to employ women drivers.

TELEGRAPH and TELEPHONE NOTES.

Spain.—A public wireless telegraph service has recently been inaugurated between Spain and Germany; the receiving and transmission stations are at Aranjuez and Konigswinterhausen respectively, and the charge is 2½d. per word.

The Telephone Service.—The P.O. Telephone Department has informed the Bromley Guardians that, owing to the shortage of staff and the havoc caused to wires by the recent storms, it is unable to entertain for the present orders for new installation work

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—June 20th. Municipal Council. Two-ton electric lorry. City Surveyor, Town Hall.

PERTH.—August 16th. P.M.G. Telegraph and measuring instruments. Schedule No. 498, W.A.*

Barking.—June 9th. U.D.C. Six or twelve months' supply of coal, slack or beans. Engineer and Manager, Electricity Works.

Dewsbury.—May 31st. Twelve months' supply (about 2,500 tons) of steam coal for the electricity works. Specifications from Mr. R. H. Campion, Borough Electrical Engineer.

Dublin.—May 30th. Electricity Supply Committee. Cast-iron exhaust pipes and supports for 1,500-KW. Belliss engine. See "Official Notices" to-day.

Fleetwood.—June 3rd. U.D.C. Rough slack coal for 12 months (2,000 tons) for the electricity works. Mr. A. Cottam, Clerk.

Liverpool.—May 31st. Liverpool Overhead Railway. Twelve months' supply of electrical fittings. Particulars from General Manager, 31, James Street.

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London.—May 30th. Metropolitan Asylums Board. Electricians' ironmongery and general stores for 12 months. Mr. T. D. Mann, Clerk.

ST. PANCRAS.—Steam coal for 12 months for the Electricity Department. Borough Electrical Engineer.

Manchester.—May 26th. Electricity Committee. Stores for one year. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall.

June 7th. Electricity Committee. Electric capstan for Stuart Street station. See "Official Notices" to-day.

New Zealand.—June 23rd. Oamaru Borough Council. Overhead mains and street-lighting equipment (Contract No. 2); power-station equipment (Pelton wheels, alternators, &c.) (Contract No. 3); service meters (Contract No. 4); line transformers and accessories (Contract No. 5).*

PAHIATUA.—July 10th. Borough Council. Overhead wires, poles, street lamps, gas engines, producers, dynamos, auxiliary apparatus and accumulators. Specifications from Borough Offices or Mr. E. J. Fenn, Consulting Engineer, Auckland.*

Swindon.—May 30th. Corporation. Steam coal for the electricity works. See "Official Notices" May 13th.

Wigan.—May 31st. Extension to boiler house at electricity works. Specifications, Electrical Engineer's office, Wigan.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

London.—L.C.C. Traction glow-lamps for the Tramways Department: British Westinghouse Co., Ltd.

Maidstone.—B. of G. Renewal and repairs of internal telephone system: Oswald Jones & Co.

Meter Contracts.—Messrs. Chamberlain & Hookham, Ltd., have received contracts for meters for the ensuing 12 months for Southampton and Falkirk.

Rawtenstall.—T.C. Accepted tenders for cable and apparatus for supply of electricity to Haslingden:—

British Westinghouse Co., Ltd.—Transformer and switch panel.
W. T. Glover & Co., Ltd.—Cable.
Oates & Green, Ltd.—Conduits.
British Thomson-Houston Co., Ltd.—Switchgear.

Tynemouth.—Electricity Committee. 220 yards of three-core cable: Macintosh Cable Co.

Worthing.—B.C. A year's supply of 3 and 5-ampere electricity meters: The Electrical Apparatus Co., Ltd.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Friday, May 26th. At 5.30 p.m. At Albemarle Street, Piccadilly, W. Lecture on "X-rays," by Prof. C. G. Barkla, F.R.S.

Tuesday, May 30th. At 3 p.m. Lecture on "Optical Research and Chemical Progress," by Dr. T. M. Lowry, F.R.S.

Physical Society of London.—Friday, May 26th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Ordinary scientific meeting.

Association of Supervising Electricians.—Tuesday, May 30th. At 7.15 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Internal Combustion-driven Electrical Sets," by Mr. W. A. Tookey.

Chemical Society.—Thursday, June 1st. At 8.30 p.m. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

Royal Society of Arts.—Thursday, June 1st. At 4.30 p.m. At John Street, Adelphi. Paper on "The Work of the Imperial Institute for India," by Prof. W. R. Dunstan, F.R.S.

NOTES.

Effect of Imperfect Dielectrics in the Field of a Radiotelegraphic Antenna.—In Scientific Paper No. 269 of the Bureau of Standards, Mr. John M. Miller deals with the variation of the resistance of an antenna with the wave length of the oscillation. Starting from the wave length corresponding to the fundamental of the antenna, the equivalent resistance of the antenna rapidly decreases with increasing wave length, and reaches a minimum; as the wave length is still further increased, the resistance rises again, but in a linear manner. The decrease in resistance is explained by a decrease in the energy radiated in the form of electromagnetic waves as the wave length increases; this so-called radiation resistance varies, as it should, inversely as the square of the wave length. It has been difficult, however, to account for the linear increase which takes place at the longer wave lengths.

A recent paper by Austin pointed out the similarity in the linear increase in resistance of an antenna at long wave lengths with the behaviour of an absorbing condenser. The fact that in the curves which he had obtained for ship stations the rise in resistance was less marked than for land stations led him to believe that the absorption was probably caused by the ground acting as an imperfect dielectric. The measurements described in this paper verify Austin's hypothesis that the effect is caused by dielectric absorption, but do not confirm the supposition that the absorbing dielectric in question is the ground.

The observed large effect upon the absorption of variable air condensers brought about by the poor dielectric properties of small amounts of insulators in the electric field suggested to the author that the absorption in antennas was likewise caused by the presence of poor dielectrics in the field of the antenna. Experiments were accordingly carried out, and proved that in the design of an antenna it is a matter of importance to keep the dielectric absorption of the antenna, regarded as a condenser, as low as possible in order to minimise the waste of energy in the antenna, and so improve its efficiency as a radiator. The capacity through wooden masts, trees, buildings, insulators, &c., must be made extremely small in comparison to the capacity of the antenna through unobstructed air. In other words, the electrostatic field of force set up by the oscillating electric charges should not be occupied by imperfect dielectrics, and especially so where the electric force is intense. One important feature of design is to cover the interior walls of rooms into which the leads to the antenna run with grounded metal screens.

Electric Steel in Italy.—Five of the steel works in Italy are now provided with electric furnaces, the total number of the latter being 13. According to *Metallurgia Italiana*, the production amounts to 78 tons per day of 24 hours, the quantity of electrical power required being 6,800 KW.

Chief Technical Assistants' Association.—Owing to the war, it was thought advisable that the annual dinner of this Association should not be held, and an informal gathering of the members took place on Thursday evening, 18th inst., at the Villa Villa Restaurant. Advantage was taken of the occasion to present Mr. MacAlister, the hon. secretary, on behalf of the members, with a handsome rose bowl, as a token of their appreciation of the work which he has put into the launching and organising of the Association. The presentation was made by the chairman, Mr. J. T. Baron. In replying, the hon. secretary stated that as they had now reached practically the maximum of their membership, owing to the limited field from which their members could be obtained, it was hoped that the members would continue, as during the past 12 months, to contribute to the general welfare of the Association by further discussions on technical matters; and although by present arrangements a large number of subjects were down for discussion, these by no means exhausted the field which was open, and of which it was hoped all members would avail themselves. The following members supported the chairman and contributed towards the evening's success:—Messrs. Young, Bradshaw, Mason, Parker, Howell, Gregory, Thompson, and Manly.

Lay-Outs for Car Sheds.—Mr. N. L. Sanow, in an article in the *Electric Railway Journal*, gives some data resulting from an investigation with a view to finding what arrangement of track would call for the least number of car movements over switch, mate and frog in electric railway work when one car was passed to each of the branch tracks, as, for instance, at the entrance of a depôt. The life of a piece of special work is practically dependent on the number of movements across it, and any system which reduces the number will result in reduced maintenance. The author concludes that in place of the plain "ladder" track from which each diverging track turns off individually, it is better to arrange the branch tracks in groups of two or three or more, each group connected by a single branch-off to the principal ladder track. The saving in movements increases rapidly with the number of tracks in the lay-out, and exceeds 50 per cent. for equipments of moderate size.

Large U.S.A. Turbine Plant.—The Narragansett Electric Lighting Co., of Providence, R.I., has decided to install a 45,000-KW. turbine set at its South Street station, which will be of the Westinghouse cross-compound type similar to, but larger than, the units in operation at the Seventy-Fourth Street station of the New York Interborough Co., which have been described in our pages. The machine is to be capable of carrying a short-period load of 50,000 KW., and will operate at its most efficient rating on 11½ lb. steam per KW.-hr. The set comprises a high-pressure turbine of the reaction type, to operate on steam at 175 lb. and 100° F. superheat, direct-coupled to a four-pole generator running at 1,800 R.P.M. The H.P. turbine exhausts into a low-pressure turbine alongside, which is coupled to a six-pole generator running at 1,200 R.P.M. Both generators will deliver three-phase 60-cycle current at 12,000 volts, and will have an independent exciter. The L.P. turbine is of the double-flow type, each end exhausting into a separate jet condenser of the Westinghouse-Le Blanc low-head type, said to be the largest jet condensers constructed. The plant will require 18,000,000 lb. of circulating water an hour, when maintaining a 28-in. vacuum with water at 70° F.

The complete turbine set will measure 46 ft. 9 in. in length by 37 ft. in width, representing 26 KW. per sq. ft. of floor space.—*Power.*

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Inquiries.—Makers of the "New Pacific" and "Empire" electric carpet sweepers are asked for.

Seats for Lift Attendants.—The Home Secretary desires to call the attention of occupiers and managers of business premises who have taken on, or may be taking on, women and girls to act as lift attendants, to the need which exists in certain circumstances for allowing the attendants facilities for resting in the intervals of work. There is a growing tendency, with a view to increasing the passenger accommodation, to make lifts without seats, and it has been represented to him that in busy establishments, where the lifts are running very frequently during certain hours, a considerable strain is placed upon the attendants, if the work is carried on without any opportunity of sitting down during such intervals as may occur. He would urge the provision of an attendant's seat when other sitting accommodation is not available, and in specially heavy cases where work is practically continuous, would recommend that one or two short intervals should be allowed for purposes of rest. A convenient form of seat, which is now being provided in some new lifts, consists of a wooden flap which closes flat against the side of the lift when not in use.

Fatality.—An inquest was held at Old Hill, on Friday, respecting the death of a lad named Humphreys (15), formerly in the employ of Burton, Dekingpole & Co. The evidence showed that the lad was helping to put on a belt, for which purpose he was hanging on to a beam in a stooping position, when he accidentally fell down as the result of an electric shock through coming in contact with an exposed electric wire. The medical evidence attributed death to the arresting of the heart's action by shock caused by electricity, and a verdict of "Accidental death" was returned, the jury exonerating the manager of the works from all blame.

Reforms in Education.—The executive of the Association of Education Committees has agreed to ask the forthcoming Conference to demand the immediate appointment of a Royal Commission on Education. The feeling of the members is that the educational system of the country will require much amendment to meet the struggle for supremacy after the war, and that a Commission should get to work at once, so that its recommendations will be ready to put in operation at the earliest possible moment. The Association represents the urban authorities of England and Wales.

The City Corporation has decided that the City of London Schools' Committee shall inquire into the syllabus of teaching at the City of London School for Boys, whether the chemistry teaching is adequate for modern requirements; and also as to the advisability of adding an engineering class to the course of instruction.—*The Times.*

Organised Science.—At the annual meeting of the British Science Guild last week, Sir Wm. Mather, the President, said that if the warnings of the founder of the Guild, Sir Norman Lockyer, had been heeded, we should have been in a far better position to carry on the war; it was at last being recognised that the organisation of science was indispensable to the prosperity of the nation. Mr. Andrew Fisher, High Commissioner for Australia, explained the constitution of the National Institute of Science and Industry in Australia, of which we gave particulars in our last issue. Moving a vote of thanks to Mr. Fisher, Surgeon-General Sir Alfred Keogh remarked that we had as able scientific men as any in Europe, who also had the invaluable quality of initiative. Dr. R. M. Walmsley, in seconding the motion, advocated strong efforts to re-establish British ascendancy in technical optics.

German Chemical Combine.—A new combine in the German chemical industry, which has been formed for a period of 50 years, is stated to be essentially a consequence of the war; it was felt that a syndication of the German chemical industry was necessary if the industry was to maintain its world-wide preeminence, more especially in regard to dyes. The new combine is stated to have a larger capital than any other existing German syndicate—namely, 225,800,000 marks. Its members are:—Badische Anilin und Soda Fabrik, Farben Fabriken Bayer, Aktiengesellschaft für Anilin-Fabrikation, Farbwerke Höchst, Leopold Cassella, Kalle and Co., and Chemische Fabriken Weilerter-Meer.

The Output of Coal.—At the suggestion of the Government, representatives of the coalowners and the Executive Committee of the Miners' Federation of Great Britain met in London last week to devise some scheme to stimulate the production of coal, which has fallen off in consequence of the withdrawal of labour for military service. The following resolution was unanimously adopted:—"In regard to absenteeism, this meeting agrees to the matter being referred to the districts on the distinct understanding that committees will be at once set up in the districts to provide and put into operation effective machinery to secure the attendance of all workmen employed to the fullest possible extent, and to inquire into the circumstances of workmen employed in the mines not being provided with work whenever they present themselves, the intention being to secure, as far as possible, the output of coal necessary for the country's needs." The joint meeting was adjourned to June 22nd to receive reports from the districts. The question of the suspension of the Eight Hours Act and the working of one hour extra per day for 60 days a year was also adjourned to the same date. It was decided to recommend to the several districts that the holidays should be curtailed, as far as possible, in the national interest, in order to increase the output of coal.—*Morning Post.*

Appointments Vacant.—Shift engineer (32s. 6d.), for the Holyhead U.D.C. electricity department. See our advertisement pages.

Rubber from Vodka.—The absolute prohibition of the drinking of spirituous liquors in Russia left a stock of nearly 7 million hectolitres of vodka available for other uses, and the Russian Government initiated researches with a view to finding industrial applications for it. A Moscow chemist named Qstromyslenski is reported to have found employment for it in the manufacture of synthetic rubber from butadienes obtained from oil-gas, and it is said that the Government has decided to erect a large factory for the purpose.

Electric Equipment of the Phœnix Assurance Co.'s Building.—With reference to our description of the above in the Electrical Review of May 5th last, we understand that the electric fires which are in use are of the "Revo" type, supplied by the Cable Accessories Co., Ltd., of Tividale, Staffs.

Large American Sign.—An unusually large electrical sign has recently been erected outside the premises of the Travellers' Insurance Co. at Hartford, Conn., U.S.A. The sign, which consists of the single word "Travellers," is 120 ft. long, with 9 ft. letters, and is stated to be readily legible at a distance of three miles.

German Cartels.—Prof. Hauser, in a recent communication to the *Bulletin* of the Socié é d'Encouragement pour l'Industrie Nationale, explains the part played by "cartels" in Germany's economic expansion. The "cartel," he says, cannot be defined as a form of industrial concentration, for a "trust" is also a form of concentration; but while a trust is the absorption of a number of enterprises by the strongest, as a brutal application of the struggle for existence, the cartel is a federative organisation which allows of the subsistence of individual enterprises. These enterprises merely renounce, on entry into a syndicate or cartel, a determinate part of their industrial or commercial autonomy. Juridically, a cartel is a joint-stock company among a number of producers, for the sale in common of the generality, or certain categories, of their products. Not every industry, and in a single industry, not all the products, are susceptible of subjection to the syndicate rule. A type of syndicate product is coal, and the Rhine-Westphalian syndicate in 1908 absorbed 98·7 per cent. of the total production of that basin; but for a cartel to succeed it is not enough that the product, for which it is created, should be subjected to the syndicate rule: it requires in addition, among the members forming it, a remarkable development of the spirit of association. Hence, as M. Hauser points out, foreign countries contemplating the introduction of this German trade method must take note of the actual conditions under which the German cartels work—the iron discipline which reigns among those consenting to be subject to it. The cartel, at least as it exists in Germany, is a specifically German institution; there are cartels in other countries, but they only remotely resemble those of Germany. It is a noteworthy fact that the cartel, if it has latterly served to favour exportation, was never conceived with that object; its primitive object was to struggle against over-production; but while permitting the syndicate producers to maintain prices on the home market, it also allowed them to export at prices defying foreign competition, their surplus product not consumed at home. It was between 1880 and 1885 that the German cartels began this exploitation policy, this policy of "dumping" which, by the way, is not a German invention, as is sufficiently shown by its name, and which consists in setting up two prices for the same product, or two scales of prices—a high price for the home market, and lower prices, varying with requirements, for foreign markets. This policy of dumping is, moreover, not without inconveniences, and M. Hauser gives several examples. In 1903, a big English shipbuilding company increased its exports to Germany by being able to buy German iron 30 per cent. below the cost of English iron. Belgium and Holland also exported into Germany nails and iron wire made with German iron. Facts such as these gave rise in Germany to vigorous opposition against the cartels. The inquiry, which took place in 1903 in consequence, resulted, however, in favour of the cartel, but with the stipulation that the latter consented to a reduction in home prices in favour of the German manufacturer exporting products. It was this new policy which the cartels had already begun to apply, which enabled Germany to oust, often completely, all competition in foreign markets, and to hinder the development of national industries in certain countries, such as Italy. With their system of premiums on exportation in all branches of industry, the Germans were able completely to strangle competition in foreign markets, and Government orders, and those of companies controlled by them mechanically, directly or indirectly, reverted to the German houses; it was in this way that, at the end of the crisis in 1906, French railway companies alone were customers for one-third of the German exports of locomotives. On the international board, says M. Hauser, the dice played by Germany were loaded, and it is foolish, under these conditions, to talk of "fair play" with so tricky a player. Steps should rather be taken to counteract and destroy the disloyal procedures of German cartels. Among means which are available to this end, M. Hauser commends those of the Canadian Government as the best. This stipulates that in case of sales below the prices of the country of origin, a double import-tax is levied—first the normal tax, based on the value of the invoice, and then a special tax, equal to the difference between the invoice price and the normal price. Arrangements such as these, M. Hauser thinks, the Allies should agree among themselves uniformly to enforce.—*La Revue Electrique.*

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U.S. Production of Copper for 1916.—If the present rate of production is maintained, the U.S. refinery production of copper for the 12 months of 1916 will for the first time on record exceed 2 000,000 000 lb. The estimated figure for the year is 2,096,875,000 lb., an increase of 449,875,000 lb. over 1915, or 27 per cent. Five producers will be responsible for 78 per cent. of this increase. Never before in the history of the industry has the increase in any one year exceeded 150,000,000 lb.

In the face of an unprecedented outpouring of the metal, sales of hundreds of millions of pounds are being made to eager buyers for delivery up to the end of the year at 27½ cents. This is the figure understood to be the price to be paid for the 300,000,000-lb. order just closed with the British Government.

Not in any year since 1873 has copper sold above 26½ cents.

The copper producers would seem to be assured of a gross business this year of at least $524,000,000, and this assumes an average price of only 25 cents per lb. If an average of 27 cents is received, the producers stand to sell their product for $565,920,000. Such is the boom conferred by the European war. The full import of these figures is appreciated when placed beside the gross value of $288 220 000 for the 1915 production and $205,066,000 for 1914.—*Boston News Bureau.*

Italian Coal Resources.—Although Italy is endowed with water power available for hydro-electric purposes in excess of many European countries, the need for coal for steam-driven electric generating plants is pressing, in order to supplement the hydro-electric plants in the drier seasons of the year. Hitherto coal has been mostly imported, principally from England or Germany. Now, however, an attempt is to be made to explore and develop such deposits of coal—chiefly anthracite and lignite—as the country may possess. Prof. Novarese, head of the Royal Mining Corporation, states that there are extensive deposits of various kinds of useful coal in the peninsula, and a recent Government decree makes provisions to facilitate the search and winning of the home article. Prof. Novarese is of opinion that the Italian deposits could be made to yield 1,000 000 tons of fuel yearly, for electric stations, and even if of a quality somewhat inferior to the imported article, the present enhancement of the price of the latter would more than compensate for any deficiencies of the Italian fuel.

Late Legal.—FALK, STADELMANN & CO., LTD., *v.* THE GENERAL CABLE MANUFACTURING CO.—Before a Divisional Court of the King's Bench Division, presided over by Mr. Justice Lush, an application was made on Wednesday regarding a new trial of this action, to recover in respect of certain Swiss electrical cable.

Mr. Clavell Salter, K.C., for the plaintiffs, said that a Divisional Court had heard an appeal from the County Court in this case, and had ordered a new trial, and a question had arisen as to whether it was intended that the new trial should be limited to certain issues. The goods were electrical cables, and defendants said there was a *force majeure* clause, and the contract was impossible because of the war. The County Court Judge found there was no *force majeure* clause in the contract, but he did not consider whether there was in fact *force majeure*. The question of impossibility he decided in favour of the plaintiffs, and he then assessed the damages. The Divisional Court took the view that the Judge did not properly determine if there was a *force majeure* term in the contract, but that the question of impossibility had been rightly decided, and at the new trial it would not be necessary to further consider the latter question. The order had been drawn up for "a new trial," without any such limitation, and as this litigation had proved costly, his clients were most anxious that the second trial should be of limited scope as directed by the Divisional Court. The only point was whether there was power to amend the order that had been drawn up.

Mr. C. Johnson, for the other side, said that the evidence must be the same again whatever happened, because evidence that would go to show that the contract was impossible of performance would also apply to the question whether there had been prevention by *force majeure* from the carrying out of their obligations. This was the third attempt made to limit the right of his clients to a new trial.

Mr. Justice Lush said that, while sympathising with the position of the plaintiffs, they could not alter the order that had been made for a new trial of the case. They ordered that the costs of the application should be costs in the cause.

Tests of Fire Extinguishers.—We have received from the Home Office the report of a Committee appointed to conduct experiments with a view to ascertaining the value of dry-powder fire extinguishers for coping with fires such as are caused by bombs. The tests showed that the dry powders checked the fire, but the application of buckets of water was far more effective in confining the fire to the immediate neighbourhood of the bomb, and eventually extinguishing the fire. A jet of water from a liquid extincteur was still more effective, but only extincteurs of reliable makes should be used. The Committee concludes that a plentiful supply of water is by far the best extinguishing agent, and that dry-powder extinguishers are practically useless for controlling fires caused by bombs. A small hose of ¾ in. diameter, similar to garden hose, with a nozzle of ⅜ in. diameter (internal), supplied with water at a pressure of 45 lb. per square inch, and discharging at the rate of six gallons per minute, extinguished a bomb fire which had been allowed to mature for three minutes; at the end of six minutes from ignition of the bomb, the fire was completely out.

These conclusions are in accord with the recommendations of the British Fire Prevention Committee, which we published in our issue of May 28th, 1915.

The Inefficiency of German Electrical Machinery.—With reference to our recent leading article on "The Dearness of the Lowest Tender" (ELEC. REV., May 5th, 1916), we observe from the *B. of T. Journal* that his Majesty's Consuls in China have not been slow to take advantage of the opportunity which has been afforded by Mr. Aldridge's report on the troubles experienced with German turbo-alternator and other plant provided for the Shanghai municipal electricity works, to give assistance to British electrical manufacturers. The fullest publicity will doubtless be given to this important matter in China in circles where German cheapness has long been little short of a scandal. German dumping of electric motors, &c., in the Chinese market at ridiculously low prices has been one of the difficulties that our firms have long had to face, and object lessons of the Shanghai kind should have a very healthy effect, and go a good way to defeat the methods which German works were continually employing in China before the war. The beneficial effect of the tribute paid to British manufactures, in contrast to German, will not be limited to that market. It is one of those examples which might fairly and legitimately be turned to profitable account in all colonial and foreign markets where the under-cutting weapon of the Teuton has been so ruinously employed for the purpose of stifling British and other trading efforts. But have the British electrical manufacturers any efficiently organised means for ensuring that the industry shall reap all the good that widespread and discriminating circulation of the facts of the case should bring?

Increased Loom Production Due to Motor-Drive.—Investigations have been conducted in a New England worsted mill, to determine the actual extent of possible benefits by the substitution of electric motors for the existing mechanical drive. The mill contains 48 looms, which are run at a load factor of 62 per cent., and a speed which varies over 11 per cent., due to the irregularities of mechanical driving. The looms operate at an average of 105 picks per minute, and, on a 59-hour week, yield 119 yards of cloth per loom. Tests show that with the installation of group-motor drive an average of 112 picks per minute can be obtained, with a load factor of 72 per cent. The resulting output would then be 147 yards per loom per week, or a gain of 28 yards per loom. The selling price of the cloth is $1.50 per yard, so that the total value of the increased product is $2,016 per week for the 48 looms for a 50-week year, and, taking 5 per cent. of the selling price as the profit, this equals $5,040. The cost of making the change, which involves the purchase of six motors, aggregating 46 H.P. connected load, was estimated at $1,100. On this basis the electric drive would pay for itself in less than three months. *Electrical World.*

Lights on Vehicles.—The recent order of the Secretary of State prescribes the use of three lamps on vehicles, two in front, white, and one at the rear, red. From June 1st the police will be instructed to enforce the law in all cases where a contravention is observed.

A High-Head Turbine Plant.—For a long time the record for height of head has been held by the power station of Vouvry, in Valais, France, with a fall of 917 metres; it passed to the works of Orlu, in the Eastern Pyrenees, where the head was 6 m. greater, but has now been far exceeded by the Fully station, which, 500 m. above the sea-level, is fed by a lake at an altitude of 2,140 m., giving a head of 1,640 m., or 5,380 feet. Prof. R. Neeser, of Lausanne, states that the pressure conduit is 4 625 m. in total length, of which 2,300 m. has a diameter of 600 mm. (24 in.), and the remainder, 500 mm. (20 in.). The walls of the tube vary from 6 to 43 mm (¼ to 1¾ in.) in thickness; up to 34 mm. the conduit is welded sheet, the rest being of weldless steel. With the exception of about 870 m. which is in tunnel, the pipe is buried in a trench 1 to 1½ m. deep throughout its length; no expansion joints are provided, and it is anchored at only one point—where it enters the works. The runner of the turbine, of the Pelton type, has a mean diameter of 3,550 mm. (140 in.) and consists of a disk of Siemens-Martin steel, weighing about 7,100 kg. (7 tons), and carrying 54 buckets. The jet is 34 mm. (1·34 in.) in diameter. The runner is carried on a steel shaft with journals 200 and 240 mm. (7⅞ and 9½ in.) in diameter, directly coupled to the alternator and running at a speed of 500 R.P.M.

The buckets are attached to the rim of the disk by a special method, patented in Switzerland by Léon Dufour; they are of pressed Siemens-Martin steel, and weigh 11·4 kg. (25 lb.) each.

The turbine is provided with an automatic regulator, which actuates a deflecting plate as well as the needle of the jet, the former acting quickly to take the load off the runner, and the latter more slowly, to prevent excessive pressure in the pipe line. A special arrangement is provided in the discharge pipe to cushion the jet when thus deflected, consisting of a cast-iron chamber followed by a converging steel casing leading to a horizontal pipe 1 300 mm. (51 in.) in diameter and 9 m. (29½ ft.) long, which is partly closed at the outer end, so that it always contains a quantity of water. This water receives the deflected jet, and absorbs the blow without injury to the walls of the passage; the device has proved quite satisfactory. The velocity of the jet at the needle valve is about 175 m. (574 ft.) per second, but at the outlet of the damping pipe its speed is reduced to a harmless value. Even under working conditions, the velocity of the water leaving the buckets is 30 to 40 m. per second, which, without such special provision would damage the masonry.—*La Revue Electrique.*

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Institution and Lecture Notes. — Institution of Electrical Engineers.— A special meeting to consider the resolution to exclude alien enemies from membership of the Institution was to be held yesterday.

At the annual general meeting held on the 11th inst., the report of the Council and the statement of accounts were presented and adopted.

The result of the election of Council for the next Session was announced, as follows:—

President: Mr. C. P. Sparks.

Vice-Presidents: Messrs. R. A. Chattock,* R. T. Smith, C. H. Wordingham,* and Dr. A. Russell.

Hon. Treasurer: Mr. J. E. Kingsbury.

Ordinary Members of Council: Messrs. W. A. Chamen, J. Christie, H. Dickinson, Prof. T. Mather, Messrs. G. H. Nisbett,* G. W. Partridge, W. H. Patchell, W. Ll. Preece,* H. F. Proctor, G. S. Ram, R. J. Wallis-Jones, W. B. Woodhouse.

Associate Members: Messrs. F. W. Crawter,* H. H. Harrison,* W. R. Rawlings.*

Associates:—Messrs. J. O. Callender,* J. Devonshire,* J. Hunter Gray.

* Elected.

The President announced that the Willans Premium had been awarded to Dr. S. Z. de Ferranti, for his Presidential address in 1910.

University College, London.—Lecturing, on May 15th, on the manufacture of nitrates from the air by electric power, Mr. E. K. Scott gave three reasons why the war broke out when it did: Germany's new-found ability to dispense with Chile nitrates; the perfection to which Zeppelins had been brought; and the gyro compass for submarines. He dealt mainly with the direct electrical method of fixation of nitrogen, and demonstrated the importance of the compounds of nitrogen in the manufacture of explosives, in agriculture, and in the production of aniline dyes.

Volunteer Notes.—1ST LONDON ENGINEER VOLUNTEERS.—Orders for the week by Lieut.-Col. C. B. Clay, V.D., Commanding.

Monday, May 29th.—Technical for Sections 1 and 2, No. 3 Company, 46, Regency Street, S.W.; Squad and Platoon Drill, Sections 3 and 4, No. 3 Company; Signalling Class and Recruits.

Tuesday, May 30th.—School of Arms, 6 to 7; lecture, Mr. J. Roberts, "Water Supply," 7.15; Recruits, 7.15 to 8.15, Archbishop's Park.

Wednesday, May 31st.—Platoon Drill, No. 3 Platoon, No. 1 Company.

Thursday, June 1st.—Platoon Drill, No. 7 Platoon, No. 2 Company; Shooting for Sections 1 and 2, No. 3 Company, Miniature Range; Recruits, 5.45 to 7.45; Instructional Class, 5.45.

Friday, June 2nd.—Technical for Sections 3 and 4, No. 3 Company, 46, Regency Street, S.W.; Squad and Platoon Drill, Sections 1 and 2, No. 3 Company.

Saturday, June 3rd.—Company Commander Fleming's Instructional Parade, 2.30.

Sunday, June 4th. — Entrenching duties: Parade, Victoria Station (S.E. & C. Railway Booking Office), 8.35 a.m. Uniforms, haversacks and water-bottles. Mid-day rations to be carried. Railway vouchers will be provided.

Musketry.—For Nos. 1 and 2 Companies, see Notice and Tables A and B, at Headquarters.

Notice.—Unless otherwise indicated, all drills, &c., will take place at Chester House.

MACLEOD YEARSLEY, *Adjutant.*

3RD BATT. (OLD BOYS) CENTRAL LONDON VOLUNTEER REGIMENT.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, May 25th, 1916:—

Week-End Parades.—Saturday.—The Battalion will Parade at Baker Street Station, at 2.30 p.m., and proceed by train to Wembley Park for Ceremonial Drill under the Commandant. Members who have their tunics at their tailors may attend.

Sunday.—The Battalion will Parade at Liverpool Street Station (Low Level entrance, G.E.R.), at 9.30 a.m., and proceed by train for Entrenching duties.

Musketry.—Inter-Battalion Cup Competition. A practice match has been arranged to be shot at Bisley on Sunday next, the 28th inst., between selected teams. Targets will be available for other members who attend. Members to report to Sergeant Burmester, at 10.5 a.m., Platform 6, Waterloo Station.

A. G. JOINER, *Major and Adjutant*, O.B.C.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

General.—Mr. AUGUST ECKSTEIN, electrical engineer, of Fallowfield, who was born in Bavaria before it became part of the German Empire, but has been permanently resident in England since 1887, was denationalised in 1888, and has been a naturalised British subject since 1894, has assumed the name of Arthur Erskine.

Mr. D. E. Ross has been gazetted second-lieutenant in the Tyne Electrical Engineers, R.E. He has been on dispatch riding in France for about a year.

The *Times* states that the curators of Edinburgh University on Monday appointed Sir JAMES ALFRED EWING, Director of Naval Education, Principal in the room of the late Sir William Turner.

Councillor C. ATKINSON has been re-appointed chairman of the Fleetwood Electricity Committee.

Roll of Honour.—Intelligence has reached Rugby of the deaths in action of five former employés of the British Thomson-Houston Co., Ltd. Rifleman E. FRANKLIN, of the Rifle Brigade, who was in the winding department, has died of wounds received on April 12th; Private R. DAVIS, of the Oxon and Bucks Light Infantry, has been killed by a trench mortar; Bombardier E. COX, of the Rugby Howitzer Battery, formerly a charge-hand in the turbine department, has been killed by shrapnel; Private B. BLAKE, of the Wiltshire Regiment, who was in the purchasing department, is reported killed in action, after being missing since June 16th last; and Lance-Corporal J. T. GURNEY, of the Royal Warwickshire Regiment, reported missing since April 21st, 1915, is now listed as dead.

The death in action is reported of Private J. JEFFRIES, of a Shropshire Regiment, who was an employé at Darwen Corporation electricity works.

Private J. H. DORBER, of the South Lancashire Regiment, formerly employed by the Osram Lamp Co., at Manchester, has been killed in action.

Private RICHARD SILCOCK, of the Canadians, who has been killed in action, was formerly employed at the works of the Chloride Electrical Storage Co., Clifton Junction.

Captain GERARD R. FLEMING, Scottish Rifles, who has been wounded, was, before joining the Army, in the employment of Messrs. Wm. M'Geoch & Co., of Glasgow.

Rifleman JOHN BARKER, Royal Irish Rifles, formerly employed at the British Westinghouse Works, Trafford Park, who was previously reported missing, is now officially reported killed. Another former worker at the Westinghouse Works, Sergeant E. MURRAY, of the Loyal North Lancashires, has been killed. Private ARTHUR ETTERICK, of the Black Watch, who has died from wounds, was also employed prior to enlistment at the British Westinghouse Works, Trafford Park.

Lance-Corporal R. QUINN, of the Manchester Regiment, formerly employed by Messrs. Hans Renold, Ltd., has been killed in action.

Corporal ELIJAH BAUGH, before the war employed as an electrical fitter by the General Electric Co., Ltd., Salford, has been seriously wounded in action.

The death in action is reported of Sergeant R. W. WOODS, Loyal North Lancashire Regiment, who was formerly employed at Messrs. Dick, Kerr & Co.'s works, at Preston.

Obituary.—MR. R. W. TWEEDY.—The death has occurred of Mr. Robert Wilkinson Tweedy, chairman of Messrs. Tyer and Co., Ltd., electrical and general engineers, Denton Holme, Carlisle, and Dalston, London. Deceased, who was 69 years of age, entered the business of his father at Carlisle, of which he ultimately became sole proprietor. On amalgamation with Messrs. Tyer & Co., 16 or 17 years ago, he became local managing director, and subsequently was elected chairman of the company. He had served on the Carlisle City Council and Cumberland County Council.

SIR CORBET WOODALL.—We regret to record the death of Sir Corbet Woodall, governor of the Gas Light & Coke Co., at the age of 75 years.

HERR F. GNAUTH.—The death has occurred, at the age of 62 years, of Herr F. Gnauth, the general director of the Felten & Guilleaume Carlswerk Gesellschaft, of Mulheim, Cologne.

NEW COMPANIES REGISTERED.

F. J. Shenton & Co., Ltd. (143,861).—This company was registered on May 17th, with a capital of £3,500 in £1 shares (3,000 ord. and 500 "B"), to carry on the business of munition makers, electrical, telephone, telegraph, mechanical, and general engineers and merchants, electricians, electroplaters, fitters, millwrights, founders, stampers, galvanisers, japanners, annealers, enamellers, painters, &c. The subscribers (with one share each) are: W. A. Barber, 51, Penshurst Road, Thornton Heath, Surrey, clerk; J. A. Matthews, 38, Lambton Road, Hornsey Rise, N. clerk. Private company. The number of directors is not to be less than two or more than five; the first are F. J. Shenton (managing director) and E. H. Smith (chairman). In the event of the decease of the said E. H. Smith, his father, L. J. Smith, or failing him, the personal representatives of the said E. H. Smith, shall have the right to appoint a director in his place. Remuneration of E. H. Smith, £50 per annum; of managing director, as fixed by agreement; of other directors, as fixed by the company. Registered office: 284, Queen's Road, Peckham, S.E.

Quead, Ltd. (143,850).—This company was registered on May 15th, with a capital of £7,000 in £1 shares, to take over the business of vendors and manufacturers of gas and electric stoves, heaters, lamps, and apparatus and appliances relating thereto carried on by F. Eads and R. J. Quainton, at 47, Marylebone Lane, W., as Eads & Quainton. The subscribers (with one share each) are: F. Eads, 47, Marylebone Lane, W., manufacturer of electric fires, &c.; F. L. Wright, 66, Windermere Road, Ealing, W., engi-

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neer; R. J. Quainton, 47, Marylebone Lane, W., engineer. Private company. The number of directors is not to be less than two or more than five; the first are F. Eads (permanent), F. L. Wright, and R. J. Quainton. Qualification. £100 shares. Secretary: H. Middleton. Registered office: 47, Marylebone Lane, W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lamplough & Sons, Ltd.—Mortgage, created by Receiver, dated May 16th, 1916, to secure £1,200, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: H. E. Taylor, 35, Church Road, Richmond, Surrey.

CITY NOTES.

United River Plate Telephone Co., Ltd.

The gross earnings of the company for 1915 amounted to £641,581, whilst the gross maintenance and other charges in Argentina and London were £447,810, leaving the profit for the year at £193,771. Deducting interest on debenture stock, preference dividend for the year, and the interim ordinary dividend, and adding £6,563 brought forward, £128,234 remains. Of this, £2,000 has been put to the staff provident fund, £20,000 to the reserve fund, £19,000 to depreciation of securities account, and a final dividend of 5s. per share on the ordinary shares, making 8 per cent. for the year, free of income-tax, absorbs £81,000, leaving £6,234 to carry forward. Annual meeting: May 30th.

Anglo-Portuguese Telephone Co., Ltd.

The annual meeting was held on May, 16th, Mr. Herbert Allen presiding. The chairman said that in a year of great events in the outer world the affairs of the company had been singularly uneventful. They earned £81,923, against £71,339 in the previous year, and expended £54,037, as against £44,875, and the gross profit was £27,886. The commercial and financial situation in Portugal was no better than one would expect it to be after the political turmoil prevailing throughout the country during recent years, and it was not easy under such circumstances to explain the steady growth of this company's business, unless it were due to their excellent service, combined with a moderate tariff. The number of subscribers increased during the year by 10½ per cent., and the gross revenue by 14 per cent. Unfortunately, however, the net profit showed little advance on that of the previous year, owing partly to the increased cost of labour and material and in greater measure to the loss on exchange. The Lisbon exchange on London was now only 34d. per escudo, a fall of about 20 per cent. in less than two years, and that it was not worse was due to the fact that imports into Portugal had practically ceased, and that the Brazilians and rich Portuguese, who formerly spent most of their time in Paris or Biarritz, were obliged now, on account of the war, to take up their residence and spend their money in Lisbon or Oporto. How they were to meet the steadily increasing cost of labour and material was not quite clear. The Portuguese railways, both private and State-owned, had solved the problem by an increase of 10 per cent. in their tariff, and if such a step could be justified in the case of native enterprises it should be still more allowable in the case of foreign companies, which had to send their profits out of the country. He feared, however, any such increase on their part would be resented by the public, and therefore was out of the question. Capital expenditure during the year was lower than for some years past. In normal times this would be no subject for congratulation, because the constant aim of a telephone company was to enlarge the scope of its operations, and that, of course, could only be done by liberal capital expenditure. But under existing conditions, when Treasury sanction for new issues was difficult to obtain, it was perhaps as well that capital requirements were, if only temporarily, on a moderate scale. This provision of working capital was a question that did not leave them altogether free from anxiety, because there must be no slackening of effort to meet the requirements of an ever-growing telephone public. At the present time the business was expanding at an unprecedented rate, and scarcely had they got their new exchange at Lisbon into working order than they were confronted with the possible necessity of further extensions. How much longer they could defer the opening of a new exchange at Oporto he did not know. For the time being the policy of the board was to restrict new work as far as possible to the actual bringing in of subscribers, but the present rate of progress could not be maintained without an adequate increase in the capacity of the exchanges and of the cable routes. Having regard to all the circumstances, it was scarcely probable that normal capital requirements would henceforth be under £20,000 a year, and the tendency would be to increase rather than to fall away. Should they be called upon to extend the area of their operations beyond Lisbon and Oporto, this estimate might be considerably increased. As in the past, they would hope to meet this expenditure largely out of surplus or undivided earnings, but the continued rise in the Lisbon exchange was making serious inroads on the profit and loss account, and the diminished surplus, if they were to maintain their normal rate of dividend, would necessitate raising some, at all events, of the requisite funds by an increase of capital in one shape or another. Fortunately their present financial position was quite satisfactory, and, subject to the absence of any turn for the worse in the military situation, they could see their way ahead for well over a year.

Electric Construction Co., Ltd.

The net profit for 1915, after providing £6,648 for debenture interest and £7,500 for depreciation, is £43,241, plus £7,471 brought forward. After paying 7 per cent. on the preference shares, and 7½ per cent. on the ordinary for the year, £12,664 is to be put to general reserve fund (making it £50,000), leaving £16,839 to be carried forward, subject to excess profits duty and assessment under Munitions of War Act, 1915. The works were declared controlled in August last. Notwithstanding the very high price of materials and an all-round increase in the cost of manufacturing, the net profits for the year were satisfactory. The improved results are due principally to a larger volume of orders having been handled through the unremitting efforts of the staff and workmen. Unexecuted orders at the beginning of the new financial year exceeded those on hand a year ago. Annual meeting: May 30th.

Shanghai Electric Construction Co., Ltd.

At the annual meeting, held in London on May 19th, the chairman said that the falling off in receipts referred to a year ago continued until the early autumn, when a marked improvement took place, and in the later months of the year nearly all the loss was recovered. The receipts for 1916 had so far continued on the same improved basis, and the position was now certainly hopeful. The trade of Shanghai also improved during the second half of the year, and the company had benefited by this, and by an increasing influx of natives into the Settlement in consequence of the disturbances in China. The gross traffic receipts were £117,975, less £31,707 for loss by native copper coinage, leaving effective receipts of £86,268, which was practically the same as in 1914. After deducting the working expenses in Shanghai, an operating profit remains of £35,003, as compared with £35,892 in 1914. After paying the 7 per cent. dividend, £1,387 was to be carried forward. The expenditure on construction account was £12,567, about £10,000 less than last year, chiefly for 10 new motor cars, temporary overhead feeder cables, land for sub-stations, buildings extension, &c. The power expenses had been reduced from £9,814 to £8,684, and had been brought down to 2.97 cents per car mile against 6.15 in 1909, the average cost per unit being 3.10 cents. A further reduction per unit was looked for when the Council had completed its new Riverside station, when the company would be able to do away with the overhead feeder cables which were put in to replace the original underground cables, which had proved unsatisfactory in many instances. The overhead cables were purchased on favourable conditions, and the materials at to-day's prices could be sold on terms that would go a long way to cover the original cost. In 1915 they carried nearly 60 millions of passengers, against 11¾ millions in 1909, and during the first three months of this year they had carried 15½ millions, or at the rate of 62 millions per annum. As they anticipated that this increase would be maintained, they had applied to the Municipal Council for permission to introduce 15 new trailers. Notwithstanding the assurances given to the Diplomatic body in Peking by the Chinese Minister of Finance, the depreciation of native copper coins had been accentuated, and the ratio of loss to gross receipts had been increased to 28.58 per cent.—9.91 per cent. on the share capital, as compared with 26.04 per cent. in 1914, and the loss for the year was £28,088, against £25,880 in 1914. At present there were good reasons for believing that the depreciation would be arrested at no distant date, and should this charge on the receipts be minimised or eliminated altogether, it was obvious that their account would in future be very materially improved. The rise in the silver exchange was also greatly to their advantage. In regard to railless traction, the Fokien new roadway had been completed in cement concrete, and the company's railless service was resumed on July 7th, the weight of the cars being reduced to meet the Council's requirements. The cars so altered had operated most successfully on the smooth surface, and since the opening to December 31st they had carried 1,439,804 passengers, run 49,753 car miles, and collected a gross revenue of $19,347.49, which, after deducting loss on native coinage, working expenses and depreciation, had paid over 6 per cent. per annum on the capital employed. The route (less than ¾ mile) was too short to get the full benefit of the seven cars available, and they had applied to the Council for an extension, which the popularity of the service and the success of the experiment should justify. They were looking forward for opportunities to expand this form of traction at no distant date, as it was proved to be well suited to the narrow streets and to the requirements of the population. They also hoped that when the war was over and the disturbances in China had ceased, the inquiries made as to starting tramways in other townships in the interior might lead to the company being invited to take an interest in such schemes, as their experience should certainly be useful to those concerned in any such new undertakings in China. Mr. Doran,

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a useful member of the staff, came home on leave to join the Army, and the deputy general manager, Mr. Smeaton, was home on leave for medical treatment. Thanks were due to the local board and to Mr. McColl. Owing to the death of General Thys last year, and to the enforced absence of M. Francqui, M. le Chevalier Edmond Carton de Wiart had been invited to represent the large Belgian interest in the company.

Anglo-Argentine Tramways Co., Ltd.

For 1915 the gross receipts were £2,709,616, less working expenses (which include £120,000 carried to depreciation renewals reserve, in addition to £265,692 expended on ordinary maintenance) £1,786,740, leaving £922,876. After adding interest on investments and deposits and transfer fees, £45,637, and £96,409 brought forward, the amount is £1,064,922. Interest and charges, absorbing £970,802, are made up as follows:—Annuity to City of Buenos Aires Tramways Co. (1904), Ltd., £70,000, 4 per cent., 4½ per cent., and 5 per cent. debenture stock interest, sinking fund for redemption of debenture and share capital, and 5½ per cent. dividend on the first and second preference. The balance forward is £94,120. During the year there was a further fall in receipts of £141,380, but by the exercise of strenuous economies the expenditure was reduced by £94,256, and it "now probably represents the minimum compatible with efficiency," while the position is aggravated by the continuous rise in the cost of fuel, upon which the price paid for electric current is based. Having regard to the difficulty of forecasting the results of the present year, the directors are unable to recommend the payment of a dividend on the ordinary shares. The balance at the credit of the profit and loss account, £94,120, has accordingly been carried forward. The general manager, Mr. G. Pedriali, in a most exhaustive report, shows how building operations in the city of Buenos Aires came to an almost complete standstill, immigration was reduced to a minimum, and the population fell. The traffic suffered more even than in 1914. The passengers carried were approximately 317 millions, a decrease of 4.5 per cent. This includes 30½ millions of subway passengers (an increase of 7.1 per cent.). The car km. run were 81½ millions, a decrease of .09 per cent. The surface receipts decreased by 6.7 per cent., and those for the subway increased by 7.1 per cent. During the year 64 new cars received from Preston were delivered to traffic. The number of motor-cars has increased from 1,768 to 1,800, the convertible trailers from 407 to 426, and the motor trolleys from 49 to 55. Details are given of the number of breakdowns of cars and of electrical equipments, also particulars concerning the maintenance of the overhead system, cables, permanent way, and buildings. A reduction of 6 per cent. has been effected in average consumption of the subway cars. The electric current used for traction has diminished by 1,105,469 KW.-hrs., and the figures per car km. run show a continued decrease. The average cost of current per KW.-hr. for traction increased from 1.431d. to 1.544d., or 7.9 per cent. Coal cost considerably more than in 1914, and but for a favourable petroleum contract the 1915 figures would have been exceeded. North American coal was largely used, three cargoes only of Welsh coal having been received in the early part of the year. The North American coal does not give such good results as best Cardiff. Petroleum has given excellent results as regards consumption per KW.-hr. The KW.-hr. of current produced required, before the war period, 884 grammes of best Cardiff coal. During 1915, owing to the use of petroleum, this figure was never reached until December, when North American coal alone was used, when the consumption was 959 grammes for every KW.-hr. of current generated, which added over 8 per cent. to the price of current. The company will be prejudiced greatly if North American coal continues to give inferior results, taking both cost and production of current into consideration. The increased cost of current has added largely to the working expenditure. The amount paid to the D.U.E.G. in 1915 for energy was £355,574. If prices of fuel had been at the normal conditions in accordance with the base price in the contract, *i.e.*, less than 7.75 gold per ton, the cost would have been £289,253, so that the difference added to working expenditure amounted in 1915 to £66,321. Mr. Pedrali closes his report with a reference to prospects as follows:—

> Never has it been more difficult to form an idea as to what the year may bring about, or the effect, either directly or indirectly, that the state of European affairs will have on our receipts. There is little doubt that no improvement on a large scale can be anticipated. Should things continue as at present, I should say that a very gradual and hardly perceptible increase will take place, but there are nowadays so many factors which may affect us at a moment's notice that this opinion must be accepted as absolutely precarious. Expenses have been cut down to the utmost limit in every department, but where we are quite unable to form an estimate of expenditure is in the expense of electric current. The price of coal and other fuel has reached such unheard-of prices (nearly three times the normal), and the outlook is so extremely obscure, that I am afraid our profit for the year will be very gravely affected by this state of affairs.

The annual meeting took place yesterday.

Swiss Electrical Companies.

The directors of the *Gotthardwerke, A.G. fur Elektrochemische Industrie, of Bodio*, state that the works were occupied to the limit of their capacity in 1915, and they propose a dividend of 10 per cent., as against a rate of 8 per cent. in 1914.

The Elektrizitats Gesellschaft Baden, in which the firm of Brown-Boveri is interested, reports net profits of £4,900 for 1915, as against £3,600 in the previous year. It is proposed to distribute 6½ per cent., as compared with 5½ per cent. in 1914.

The Motor A.G. fur Angewandte Elektrizitat, of Baden, which owns generating stations, and is also interested in supply works, in various countries, records net profits of £87,000 for 1915, as contrasted with £99,000 in the preceding year. The directors recommend a dividend at the rate of 7 per cent. on the ordinary share capital of £1,200,000, being the same rate as in each of the three preceding years.

Anchor Cable Co., Ltd.—The report for 1915 states that the profit, after making provision for war taxes and contingencies, amounted to £47,251, plus £32,129 brought forward. Interest on debenture stock absorbs £2,250, depreciation £20,000, written off investments £107, leaving an available balance of £57,023, which it is proposed to deal with as follows:—Dividend of 20 per cent. on the shares £13,000, carrying forward £44,023.

STOCKS AND SHARES.

TUESDAY EVENING.

Stock Exchange markets have further developed the accession of strength to which we have drawn attention in our last two issues. Various reasons are ascribed for the substantial buying now in progress. Some people put it down to rumours of peace and consequent eagerness on the part of investors to get in before the expected peace boomlet starts. Others say that the buying is simply employment of capital which is being made out of munitions and war-work generally. Possibly both reasons contribute to the robustness of investment markets as a whole—a strength which is led by Consols and which permeates practically everything of an investment nature.

The spectacular event of the week is a rise of over 20 points in a day in Cities Services common shares. The company has just issued its annual report to April 30th last, showing a remarkable expansion in profits; and Montreal vied with New York in competing for shares. Another feature of the week is a spurt in Brazilian Traction common shares, which carried the price from 56½ to 64½, with hardly a break. The motive power here, also, was New York buying, with the Rio exchange up to 12 9/16d. to back it. The Home Railway market is good, with further recoveries in the Undergrounds; and amongst the industrial descriptions, manufacturing shares stand out with noticeable firmness.

It is something of an anti-climax to go on to remark that home electricity shares are inclining rather to the dull side. County of London preference and Westminster ordinary are both easier. The only improvement in the list is one of 1/16 secured by the London Electric shares; and the market explanation of the dulness of this section naturally falls back upon the Daylight Saving Bill as responsible for holding back orders which might otherwise have come in. The tone, notwithstanding these two small falls, is quite good; and any resumption of demand for the shares would put up prices smartly enough.

Another dull spot in the following price lists is that for Anglo-Argentine Tramway shares. The report of the company elaborates the reasons for the directors' decision not to recommend the payment of a dividend on the ordinary shares. The continuous rise in the cost of fuel is the principal difficulty; and the directors state that expenditure has been reduced until it now probably represents the minimum compatible with efficiency. The meeting was fixed for the Thursday in this week.

Central London assented ordinary stock, after being stagnant literally for months, suddenly developed strength and rose 2½ to 70, with very little stock to supply the buyers. District ordinary gained ½, and Underground Electric income bonds held their previous good rise. The Home Railway market is good in all its sections. Removal of the minima from the prior-charge stocks has brought in more buyers than sellers; and instead of the expected flood of stock, the market is astonished to find that there is little supply to meet the considerable demand. Nor is this the case in London only, for correspondents of ours report that the same conditions prevail in the Glasgow Stock Exchange, while from some of the other important provincial centres there are insistent inquiries for the offer of reasonably-priced stock.

It is in the telegraph market that the principal strength is shown. The Eastern group is again favoured; there are rises in "China" shares, Eastern ordinary, Globes, and Western shares. The American section is also decidedly better on the week. Anglo-American Telegraph deferred is up to 22, a rise of ⅜; and the preferred stock has at last gone over par. American railway shares enjoyed a boom on their own account; and almost everything connected with the States is held in high favour.

West India and Panama shares recovered 1s. 6d. to 19s., support being rendered on the assumption that the directors had done the wisest thing in passing the dividend, and so laying the foundation for a better year next time. United River Plate Telephones rose another ⅛ on the issue of the report, which makes pleasant reading for the proprietors. Marconis improved to 44s. 6d., and there has been a little

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business in Americans on the basis of 14s., though in others of the group there has not been much alteration.

One important feature of the week is the announcement of a working agreement between Brunner, Mond & Co. and the Castner-Kellner Alkali Co. The secret had been very well kept, and the news of the *rapprochement* caused a sharp rise in the shares of both companies, Castner-Kellners gaining ½ at 3 7/16. Electric Constructions put on 6d. to 17s., the report being even more satisfactory than the dividend announcement had led the market to expect. Callenders are nominally unchanged at 11½, but there are very few shares about, and the company's report, which came out a few days ago, shows the undertaking to occupy a very strong position.

The news from Mexico does not greatly encourage activity in the stocks and shares connected with the country. At the same time, however, with such rapid rises taking place in the prices of stocks in companies that operate in North and South America, there is more disposition to look kindly upon the Mexican utilities, with the result that the 5 per cent bonds of the Tramways and the Mexican Light and Power concerns have each a rise of a point to their credit.

In the armament group there is no change from the previous quietude, but the rubber market continues to improve. Although the price of the raw material hangs back, buyers are once more pressing in to take advantage of the slightly lower prices than those which ruled a few weeks ago. At the same time, the excitement which then characterised the market is not so evident, thanks, of course, to the spread of public interest to so many other sections of the industrial market.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price May 23, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6¾	—	£7 8 2
Charing Cross Ordinary	5	5	8¼	—	7 18 10
do. do. do. 4½ Pref.	4½	4½	8¼	—	6 18 6
Chelsea	5	4	8¼	—	6 8 1
City of London	9	8*	12	—	6 18 4
do. do. 6 per cent. Pref.	6	6	10½	—	5 14 8
County of London	7	7	10½	—	6 16 7
do. 6 per cent. Pref.	6	6	10⅜	— ⅛	5 15 8
Kensington Ordinary	9	7	5	—	7 0 0
London Electric	4	3	1 5/16	+ 1/16	7 11 0
do. do. 6 per cent. Pref.	6	6	4¼	—	7 1 2
Metropolitan	8½	8	2⅜	—	6 6 4
do. 4½ per cent. Pref.	4½	4½	3	—	7 10 0
St. James' and Pall Mall	10	8	6	—	6 13 4
South London	5	5	2⅝	—	8 18 10
South Metropolitan Pref.	7	7	1 3/16	—	6 14 0
Westminster Ordinary	9	7	5⅜	— ⅛	6 4 5
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	101 xd	+1	5 19 0
do. Def.	80/-	83/6	22	+ ⅜	7 10 9
Chile Telephone	8	8	6⅜	+ ⅛	6 5 6
Cuba Sub. Ord.	5	5	7½	—	6 13 4
Eastern Extension	7	8	14⅜	+ ⅛	*5 11 4
Eastern Tel. Ord.	7	8	146	+2	*5 9 7
Globe Tel. and T. Ord.	6	7	12⅜	+ ⅛	*5 14 8
do. Pref.	6	6	10½	—	5 17 5
Great Northern Tel.	22	22	36⅛	—	6 0 7
Indo-European	13	13	49	—	6 12 8
Marconi	10	—	2 3/16	+ 3/16	4 10 4
New York Tel. 4½	4½	4½	100⅜	—	4 9 6
Oriental Telephone Ord.	10	10	1⅛	—	5 10 6
United R. Plate Tel.	8	8	6 3/16	+ ⅛	*6 9 4
West India and Pan.	1	Nil	19/-	+1/6	9 6 1
Western Telegraph	7	8	14½	+ ½	*5 10 4
Home Rails.					
Central London, Ord. Assented	4	4	70	+2½	5 14 4
Metropolitan	1½	1	25½	—	3 18 6
do. District	Nil	Nil	19½	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	1⅜	—	Nil
do. do. "A"	Nil	Nil	6/-	+6d.	Nil
do. do. Income	6	6	87	—	*6 18 0
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4¾	— ⅛	6 6 4
Anglo-Arg. Trams, First Pref.	5½	5½	3⅜	—	7 17 2
do. 2nd Pref.	5½	5½	3¼	—	8 9 2
do. 5 Deb.	5	5	78	—	6 8 2
Brazil Tractions	4	4	64⅜	+⅜	6 4 0
Bombay Electric Pref.	6	6	10⅜	—	5 15 8
British Columbia Elec. Rly. Pfce.	5	5	59	—	9 9 8
do. do. Preferred	—	Nil	40	—	Nil
do. do. Deferred	—	Nil	38	—	Nil
do. do. Deb.	4½	4½	62	—	6 17 1
Mexico Trams 5 per cent. Bonds	—	Nil	42	+1	Nil
do. 6 per cent. Bonds	—	Nil	35	—	Nil
Mexican Light Common	Nil	Nil	20	—	Nil
do. Pref.	Nil	Nil	32	—	Nil
do. 1st Bonds	Nil	Nil	42	+1	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	23	—	5 14 3
British Aluminium Ord.	5	7	22/- xd	—	6 7 3
British Insulated Ord.	15	17½	10½	—	7 2 10
British Westinghouse Pref.	7½	7½	44/-	—	6 16 6
Callenders	15	20	11¼	—	6 10 5
do. 5 Pref.	5	5	4½	—	5 17 8
Castner-Kellner	20	—	3 7/16	+ ½	5 14 3
Edison & Swan, £3 paid	Nil	—	10/6	— 6d.	Nil
do. do. fully paid	Nil	—	1⅜	—	Nil
do. do. 5 per cent. Deb.	5	5	57	—	8 15 8
Electric Construction	6	7½	17/-	+ 6d.	8 16 6
Gen. Elec. Pref.	6	6	9⅜	—	6 4 8
Henley	20	—	14⅛	—	*6 18 0
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	10⅛	—	*9 10 6
Telegraph Con.	20	20	87	—	*6 16 0

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, May 24th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec
a Acid, Oxalic	per lb.	1/8	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	,,	£54	..
a Bisulphide of Carbon	,,	£28	..
a Borax	,,	£30	£1 inc.
a Copper Sulphate	,,	£53	..
a Potash, Chlorate	per lb.	2/6	..
a ,, Perchlorate	,,	2/-	..
a Shellac	per cwt.	96/-	..
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	,,	£14	..
a ,, Lump	,,	£10	..
a Soda, Chlorate	per lb.	1/4½	..
a ,, Crystals	per ton	120/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	1/5½ to 1/6	½d. inc.
c ,, Tubes (solid drawn)	,,	1/6½ to 1/7	½d. to ¾d. in.
c ,, Wire, basis	,,	1/6½ to 1/6½	½d. inc.
c Copper Tubes (solid drawn)	,,	1/9 to 1/9½	½d. inc.
g ,, Bars (best selected)	per ton	£174	£7 inc.
g ,, Sheet	,,	£174	£7 inc.
g ,, Rod	,,	£174	£7 inc.
d ,, (Electrolytic) Bars	,,	£160	£8 inc.
d ,, ,, Sheets	,,	£178	£8 inc.
d ,, ,, Rods	,,	£167	£8 inc.
d ,, ,, H.C. Wire	per lb.	1/8	1d. inc.
f Ebonite Rod	,,	3/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/3	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	2/8½	1½d. dec.
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
l ,, Wire, galv. No. 8, P.O. qual.	,,	£36	..
g Lead, English Pig	,,	£33	£2 5 dec.
g Mercury	per bot.	£16 12 6 to £16 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e ,, ,, ,, medium	,,	8/6 to 6/-	..
e ,, ,, ,, large	,,	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/8½	..
r Steel, Magnet, in bars	per ton	£85	..
g Tin, Block (English)	,,	£197 to £200	..
n ,, Wire, Nos. 1 to 16	per lb.	3/-	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Mirrlees, Bickerton & Day, Ltd.—The report for the year ended March 31st states that the net profit, after providing for depreciation and directors' fees, is £16,101, which, with £1,730 brought forward, makes £17,831. Dividend at the rate of 7½ per cent., less tax, on the ordinary share capital, £5,000 to reserve; £2,037 carried forward.—*Financial Times.*

West African Telegraph Co., Ltd.—The net profit for 1915, including £633 brought forward, is £25,347. £13,000 has been transferred to general reserve, and a further dividend of 2 per cent., making 4 per cent. for the year, is recommended, carrying forward £991.

Reduction of Capital.—*Robt. W. Blackwell & Co., Ltd.*—A petition for reducing the capital from £250,000 to £50,000 by cancelling capital which has been lost or is unrepresented by available assets, is to be heard on May 30th.

Great Northern Telegraph Co., Ltd., of Denmark.—The receipts for 1915 were £968,599, and the expenditure was £287,461. Dividends and bonus proposed aggregate 22 per cent. for the year, leaving £76,406 to be carried forward.

Cleveland & Durham County Electric Power Co.—The *London Gazette* of May 23rd contains the full statement of capital expenditure and revenue of this company for the year ended December, 1915.

Bombay Electric Supply & Tramways Co., Ltd.—The directors recommend a dividend on the ordinary shares at the rate of 7 per cent. for the year ended December 31st, 1915.

Castner-Kellner Alkali Co., Ltd.—Interim dividend, 9 per cent. for the six months ended March 31st.

Adelaide Electric Supply Co., Ltd.—Interim dividend 5 per cent., free of tax, on the ordinary shares.

Doulton & Co., Ltd.—Dividend 5 per cent., less tax, on the preference shares for year 1914.

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EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING APRIL, 1916.

THE April returns of electrical export and import business, which we tabulate below, show as regards the former a general falling-off in values, while the total of the latter shows a very considerable increase.

The exports, which in March were valued at £432,396, fell in value to £353,266 in April, the decrease in the total being mainly attributable to the falling-off in the machinery, cable, telegraph and telephone exports, while only in three sections were minor increases in value recorded.

On the other hand, the imports, which in March reached a total value of only £196,251, in April amounted to £256,099. This considerable increase is due to the greater values, particularly of machinery, of telephonic and telegraphic material—which more than doubled the March values—and of glow lamps, which were imported into this country.

Battery imports were also in advance of the previous month's value, while carbon and cable imports were on a reduced scale.

The re-exports for the month were valued at £15,391, as compared with £17,383 in March.

India, as usual, was our best market during the month, while the Australian States and France were also prominent customers.

Of the importers, the United States naturally heads the list, with a total of £175,060—largely machinery and telephonic material; Holland occupies a prominent second place, due to her sending us nearly £35,000 worth of glow lamps—a record amount, last month's figure being £21,600 worth. Business with the Scandinavian countries also was on a larger scale.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports	Electrical goods and appliances.	Wires and cables rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	1,804	4,453	45	181	774	1,718	7,263	180	245	634	2,218	2,684	22 199
Netherlands, Java and Dutch Indies ...	2,208	12,566	204	...	...	...	170	....	106	19	258	14,220	2,974
Belgian Congo	10	...	...	...	...	...	...	...	...	...	23	172	205
France	2,746	2,463	184	115	326	...	11,790	5,941	476	173	1	2,645	26,859
Portugal	303	2,617	45	42	...	16	...	...	102	...	703	192	4,020
Spain, Canary Isles and Spanish N. Africa...	356	336	152	82	94	600	2,087	555	46	...	211	516	5,035
Switzerland, Italy and Austria-Hungary ...	...	55	...	...	...	195	969	71	20	...	2,566	2,506	6,382
Greece, Roumania, Turkey and Bulgaria ...	...	...	...	...	...	...	...	...	...	...	...	...	...
Channel Isles, Gibraltar, Malta and Cyprus...	57	226	272	107	...	...	193	11	282	...	...	16,200	17,258
U.S.A., Philippines and Cuba	388	7	233	...	...	145	499	600	28	33	4	1,197	3,134
Canada and Newfoundland	310	10	34	100	...	619	1,950	...	1,661	25	430	658	5,797
British West Indies and British Guiana ...	59	138	...	34	69	...	98	...	...	23	...	44	465
Mexico and Central America	...	...	6	...	...	...	5	...	...	...	...	...	11
Peru and Uruguay	1	...	135	103	...	33	129	44	...	...	...	...	445
Chile	330	353	23	121	...	...	4,053	390	...	...	...	...	5,270
Brazil	62	526	20	121	...	77	588	135	785	51	167	107	2,639
Argentina	998	3,044	1,000	412	...	1,035	1,941	91	423	341	1,809	99	11,193
Colombia, Venezuela, Ecuador and Bolivia...	13	394	...	83	...	103	30	...	...	...	227	45	909
Egypt, Tunis and Morocco	218	1,926	...	182	...	85	934	...	1,398	...	494	309	5,596
British West Africa	61	88	18	198	...	31	1,021	...	14	...	491	211	2,133
Rhodesia, O.R.C. and Transvaal	721	1,854	456	1,089	608	186	1,964	...	279	18	14	1,094	8,283
Cape of Good Hope	255	4 763	383	226	...	496	2,233	217	1,291	...	1,009	365	11,238
Natal	1,145	1,939	33	220	...	123	5,793	98	1,070	42	196	...	10,659
Zanzibar, Brit. E. Africa, Mauritius & Aden	68	31	...	...	...	...	132	...	...	...	...	114	345
Azores, Madeira and Portuguese Africa ...	12	21	...	48	...	...	55	9	20	41	...	13	219
French African Colonies and Madagascar...	...	....	...	...	...	...	...	...	...	...	...	...	...
China and Siam	453	1,431	200	85	...	630	2,115	2,145	394	255	294	462	8,464
Japan and Korea	56	262	....	93	...	1,664	817	52	1,310	16	...	495	4,765
India	3,946	16,595	2 579	2,113	99	1,607	19,127	660	6,296	62	1,321	309	54,714
Ceylon	54	638	289	274	...	113	115	99	287	...	...	845	2,714
Straits Settlements, Fed. Malay States and Sarawak	158	1,051	194	499	...	294	255	43	447	12	194	160	3,307
Hong Kong	444	2,621	5	237	...	10	319	...	65	...	277	31	4,009
West Australia	187	2,585	304	...	...	1,030	476	...	...	1	324	563	5,470
South Australia	117	683	83	81	...	167	797	741	45	...	960	8	3,682
Victoria	2,671	17,636	709	1,388	94	178	3,623	217	296	17	1,152	3	27,984
New South Wales	1,065	7,775	732	1,551	277	2,712	7,264	1,351	...	31	11,712	710	35,180
Queensland	...	625	108	150	...	103	453	208	1,967	83	5,536	46	9,279
Tasmania	20	...	14	140	16	...	55	...	...	...	...	...	245
New Zealand and Fiji Islands	992	2,972	456	913	5	677	3,292	1,184	522	86	2,234	78	13,411
Total, £	22,288	92,684	8,915	10,998	2,362	14,652	82,574	15,042	19,875	1,963	34,822	47,101	353,266

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	42	...	...	...	1,746	562	6,358	...	3,749	1,042	4,645	18,144
Germany	...	...	...	...	...	...	...	...	...	...	...	...
Holland...	...	461	...	34,532	321	...	157	...	67	...	...	35,538
Belgium	...	...	...	...	...	...	...	...	...	...	...	...
France	156	...	33	137	439	1,003	132	...	9,015	1,263	141	12,332
Switzerland	2,266	....	29	291	...	2,328	2,502	...	581	420	278	8,698
Italy	90	4,309	...	...	...	...	160	570	...	100	...	5,229
Austria-Hungary	...	...	...	...	...	...	...	...	...	...	...	...
United States	6,591	1,342	516	3,886	2,669	1,230	12,442	86,094	3,782	6,998	49,560	175,060
Total, £	9,145	6,112	578	38,846	5,175	5,123	21,751	86,664	17,147	9,823	54,627	254,991

Additional imports.—Spain, carbons, £45; Japan, electrical fittings, £100; glow lamps, £320; meters, £212; Egypt, goods, £38; arc lamps, £13; machinery, £5; telegraph and telephone cables, £5; Canada, electrical goods, £85; fittings, £55; telegraph and telephone cables, £240.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above... ...	1,032	1,428	...	3,834	62	1,839	3,799	...	64	87	3,216	15,391

TOTAL EXPORTS: £353,266 TOTAL RE-EXPORTS: £15,391 TOTAL IMPORTS: £256,099

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

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THE SHILDON-NEWPORT RAILWAY ELECTRIFICATION.

The North-Eastern Railway Co. was one of the first of our great railway companies to adopt electric traction, having as far back as 1904 successfully applied electrical operation to their Newcastle and Tyneside suburban traffic. Once more this company has acted as a pioneer of electric traction in applying it to heavy freight haulage on the Shildon-Newport line, on which electric working was first started on July 1st, 1915.

Following a report by Messrs. Merz & McLellan, the company's consulting electrical engineers, the Shildon-Newport route was selected for trial as being an important freight line, dealing almost exclusively with heavy mineral traffic.

Some historical interest attaches to this selection, since the track runs over a portion of the original Stockton to Darlington railway, the first public railway on which steam locomotives were used for conveying passengers and goods.

Beyond the usual considerations affecting the decision to apply electric traction to such a line, a special factor which differentiated the North-Eastern Railway lines from others in the United Kingdom was the ample supply of cheap electrical energy available from the systems of the existing power companies, and this fact, obviating the necessity for a large capital expenditure by the railway company on power-station plant, had an important bearing on the whole scheme.

The electrified line, between 18 and 19 miles long, connects the mineral sidings at Shildon with the Erimus siding at Newport, near Middlesbrough (fig. 1); considerable portions of the sidings at both ends are also electrified, so that, including the sidings, about 50 miles of single track are equipped for electric working.

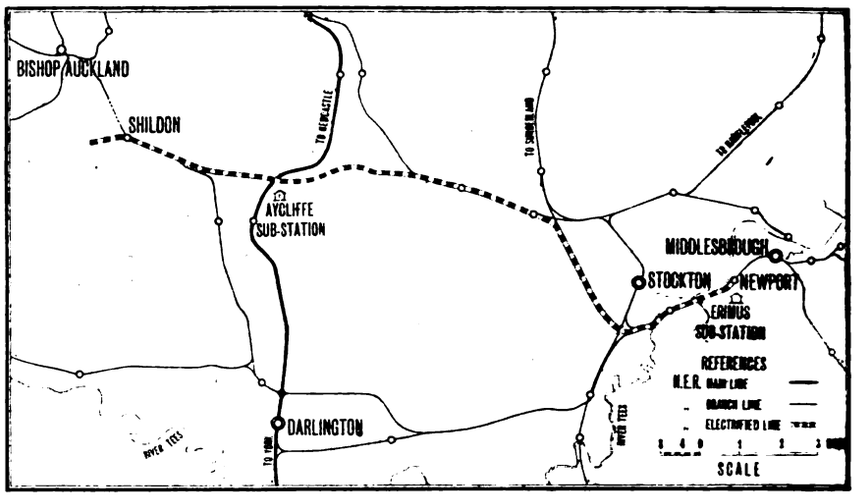

Fig. 1.—Route Plan of the Shildon-Newport Electric Railway.

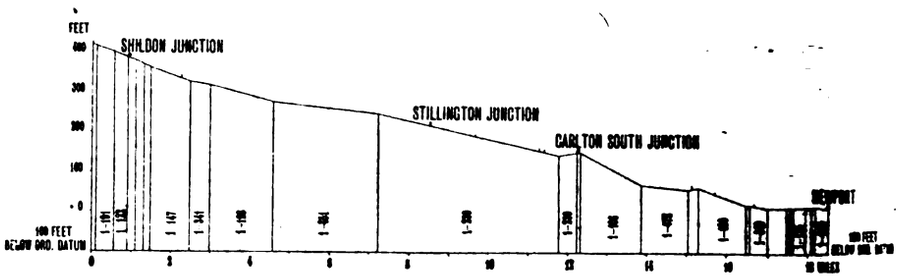

Fig. 2.—Profile of the Shildon-Newport Line.

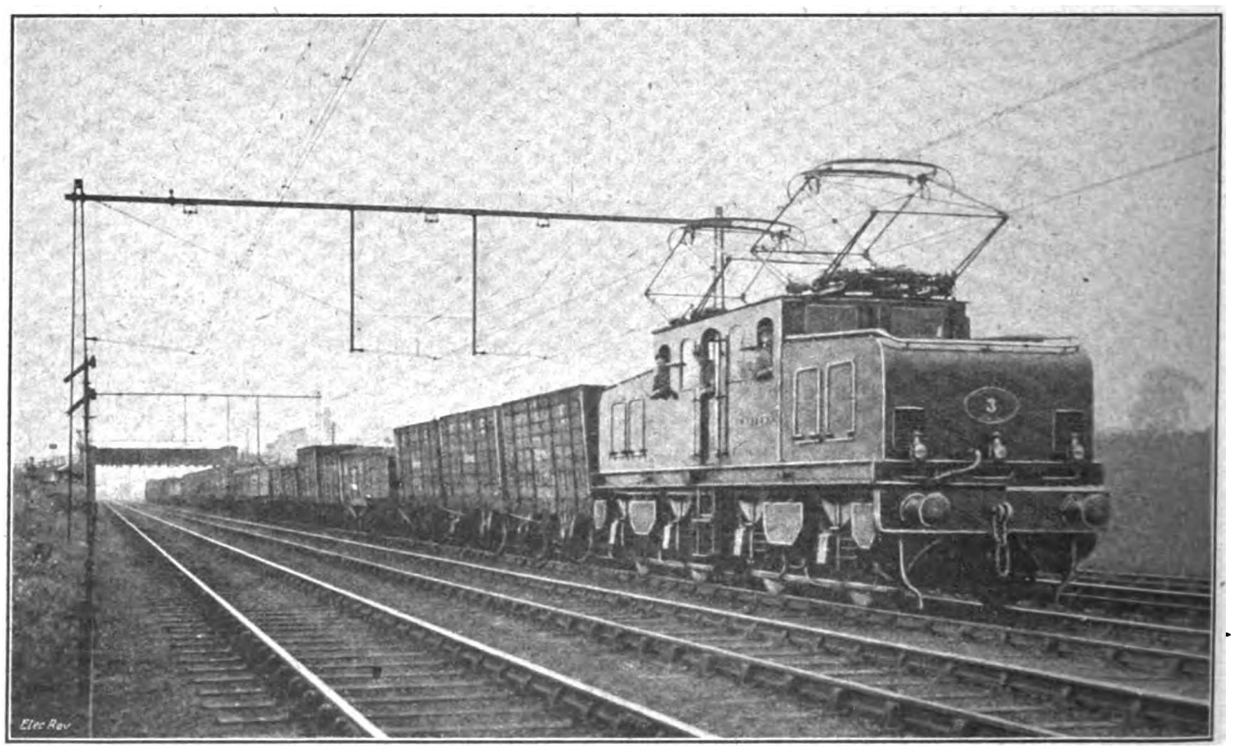

Fig. 3.—North-Eastern Electric Freight Locomotive and Train.

The general gradient, fig. 2, is in favour of the laden traffic, the steepest gradient being 1 in 103. The line carries the heavy mineral traffic from the South-West Durham coalfields to the Middlesbrough district, supplying the large number of blast furnaces

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and iron works concentrated there. On the return journey, the load consists mainly of empty wagons returned to Shildon sidings.

It was decided to adopt the high-tension direct-current system, current being supplied to the locomotives through overhead contact wires at a pressure of 1,500 volts from the two rotary-converter sub-stations described later.

The overhead track equipment was carried out by Messrs. Siemens Bros. Dynamo Works, under the supervision of the railway company's then chief engineer, Mr. C. A. Harrison.

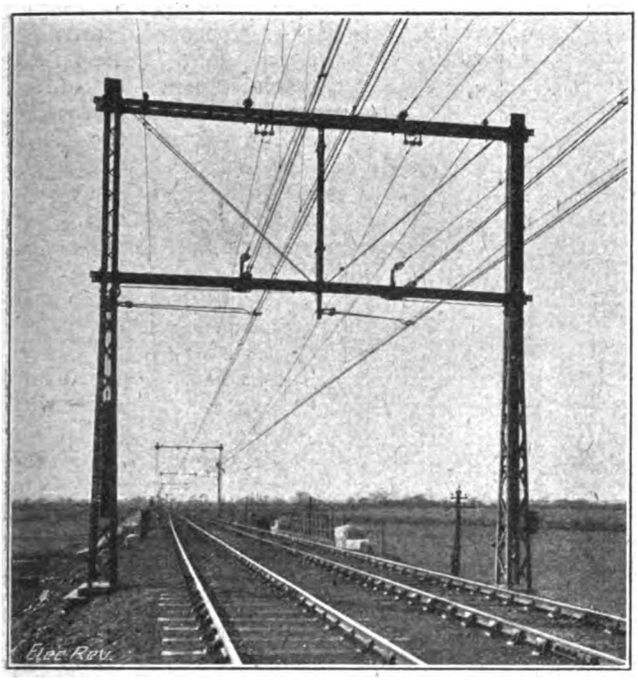
The overhead contact wires on the main portions of the track consist of two .155 sq. in. section hard-drawn copper conductors, but on certain portions of the sidings where the loads are not so heavy, a single contact wire only is used.

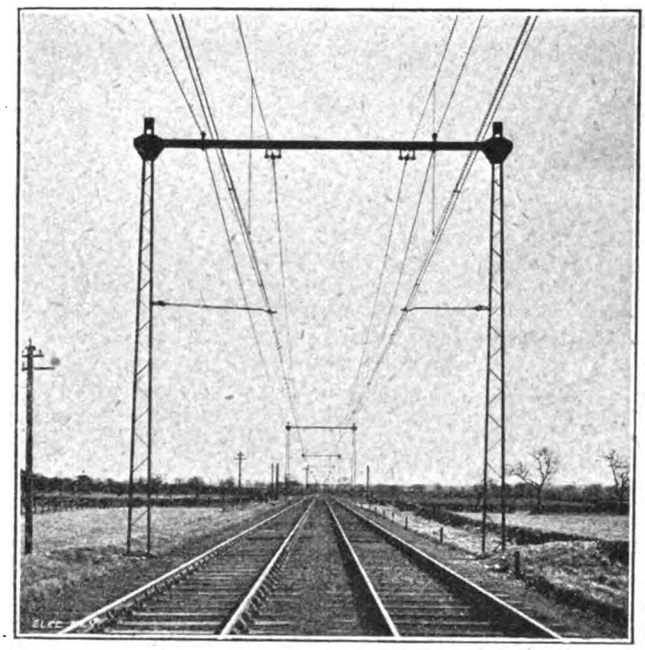
The wires are supported by a solid steel auxiliary catenary wire, to which they are attached by sliding clips. This auxiliary catenary is, in turn, suspended from the main stranded steel catenary by means of steel wire droppers. The main steel catenary wire is supported from the steel structures by means of special insulators, double insulation being used throughout (figs. 4/5).

The normal span between the steel structures is 110 yds., but on curves and sidings they are placed at lesser intervals, depending on the conditions existing.

The normal height of the contact wire from rail level is 16 ft. 6 in., but at level crossings this is increased to 18 ft. 6 in., and under some of the low bridges, of which there are a large number on this route, the height from the rail level is reduced, the minimum height being about 13 ft. 8 in.

Two auxiliary overhead stranded-copper feeder wires, each of .194 sq. in section, are connected in parallel with the main contact wires at frequent intervals, to increase the conductivity of the overhead equipment.





FIGS. 4 AND 5.—TYPICAL VIEWS OF OVERHEAD CONSTRUCTION TENSIONING STRUCTURE IN L.H. VIEW.

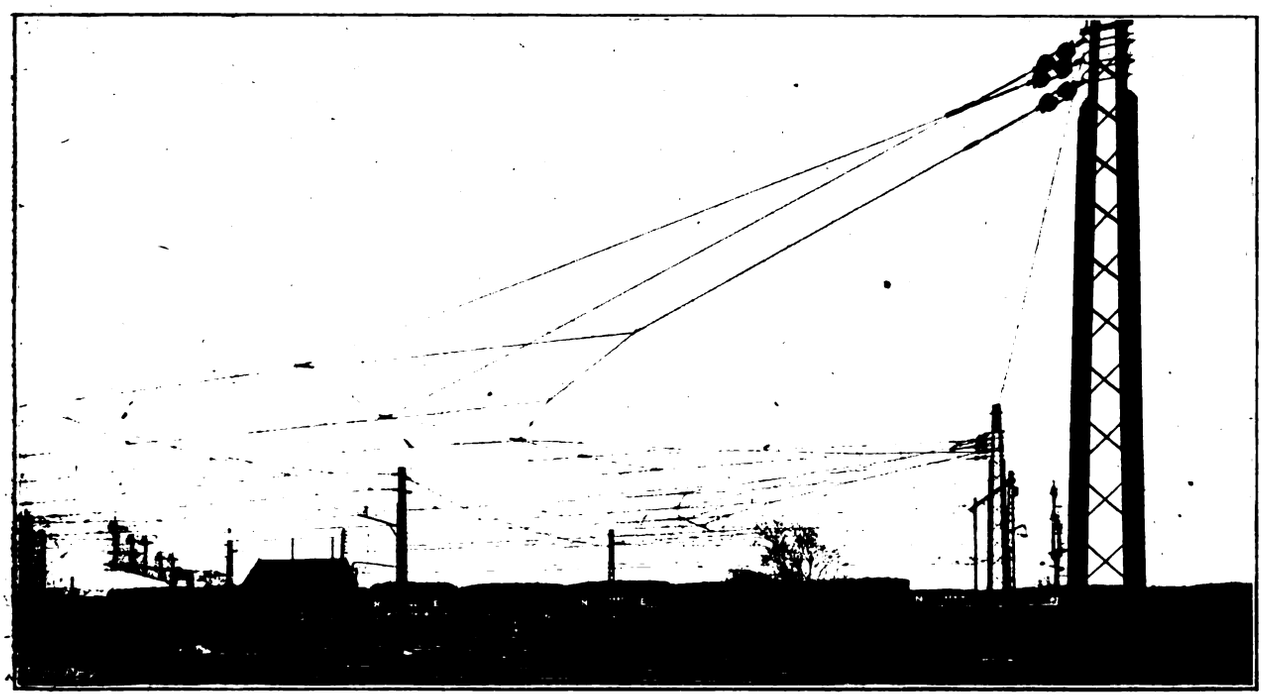


FIG. 6.—VIEW SHOWING TERMINAL ARRANGEMENT OF OVERHEAD CONSTRUCTION.

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Each steel structure carries a pair of insulated steadying arms, pivotted in all directions and attached to the contact wires by means of clips, their purpose being to fix the position of the contact wire relatively to the track. The contact wires are staggered in the usual way to prevent undue wearing of the bow collectors.

The general types of steel structure carrying the wires over the track can be seen in our views.

These all-steel structures are bonded to the running rails by means of a hard-copper bond of No. .08 sq. in. section, and any steel structures carrying signals, which are in proximity to the electrical equipment, are also similarly bonded to the running rails.

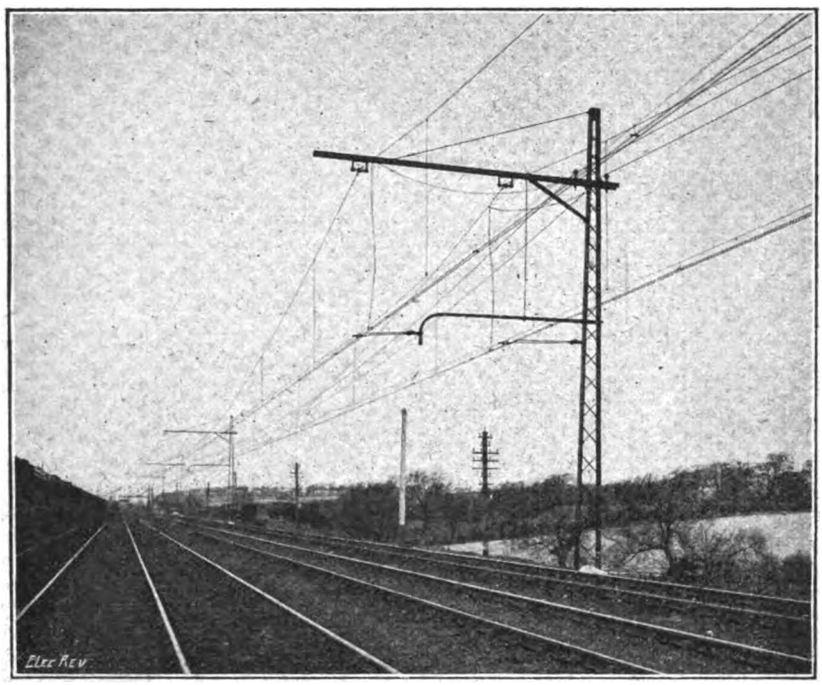

Fig. 7.—Section of Line with Cantilever Overhead Construction.

In order to limit, as far as possible, the sag of the contact wires due to temperature variation, automatic tensioning was adopted, the tensioning points being approximately 1,100 yds. apart.

Two of these structures are placed 65 yds. apart at the end of each tension length, the wires from the opposite lengths overlapping by this amount. The end of each contact wire is raised at the tensioning structure to which it is fixed, to a height of about 18 in. clear of the normal level at that point, so that the locomotive bows ride gently and without shock from one tensioning length on to the next.

The contact wires are anchored to the auxiliary catenary wire at a point two-thirds of the distance along each tensioning length in the running direction.

The tensioning weights are slung in the centre of the mast structure by chains passing over pulleys attached to the contact wire. A normal tension of about one ton is maintained by this means in the double contact wire. The auxiliary catenary wire is in all cases anchored off to the lower girder of the tensioning structure, but the main catenary is continuous, except at tensioning points at which section switches are fitted. At the latter points, the main catenary is also anchored off, but to the top girder.

On some of the sidings where only shunting work is done a single contact wire is used over each track, with ordinary tramway span wire construction.

On some of the marshalling and reception sidings, which are not equipped throughout and on which it is only necessary for the overhead construction to permit of the locomotives entering to pick up their load, the wires are terminated as shown in fig. 6.

Danger boards are fitted beyond which electric locomotives should not pass, but if by any chance they should over-run these, the terminal construction is such that no damage would be done to the bow collectors or to the overhead track.

At some of the low bridges it is possible to carry the main catenary wire through the bridge, but at most of them it is necessary to anchor it off to the bridge. In these cases, to obtain sufficient clearance, the contact wires, with the auxiliary catenary, are brought towards the centre of the bridge, and in order to prevent the edge of the bow collector from striking the bridge a guard wire is fitted.

The track is sectioned on the normal length at intervals of about 2½ miles, and considerably more frequently on sidings. Section points are arranged to occur in most cases at tensioning points, so as to avoid the use of section insulators.

Fig. 10 shows the type of section switch adopted, fitted with a horn-break arrangement, and operated by levers in the signal cabin.

Fig. 9 is a view of five section switches fitted on a girder.

As the train-control system of working is in use on this route, the signal cabins are connected by telephone with a central control office situated at Newport, and the handling of these switches is directed from the same point.

In certain positions, where it was impossible to avoid their use, section insulators are fitted, of the type shown in fig. 8. The track rails are suitably bonded at the joints and cross bonded between rails with stranded-copper bonds.

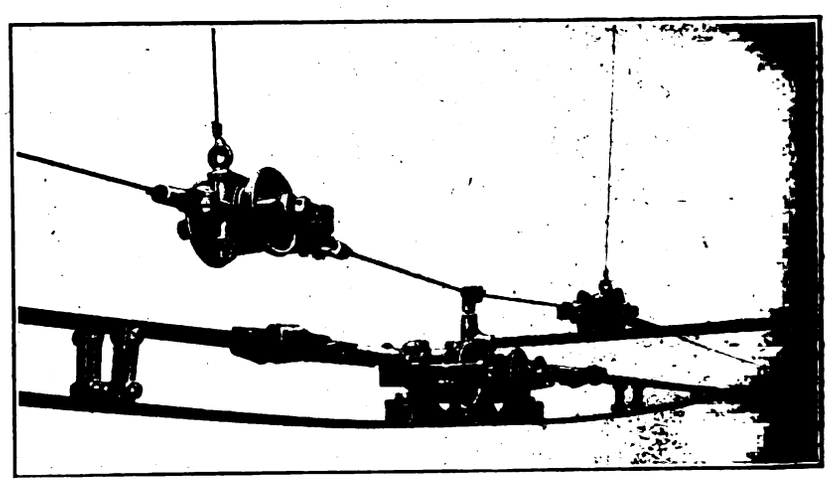

Fig. 8.—Detail View of Section Insulator.

The freight locomotives were designed and built at the N.E.R. locomotive works at Darlington, the electrical equipment being supplied and fitted by Messrs. Siemens Bros. Dynamo Works, Ltd. They are designed to haul trains weighing 1,400 tons at a speed of not less than 25 miles per hour on the level; a locomotive and train are shown in fig. 3.

The work was carried out under the direct supervision of the chief mechanical engineer, Mr. Vincent L. Raven.

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The engine may be described as an articulated truck locomotive in which the tractive effort is transmitted through the truck frames.

The cab, with sloping ends, is supported on the centre of each truck by strong steel castings, which embody the centre pin bearings and side rubbing sur-

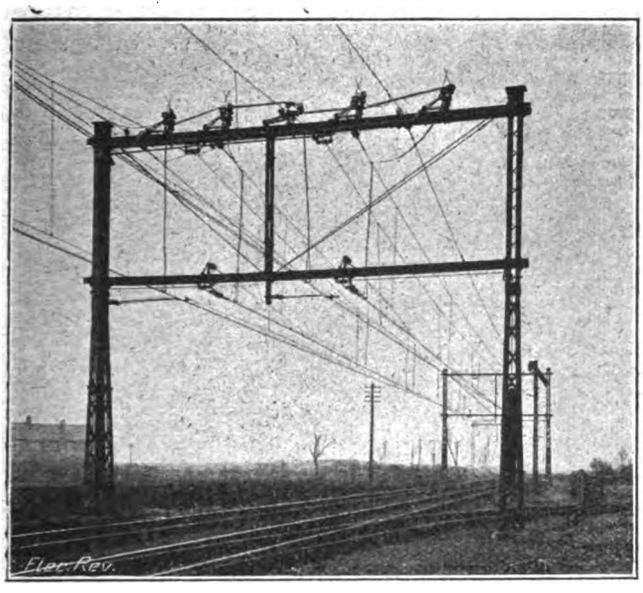

Fig. 9.—View of Gantry With Section Switches.

faces in one casting. The centre pin at No. 1 end is a good working fit in its bearings on the centre of the transom. At No. 2 end provision is made for creeping up of the trucks when passing round curves, but no allowance for movement transversely.

The trucks are securely held together by means of a draw-bar and spring, which can be adjusted (the compression of spring being $\frac{3}{8}$ in. per 7-ton load)

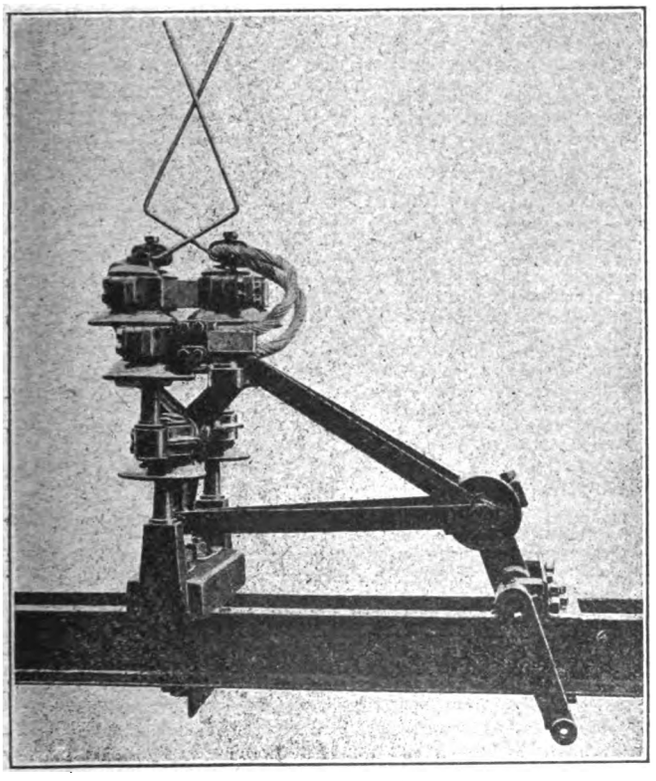

Fig. 10.—Detail view of Section Switch.

to act as a connection between the two trucks. This spring cannot be subjected to heavy compression, resulting from buffing action, as the buffer part of the coupling between trucks receives the buffing stresses directly through the truck frames without subjecting the centre pins and platform to any stress other than that due to the weight of the cab apparatus on them.

The sloping ends are partitioned off from the cab and contain the resistances, contactors, motor cut-out switches, multiple cut-out switches, and all high-tension electrical apparatus. Entrance to each sloping end can be obtained through doors which are normally locked.

The bow collectors on the roof of the cab are raised and maintained in connection with the contact wire by compressed air. A cock is fitted in the air system, the removable handle of which forms the key of the doors mentioned. This handle is so arranged that it can only be removed when the cock is in the exhaust position, so that it is impossible to open the doors of the sloping ends while the bows are in contact with the overhead wire.

In the cab two master controllers are fitted, one at each end. The cab also contains auxiliary switches for controlling the air compressor and the two dynamotors described later, and for lighting and heating. It also contains the control valves for the Westinghouse brake and for air sanding. In the centre of the cab there is a vertical hand wheel for the hand-brake.

The dynamotors are securely fixed to the floor, the switches, &c., being fixed on the sides of the cab and weather boards.

Particulars of Motor, Gearing, &c.

	tons.	cwts.
Weight of electrical equipment, inclusive of motors	24	5
Do. of mechanical parts	50	3
Do. of motors without gear wheels and gear cases	3	3
Do. do. with gear cases and gear wheels	3	13
Total weight of mechanical and electrical apparatus	74	8

Main dimensions of motors :—	in.
Axial length over windings	$24\frac{1}{16}$
Length over core	$11\frac{1}{16}$
Diameter of armature	$21\frac{1}{8}$
Diameter of commutator	$17\frac{7}{64}$
Length of commutator	$7\frac{1}{8}$
Number of segments	195
Air gap	$\frac{15}{64}$

Speed of motors at normal loco. speed of 25 miles per hour = 787 R.P.M.

Leading Dimensions of Locomotives.

	ft.	in.
Length over buffers	39	4
Width over footplate	8	4
Total wheel base	27	0
Wheel base of truck	8	9
Centres of trucks	18	3
Diameter of wheels	4	0
Height of centre of gravity	4	6

(*To be continued.*)

Training Electrical Housewives. — So that the housewives of to-morrow will have a clear knowledge and understanding of the various and important uses of electricity in the modern household, the Domestic Science Department of the Washington Irving High School, New York City, maintains a thorough course in electric household appliances. There are 800 girls enrolled in the Department, of which Miss Florence Willard is the head. Among other electric appliances which were installed under the supervision of the Heating Bureau of the New York Edison Co., are more than 20 electric flat irons, electrical percolators, chafing dishes, tea kettles, toasters, and grills. Some women shrank from touching anything electrical, for fear of a shock. It is the plan of E. C. Zabriskie, principal of the school, by means of this course in the domestic uses of electricity, to dispel for ever these false and ridiculous notions from the minds of the future generations of house-keepers, and teach them that electricity is their friend and servant.—*Elec. Rev. and Western Electrician.*

Protecting Canadian Power Plants.—So great is the fear that the big Canadian power plants at Niagara Falls, Ont., will be destroyed and otherwise crippled by German secret agents, that the Dominion authorities have ordered the erection of barbed-wire entanglements along part of the frontier of Canada in the vicinity of the electric generating plants. The present armed guard has been greatly increased by the arrival of additional troops from near-by concentration camps. The area of the Victoria National Park about the plant has been closed to the public. Arc lamps have been erected to illuminate the fence at night, and the cars of the Great Gorge Route Railway, which passes close to the power house, while making the loop in the vicinity of the Canadian Horse Shoe Falls, are escorted through the enclosures under armed guard.—*Electrical World.*

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FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

RUSSIA.—A decree dated April 1st has been issued by the Minister of Finance temporarily establishing regulations under which Customs duties must be paid on clearance of goods, not later than six months after deposit at the Port of Petrograd Custom House and two months at the Finnish Railway Station Custom House, counting from the day of the acceptance of the goods within the control of the Customs authorities.

FRENCH COLONIES.—A decree dated April 19th of the Minister for the Colonies prohibits the exportation of zinc ore to any destination except under special authorisation.

GREECE.—The exportation of searchlights and parts thereof is prohibited by Ministerial Order published on April 6th.

BRAZIL.—A revised tariff of fees to be charged by Brazilian Consular Officers has been establish by a decree, dated February 23rd, to take effect as from April 1st. The full tariff, including also the instructions for the levying of the fees, may be consulted at the Commercial Intelligence Branch of the Board of Trade.

DENMARK.—Telegraphic information has been received at the Foreign Office that the exportation of platinum and platinum wire has been prohibited.

PORTUGAL.—By a decree dated April 29th the exportation and re-exportation to foreign countries of wire and cables for electric light installations is absolutely prohibited. The decree also provides for the payment of a surtax, in addition to the ordinary export duty, on the following among other articles :—

	Rate of surtax.
Copper ore and precipitate	3 per cent. *ad valorem*.
Tin and tin ore	16 escudos per metric ton.
Wolfram	180 escudos per metric ton.
Other ores not specified	3 per cent. *ad valorem*.
Metals in the rough, in bars, in wire or scrap, and their alloys	50 per cent. *ad valorem*.
Wares of antimony, lead, copper, tin, zinc, and their alloys	50 per cent. *ad valorem*.

These articles may not be exported to foreign countries except under authority issued by the Ministry of Finance, based upon special reasons of an international character resulting from the state of war.

MEXICO.—A decree dated Feb. 20th, published in *El Constitucionalista* for March 10th, amends previous decrees respecting the export duties on Mexican produce and the suspension and reduction of Customs duties on various articles imported into Mexico. Full particulars of the revised duties are available at the Commercial Intelligence Branch of the Board of Trade.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

6,585. "Magnetically-operated prime mover or motor." W. H. Higgins. May 8th.

6,589. "Starting and stopping devices for electric motors." J. G. Henderson May 8th.

6,594. "Electric lamps." F. B. Soares. May 8th.

6,596. "Electrical machines for variable-speed gearing." T. von Zweigbergk. May 8th.

6,603. "Sparking plugs." K. E. L. Guinness. May 8th.

6,616. "Holders for incandescent electric lamps." H. Lancaster. May 9th.

6,619. "Electric lamp sockets." W. Hunt (Bryant Electric Co.). May 9th.

6,629. "Means for telephonic communication to and from moving railway trains, &c." K. H. Warevinge & V. G. Werner. May 9th. (Sweden, May 11th, 1915.)

6,639. "Electric motor control systems." British Thomson-Houston Co. (General Electric Co., U.S.A.). May 9th.

6,654. "Switchboards for telephones or telegraphs." L. K. Cunningham. May 9th.

6,679. "Switches for electric battery lamps." F. Westwood. May 10th.

6,682. "Railway or tramway switch-operating mechanism." A. Galston. May 10th.

6,696. "Means for discharging static electricity from moving-picture films, &c." C. van Deventer. May 10th. (U.S.A., May 17th, 1915.)

6,702. "Electrolytic deposition of copper from acid solutions." F. E. Studt. May 10th.

6,735. "Electrolytic cells." C. Churchill & Co. and E. Geeraerd. May 11th.

6,737. "Synchronisation of sounds and movements." C. H. Verity. May 11th

6,745. "Electrical radiators." J. S. A. Primrose. May 11th.

6,746. "Former for electrical radiators, &c." J. S. A. Primrose. May 11th.

6,771. "Electric headlights." O. R. Sell. May 11th.

6,780. "Electric heat radiators." A. F. Berry. May 11th.

6,809. "Sealing and bonding glands for electrical junction boxes." G. S. Boothroyd and Callender's Cable & Construction Co. May 12th.

6,823. "Automatic machine for manufacture of stems for metallic-filament electric lamps." J. A. Allison and Morris & Whitham. May 12th.

6,836. "Sparking plugs." V. Perrett. May 12th.

6,849. "Method of suspending metallic articles during electro-deposition." S. O. Cowper Coles. May 13th.

6,859. "Carbon holders for electric arc lamps." J. White. May 13th.

6,861. "Sparking plug cut-out for internal-combustion engines." R. Crookall. May 13th.

6,867. "Electric lampholders." E. A. Welch. May 13th.

6,887. "Electrically-actuated devices for electric alarms, &c." J. R. Quain. May 13th.

PUBLISHED SPECIFICATIONS.

1915.

5,757. Machines for Internally Shaping Telegraph Insulators and the like. H. L. Doulton & W. Podmore. April 17th.

5,832. Process for the Manufacture of Heating Conductors for Thermic Telephones from Wires Treated by the Wollaston Process. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. April 19th. (February 6th, 1915.)

5,833. Sound Chamber for Thermic Telephones and the like intended to be introduced into the Auditory Passage. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. April 19th. (February 8th, 1915.)

5,834. Construction of Heating Conductors for Thermic Telephones. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. April 19th. (February 8th, 1915.)

5,835. Process for the Manufacture of Heating Conductors for Thermic Telephones from Wires manufactured by the Wollaston Process. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. April 19th. (February 9th, 1915.)

5,836. Thermic Telephones. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. April 19th. (February 10th, 1915.)

5,837. Thermic Microphone. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. April 19th. (February 11th, 1915.)

5,838. Thermic Telephones. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. April 19th. (February 11th, 1915.)

5,839. Thermic Telephone with Adjustable Sound Effect. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. April 19th. (February 12th, 1915.)

5,840. Thermic Telephones. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. April 19th. (February 12th, 1915.)

5,842. Heating Conductors for Thermic Telephones. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. April 19th. (February 13th, 1915.)

5,843. Heating Conductors for Thermic Telephones. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. April 19th. (March 6th 1915.)

5,844. Manufacture of Heating Conductors for Thermic Telephones from Wollaston Wires. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. April 19th. (March 6th, 1915.)

5,845. Thermic Telephones. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. April 19th. (March 17th, 1915.)

5,846. Thermic Telephones. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. April 19th. (March 17th, 1915.)

5,847. Thermic Telephones. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. April 19th. (March 17th, 1915.)

5,918. Electrical Apparatus having Windings or other Portions in which Resonance Phenomena may occur. British Thomson-Houston Co. (General Electric Co., U.S.A.). April 20th.

6,542. Electric Signalling System for Railways. W. J. Mackenzie. May 1st.

6,586. Thermic Telephones and Microphones. R. A. B. Van Lynden and Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. May 3rd. (Cognate application 12,256/15.)

7,016. Process for the Manufacture of Tapes containing Parallel Electric Wires. A. de Capitani. May 10th. (May 9th, 1914).

7,092. Controlling Means for Electrically-propelled Vessels. Svenska Turbinfabriks Aktiebolaget Ljungström. May 11th. (September 17th, 1914.)

7,311. Combined Interrupter and Rectifier for the Production of Unidirectional High-tension Impulses of Large Capacity as used for X-ray Work. A. C. Gunstone. May 15th.

7,864. Sparking Plugs for Internal-combustion Engines. M. G. W. Burton. May 27th.

8,107. Oil-cooled Transformers. British Electric Transformer Co. & W. McWilliam. June 1st.

9,519. Magneto Ignition Devices for Internal-combustion Engines. A. F. Payne. June 30th.

9,635. Winding Devices for Conductors Conveying Power to Movable Electrically-driven Machines. H. S. Cassel. July 1st.

9,697. Shade-carrying Electric Lampholders. F. W. Dullingham. July 3rd

10,026. Electric Junction Box. G. H. Scholes. July 9th.

13,600. Electric Lampholders. T. H. A. Brown. September 24th.

16,155. Glands or Grips for Securing Electric Cables and the like. E. A. Graham. November 16th.

16,780. Switches for Electric Cycle Lamps. F. Westwood. November 29th. (Divided application on 7,909/15, May 28th.)

1916.

3,534. Electrolytic Condenser or Electrolytic Valve. G. Giles. March 9th (March 9th, 1915.) Patent No. 100,157.

3,780. Tools for Internally Shaping Telegraph Insulators and the like. H. L. Doulton & W. Podmore. April 17th, 1915. (Addition to 21,923/14. Divided application on 5,757/15.) Patent No. 100,261.

New Electric Signal Lamp.—Mr. E. G. Fischer, Chief of the Instrument Section of the Coast and Geodetic Survey, Department of Commerce, has just completed the design and construction of a signal lamp, which will be used during the coming summer in the mountainous regions of Idaho and Oregon on primary triangulation, where the distance between stations is frequently as much as 100 miles. This lamp has been tested by the Bureau of Standards, and shown to be more than 150 times as powerful as the acetylene signal lamps, which have been used for a number of years by the Survey. These acetylene lamps have been observed with the telescope over lines more than 120 miles in length. The new lamp is an electric one, with a specially designed filament, and the energy is derived from ordinary dry cells. While no tests have been made in the field with the new lamp, it is expected that ordinary haze or smoke will seldom prevent observations.—*U.S.A. Commerce Reports.*

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ELECTRIC FREIGHT HAULAGE.

THE description, which we conclude in the present issue, of the electrification of the North-Eastern Railway Co.'s mineral route from Shildon to Newport, near Middlesbrough, records the first real step towards the introduction of electric traction for heavy goods service on our railways, and on a practical scale.

The work of conversion has been in progress for some time, and sufficient experience has been obtained to demonstrate the technical success of what must presumably still be termed "the experiment," inasmuch as no pronouncement has yet been made as to the actual, or expected, commercial result of the conversion.

We trust that in this instance, the North-Eastern Railway Co.—to whom, and to the consulting electrical engineers for the work, Messrs. Merz and McLellan, we tender our congratulations—will see fit to depart from the traditional railway habit of secrecy, and publish, when available, such information as to the working of the line, as will indicate its success or otherwise *to the public*. It is essential that public opinion should be influenced, if possible, favourably towards the development of electric railway traction generally, for it is not often realised that a very large percentage of the public is either directly or indirectly interested financially in the railways, and that the investing public may ultimately decide the question of railway electrification on any extensive scale.

There are probably many other mineral lines in this country with characteristics similar to those of the Newport-Shildon line, for which, in the event of the latter proving successful, electrification may be considered; moreover, there are trunk lines in populous districts carrying heavy passenger and goods traffic, for which, to meet the growth of traffic in the near future, electrification must be considered as an alternative to purchasing property at an exorbitant price for widenings and perpetuating steam traction.

There is another aspect of the question which needs little emphasis at the present time, *i.e.*, the urgent necessity of making the utmost of our resources, engineering or otherwise, after the war; and, were this the sole consideration, there is little doubt that a very large percentage of our steam locomotives could be profitably relegated to the scrap heap, or otherwise disposed of, and electric traction substituted.

Such, at least, can be deduced from the statement made regarding the electrical operation of the heavy freight and passenger service on the first 115 miles of the Chicago, Milwaukee and St. Paul Railway to be converted to electric traction, and from our own experience in suburban railway electrification. Although this railway doubtless operates under conditions which have no exact counterpart in this country, the statement of Mr. Goodnow,* assistant to the president of the line, is sufficiently indicative of possibilities in other directions to deserve close attention on this side. For instance, he mentioned that one electric locomotive was taking the place of four steam locomotives, and promised eventually to supplant an even larger proportion of steam power. Moreover, the electric locomotive handled its tonnage at 15 to 16 miles per hour, as against 8 or 9 miles per hour by steam traction; also the mileage of the heavy trains drawn by electric locomotives was 200 in 24 hours, as compared with 114 miles by steam locomotives. On the 115 miles of line operated electrically, 24 heavy steam locomotives had been released by nine electric locomotives, and it was estimated roughly that locomotive repair costs would be halved.

* ELECTRICAL REVIEW, May 12th, 1916.

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An earlier statement in regard to the electrification of this line was that a return of 20 per cent. per annum was anticipated on the expenditure, due to the saving in fuel and in mechanical upkeep, increased hauling capacity, and the maintenance of speed schedules.

This railway, of course, operates in mountainous country, and the results of its working, obtained on an extensive scale for the first time, confirm the expectations of American engineers, based on smaller schemes of the same kind actually working. But it is not only for the operation of heavy traffic on mountain divisions that American railway engineers are turning to electric traction. We published recently some particulars of the West Side Improvement in New York city, in connection with which the New York Central Railroad proposes to electrify its 12-mile freight entrance to the city, at a cost of some £10,000,000.

There are four important freight yards on the route, and the trains will be hauled electrically from New York to Croton, the northern end of the company's electric zone, a distance of 34 miles.

The carrying out and operation of this scheme, if approved, will be watched with the greatest interest, although its success, in view of past experience, can scarcely be doubted.

The Shildon-Newport electrification is a comparatively minor affair in comparison with the two American projects just referred to, but its successful operation will, nevertheless, help to turn the scales when more important schemes are under consideration, and it may incidentally assist towards a solution of the exceedingly knotty problem of the system to be adopted, our inability to arrive at any definite decision in regard to which has undoubtedly hampered projects of this kind in the past.

British railway working, to give it its due, has attained a high, and probably in practice a limiting, standard of efficiency under steam operating conditions; but times change, and although our railways, as a whole, cannot be accused of any great eagerness to change with them, it will probably require the strongest of arguments to justify the continuance of present methods, if the higher standard which our national welfare demands in the future can be realised by the introduction of electric traction.

Training Munition Workers.

On Monday last, by the courtesy of the Ministry of Munitions, we were enabled to inspect one of the 64 schools which have been established by the Ministry for the purpose of training unskilled persons for service in factories making munitions of war; we afterwards visited one of these factories, which is staffed almost entirely with operatives trained at these schools, in order to see them actually at work. It was exceedingly interesting to see men and women differing most widely in age, figure, and class, busily engaged in qualifying themselves for employment on the engineering side of the war, in a large hall formerly the pride of a London County Council School of Building, but now filled with machine tools, shafting, and benches, and humming with activity and zeal.

We cannot withhold a tribute of congratulation from the instructors who laid out the plans and themselves erected the steel framework to carry the countershafts, fixed the machines, and organised an excellent course of training for the "students," the majority of whom were innocent of the least acquaintance with the most rudimentary mechanical operations. A brief account of the equipment of the school and of the methods of instruction adopted is given elsewhere in this issue; here we need only say that from a personal examination of the system, and of the work done by the pupils, we can testify to the excellence of the results attained, and can cordially recommend the students to employers in need of semi-skilled labour for the manufacture of munitions. It is worthy of note that after passing through the initiatory stages, as a rule each operative is trained to do a particular class of work; no attempt is made to achieve the impossible and to turn out all-round mechanics in six weeks, but no difficulty is found in teaching a worker *to do one thing thoroughly well* in that period. Those who show special aptitude for the work are further trained on a broader basis, as tool setters on lathes, milling machines, &c., and as gauge-makers; a number are taught lead-burning, and some women tracers have been trained. In London alone over 3,000 certificated workers have been trained since July last year, of whom 2,700 are known to have entered factories or H.M. Forces; over 300 firms have been supplied with operatives, and a number of firms not only ask for them, but actually supply special machine tools for the pupils to be trained upon. It is obvious that by obtaining workers from these schools, the employers not only are sure that the operatives will immediately fall into the routine of their shops and commence commercial production right off the mark, but also are relieved of the necessity of setting apart a portion of their valuable machinery and space, and providing skilled instructors, for the purpose of training them from the raw material. Shop methods are adhered to as closely as possible, and in some cases items such as shell bases are manufactured in the schools on commercial lines and supplied to munition makers.

Turning from the school to the workshop, the factory which we inspected was crammed with plant for the production of shell cases, working at full pressure, and was "manned" largely by women; most of the operatives had been trained at the L.C.C. schools, and carried out their duties with ability and industry which left nothing to be desired. In this class of work there is no room for carelessness or incompetence; every individual shell case has to pass inspection at various stages in its manufacture, and bad work cannot escape detection. It is obvious, therefore, that the work which is done by these trained operatives is well done; and it is done quickly. We left the place deeply impressed with the undeniable success of the new system, and marvelling not a little at the extraordinary revelations to which the war has given rise, as to the degree of skill and the time required for the performance of repetitive machining operations.

Linking-up.

In our "Notes" to-day will be found an important item on this subject, received whilst we were going to press; we commend it to the attention of all station engineers.

Copper.

There has been a rather startling transformation scene in the copper outlook, as may be gathered from the rapid downward movement which has taken place in prices within the last ten days or so. The break originated in the standard market, the price of which has already come down by no less than over £25 a ton, while the value of electrolytic copper has been affected by about £10 a ton. Such big fluctuations in so short a space of time have hardly ever been witnessed, but they must, of course, be regarded as the inevitable outcome of a dangerously inflated level of values following upon a decided lull in the demand, which has not unnaturally set a good many people thinking that the height of the "big war boom" has at last been seen. Indeed, there does not seem to be much doubt on that point, although it is only correct to point out that so far the American copper magnates have not made the least attempt to test the market, and have, as a matter of fact, not modified their limits. The collapse in the price of standard copper has aroused the more astonishment considering the prohibition

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of speculative dealings under the Defence of the Realm Act, but it none the less betokens the swift change in sentiment wrought by an absence of demand alongside of the persistent talk of peace in the foreign Press. American news has been rather adverse for some little time past, which for one thing has had a disturbing effect. The forcing up of prices in recent months was entirely the result of the huge orders placed by Allied Governments for munitions over the whole of this year, which orders may aggregate not far short of a quarter of a million tons. Copper producers have really no reason to feel very apprehensive as to developments in the near future, for they will still be reaping huge profits against their deliveries for months to come, nor may they feel much inclined to re-enter the market for some time yet.

Meanwhile, second-hand copper appears to exist across the Atlantic in fair quantities, and should sales be pressed, prices may fall a good deal further Should the moderate surplus held speculatively, however, be cleared off the market by the filling of additional needs, this may have a steadying effect and enable the American magnates to retain control of the market, although there is not much doubt that, with a fast increasing production, some surplus in first hands is bound to arise at no distant date. Therefore, it is generally inferred that, sooner or later, American producers must take action to regulate prices on a less extravagant basis, in order to guard against severe disturbances later on, when peace conditions are restored. Admittedly, the outlook is very obscure, while the war demand for the time being, at any rate, has been fully satisfied. In America, consumption has been on a huge scale for some months past, but there is ground for believing that it has seen its best, while the special orders placed last year for export in connection with munitions are now being worked off, which must lead to some contraction in the meltings on the part of American manufacturers, and thus make room for an increasing exportable surplus of refined copper. Reserve supplies on this side are still badly depleted, but this is no longer being felt in view of the stagnant demand, and, given easier freight conditions, some increase in current supplies may be pretty safely looked for. The policy of consumers is now obviously to confine their purchases strictly to urgent needs.

Water-Power in Spain.

The comparative scarcity of coal in Spain, which in the past has depended largely upon imports for meeting the requirements of the railways, industries, city lighting, shipping, &c., has resulted in attention being again directed to the waterfalls existing in that country, with a view to the production of electrical energy on a considerably larger scale than is the case at present, so as to render the country more independent of supplies of coal from abroad. It is estimated that the watercourses would be able to yield 5,000,000 H.P., and that a further large amount could be obtained by utilising the mountain torrents. It is urged that the railways should be operated by electricity, the works and factories be driven by it, the industrial furnaces be electrical, and the public and domestic lighting also be provided by means of the same agency. The reasons why such work has not been carried out are declared to lie in the negligence and lack of precision on the part of the governing authorities and the lack of initiative and of industrial understanding of Spanish capitalists. It is held that the native agricultural industry was saved from disaster by the Copta irrigation policy, and it is suggested that if a similar policy were adopted in the case of the utilisation of water powers for electrical purposes it would be possible to raise the position of Spain to the level of the great industrial nations.

LABOUR AND INDUSTRY.

(*Continued from page* 585.)

Mr. Hodge, M.P., who presided at the meeting of the British Workers' National League, is the late acting chairman of the Parliamentary Labour Party, and he was as definite as Mr. Hughes in his pronouncement of policy. So also were Stephen Walsh, M.P., Will Crooks, P.C., M.P., and J. A. Seddon. Mr. Hodge, as a Labour leader, recognises, as everybody else must do, that there will be great changes when peace comes, and we must prepare to take time by the forelock. There was no attack on Capital, none of that spirit which will demand what it regards as its due reward, indifferent as to the ability to give it. Here was Labour asking that more money should be spent on scientific research and on technical and other education. The workers had been crying in the past for a minimum wage, but now they were told that, if they were able to think, they must see that they could not have a minimum wage unless they gave the employer protection against the sweated goods of Germany or any other country. They had to bring the cold logic of reason to the economic problem. This was the line along which Labour was going—such the goal that it had in view. They did not want "economic war"—they wanted fair play. "The open door for an open door, but not an open door against a shut one." With such sentiments Mr. Hodge introduced Mr. Hughes, the Australian Prime Minister, acknowledging at the same time the lead which Australia had given in Labour legislation. Mr. Hughes delivered one of his thorough-going and characteristic speeches, covering much ground which is by now familiar to those who have followed his doings. One or two points will suffice to show the advice that he vouchsafes to British Labour at this critical emergency. The war means life or death to Labour. If Germany were to win, good-bye to all chance of Labour realising its ideals, for all its opportunities rested upon the foundations of those free institutions which Englishmen enjoyed and Germans did not. The war was a struggle for these free institutions . . . the people must win the war . . . or they must lose all those privileges of freedom for which their fathers had fought and died. He repeated that the war meant everything to Labour. Labour had set itself to improve the conditions of the masses; it had organised itself to that end. Nationally, we must organise to retain the fruits of victory. Industrially we must organise, for successful industry was impossible without organisation and co-ordination when competing against the most efficiently organised industries of the world. Every industry would not require the same treatment—some might not require help of any kind, others must have it. We must see that our raw material resources were developed and controlled as British industries—must make new industries, and develop some that already existed. After covering this familiar ground, Mr. Hughes developed his ideas to show how these matters were related to the well-being of Labour. He said that the conditions under the new *régime* must be such as would ensure a healthy and virile population, and this was to be arrived at by the payment of a reasonable wage to enable a man to bring up a family in a manner compatible with British greatness. Nothing short of that would serve, and the organisation of British industry could do it. "If the British employer is to give fair and reasonable wages he must know where he is. He must be aided in the foreign market. We have to consider the question as a whole, and not in parts. . . . We shall be faced with infinitely greater problems after the war. If we do not want to see industrial chaos and unemployment in the land we must act, and act now. Are these millions of men going to be employed again if we open our doors to the enemy, and allow her to dump her goods into our markets?" He argued for Protection as a measure of safety for the nation. Many more utterances of an equally energetic and spirited nature fell from Mr. Hughes's lips as he gave the new Labour movement its send-off. The argument is not new, but the times are changed, and we print the foregoing review because we feel that the League represents what may be expected to become a strong movement in the coming months and years, for the problems of the industrial world

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bid fair to become so great that the workers will be more keenly interested in such matters, especially as the horrors of German methods in warfare have aroused within them such feelings of repugnance against German goods, that they will not want them to be admitted unhindered, whether they are cheap or not. We need not refer further to the proceedings at the Queen's Hall, except to briefly indicate two points from other Labour speeches which show how the wind blows in these changing days. Mr. Stephen Walsh, M.P., said he had been a Socialist ever since he could remember; he was early orphaned, and owed his all to the State which had brought him up, educated him and given him his chance; he had yet to learn that in a time of great emergency a Socialist should not stand by the State to which he was a debtor. This naturally reminded us of the pre-war talks of war being prevented by Labour in all countries concerned "downing their tools" by international understanding between the workers when the call to arms was given. We have since seen Nationalism prevail against Internationalism; the Socialists of England and of France, and of Germany too, have leaped to the help of the land of their birth. It may yet lie with the Socialists of Germany to displace that nostrum "Kultur" and introduce a true culture based upon Democratic civilisation—who can say? How does this bear upon the Labour problem? Does it not suggest that the British Socialist-Patriot who feels it his bounden duty to stand by the State in military emergency will also be prepared for the policy of protecting his own kith and kin against aggressors when the economic emergency arises? Are not the State and Industry practically interlooked or intermeshed? Do not industrial security and prosperity assist to ensure national security and prosperity? The second point arises from an effective remark made by Mr. Will Crooks, whom Labour, in many of its parts, loves and follows: "Hundreds of Belgian young women—all single—at a railway terminus—in terror, ready to flee before the Huns. A soothing voice: 'Don't be afraid—they don't make war on women!' The Huns came—the women disappeared—they've never been heard of since. Can yer buy from Germany again as yer did before, after that sort of thing?" In these and other ways are we permitted to see what is working in the mind of Labour. We make no deductions—they are not necessary; we merely record the bare signs of the times. Labour is to-day more against the enemy than against Capital in its own country. Will it remain so when wages fall and we are merely master and man again? That is an all-important question for us all; but at present the same sentiments of patriotism and of horror possess capitalists, and who shall say that they may not yet be found to form one of the strong ties of common interest between Capital and Labour, which may strengthen our feet and assist us as we feel our way along towards industrial harmony? Perhaps they are not sentiments that will be permanently healing or reconciling, but they may tide us over the first critical period. Everybody seems now to recognise that Labour has been antagonised in the past by a deplorable suspicion of Capital, and that Capital has had to be continually on its defence because Labour has made exaggerated demands in a regrettable spirit, and with apparently little regard to such elementary considerations as the sanctity of contracts, and the burdens that a business could carry and still survive against foreign competition. The new teaching that, unless the master knows where he stands, the labourer cannot very well have his demands satisfied, will probably be listened to with sympathetic ears, and may serve to prevent a renewal of that spirit of suspicion where, as in so many cases, it has had no justification in fact.

Returning now to the general question, we observe that Mr. W. A. Appleton, the secretary of the General Federation of Trade Unions, whose representatives to the Special Joint Labour Committee, as stated last week, have not yet been appointed, has been expressing his views on the situation. He holds that it is of profound importance that Trade Unions should decide at once what they want; how far their wants are within the bounds of possibility; and then what kind of organisation should be set up, and how much money is needed, to win through. He, too, sees that during the period of industrial and commercial readjustments which will follow the signing of peace, the fate of movements as well as nations, will be decided. "Trade Unionism must not depend upon promises, or hope to receive preferential treatment; it will secure just what it is strong enough to take—that, and nothing more. Such a statement does not imply criticism or any charge of breach of faith; it is just a statement of fact, and is based upon historical and economic experience."

Of course, those who know anything about Labour organisations and Labour gatherings know that it is not customary amid such surroundings to mince matters, or to clothe one's sentiments in over-courteous dress; a spade is sometimes called a spade, and, even under stress of conditions, a sanguinary shovel. But hard words break no bones, though they do sometimes stir up bad blood. In this case, all that Mr. Appleton is doing is telling Trade Unionism that it must be as strong as it possibly can, or, when Labour wrestles for its rights, it will not rend them from Capital. He is saying no more to Labour than many have said to the employers:—If you would be equal to the coming emergency, you will need to consolidate your forces. As Mr. Hughes says: "Organise, or you cannot win." Masters must have a solid organisation to negotiate with organised Labour, as well as to compete with the Enemy. If they are not so organised, how will they be able to represent national industries in the presence of a Government which, after the war, is bound to give ear to the counsels of Labour, which it has so often told is doing so much to win the war? In the past Labour has won much because it has been organised—better organised than have the manufacturing interests of the Empire. What will be the true strength of Trade Unionism after the war? Will it represent the workers *en masse*? Do we not observe differences of policy among different sections; are there not already different sections, some of which appear to regard the coming emergency as one in which they can parade their Utopian ideals, while others base their demands upon facts? Is there not just a possibility of Ideal and Fact once again coming into collision, even within the ranks of Labour itself? The last thing in the world that can be detected at the moment is any uniformity of policy on the part of the great forces of Labour of the United Kingdom. Things are very much in a state of flux, and such programmes as we summarised last week will, doubtless, undergo a good deal of revision as the Trade Unions, in the words of Mr. Appleton, come to decide "how far their wants are within the bounds of possibility." Perhaps, all the at present diverse sections of Labour will yet consolidate in one organisation. We believe that individually the manufacturer prefers to deal with a Trade Union rather than with disorganised employés; and probably it would be more satisfactory for strongly and efficiently organised Labour to negotiate, as occasion arises, with strongly and efficiently organised employers. But whatever may be the developments along these lines, if the workers, as a whole, can be induced by propaganda, by the Press, and by meetings, to look calmly, fairly, and squarely into "how far their wants are within the bounds of possibility" as "after the war" possibilities develop, we believe that they will feel that there will be as much as the nation and the Allies can do to deal with the serious facts in a practical way, and to relinquish, at any rate for a time, the grand ideals to which we never can attain save by a gradual evolutionary process.

(*To be continued.*)

BATTERY ROOMS.

By GEO. R. ARCHDEACON, A.M.I.E.E.

NOTHING in the whole scheme of things electrical seems to receive such scant attention as the design of battery rooms. The care bestowed on the battery itself is generally just about the minimum required to keep it running, but the care bestowed upon the building in which it is intended to install it seems to be, if possible, even less. First of all, the author intends to draw attention to the faults most prevalent in the design and situation of battery rooms. This subject lends itself to three sub-divisions—i.e.,

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central station battery rooms; workshop battery rooms; house lighting battery rooms.

In a central station, one would naturally suppose that the technically trained men usually employed therein would so direct things that the building wherein it was intended to install an important section of the plant, costing anything from £1,000 to £15,000, would be as free from errors as it was possible to arrange. Yet even here one finds the most haphazard methods, and the most casual attention paid to the situation of this most important item.

To quote a few instances of the neglect in this direction, the author can point to a central station wherein the battery room is located so close to the boiler house, that steam, ashes, dust, &c., penetrate the crevices of the doors and windows to such an extent, that the floor of the battery room is covered with dust and dirt unless swilled out twice a week.

Another instance. In this case it is necessary to squeeze sideways past the main coal-bunkers to get to the battery-room door. This room is situated under a fitting-shop, and the tops of the windows come on the level with the top of the coal-bunker. If by any chance the windows are opened to ventilate the room—well! the author leaves the result to the reader's imagination.

In another instance, the main doors of the battery room are situated within some 12 ft. of the ash conveyor. In several cases the battery room has been constructed over the economisers (presumably to keep them warm).

All these obvious errors are repeated, and will doubtless continue to be repeated in dozens of stations, until the central station engineer is converted from his present feelings of doubt and suspicion towards the storage battery, which he so frequently regards as some weird chemical contrivance which is frightfully "messy" to handle, possessing a most potent faculty for destroying his clothes, yet of unquestionable value in coming to his assistance when his pet favourites have refused duty and failed him in his hour of need.

Not until the central station engineer ceases to look upon the storage battery as a mere appendage to his generating plant (a sort of necessary evil), will he trouble to interest himself more in its welfare.

Workshop battery rooms, with few exceptions, suffer from most of the defects of design and situation already enumerated, the bad lighting arrangements being especially noticeable.

Usually the space occupied by the battery room is considered "unproductive"; therefore it is cut down to the smallest proportions, and is so cramped as to prevent the attendant working in comfort; this naturally reacts on the amount of attention the battery receives.

House lighting battery rooms in the main are in a deplorable state of chaos. With few exceptions most of these battery rooms seem to have been fitted up with the special object of being unsuitable. They are fixed in stables, hay-lofts, greenhouses, cellars, &c., in fact, anywhere where they are out of sight. Badly lit, cramped, damp, dusty, up rickety stairs, down dark passages, complete with all the bad features, and with never a good one to recommend them.

Having briefly pointed out the grave errors found so frequently in the design and situation of battery rooms, the author intends to offer a few suggestions and hints which may assist some engineer who is considering the adoption of a storage battery, and has not yet decided where it shall be placed.

The battery room should be lofty, situated (where possible) in an open space where it will have access to the wind in all directions. Glass is cheaper than bricks, and a good light is preferable to a bad one, so let there be plenty of windows.

Attention must be paid to the ventilation of the room. Unless this is quite adequate, it will be impossible to work in the battery room during prolonged periods of charging. Three to six cowl ventilators (according to size of roof) should provide a sufficient means of exit for acid fumes, &c. The doors should be of ample proportions to admit freely carboys, new cells, boxes, &c, which from time to time may be required.

All necessary precautions must be taken against the possibility of bits of lime, plaster, dirt, &c., falling from the walls or ceiling into the cells. One of the most substantial, and, at the same time, pleasing results, will be obtained by having the ceiling and walls entirely finished off with concrete, instead of plaster.

If it is proposed to have a flat roof, this can be entirely covered in sheet-lead, upon which should be spread a thin layer of concrete; bitumen is then poured over the whole to finish off. This appears to afford excellent results, and few complaints of leakage are ever made if the job is well carried out.

The author's objection to this method is based upon the very slow drainage; whatever precautions are taken, a flat roof of fairly large area will hold up sufficient water to find a weak spot sooner or later, and then penetrate. A well-slated steep roof, in the writer's opinion, gives the maximum protection against inclement weather.

One of the most satisfactory designs that has come to the author's notice is in the form of a saw-tooth roof, the steeper side consisting of long glass panels, for preference facing towards the north, and thereby preventing too much direct sunlight from entering the battery room, and so increasing the temperature beyond 60° F. This roof may be supported entirely upon wooden side and cross beams. Of course, all woodwork must be treated with two or three coats of acid-resisting paint.

The floor of the battery room may be covered with acid-resisting tiles, with tiled gutters running down the sides of each row of cells; or, if preferred, the floor to the depth of 2 in. can be of rock-asphalt, having a whaleback form to drain down to the gutters. In any case, however, to get a good level surface, about 12 in. of cement concrete should form the foundation for any construction it is intended to employ.

The cells should be erected in single tiers only. Double tiers, whilst saving space, do not add to the comfort of those whose duty it is to work the battery; and the personal element must never for a moment be lost sight of. With this point in view and having regard to the increase in working speed of the attendant, the author would advise in the lay-out of a large battery of, say, 250 cells, an arrangement as follows:—One single tier, single row, 3 ft. from wall; one single tier, double row, down centre of room; one single tier, single row, 3 ft. from wall. Space on both sides of double row 4 ft. 6 in.

It is an advantage to make an alley-way across each row of cells half-way down, leaving elbow room and head room with the connections.

This item will be well appreciated when some special cell is in need of attention, as to have to walk the whole length of the battery-room every time one wishes to look at the hydrometer is not only fatiguing, but intensely provoking.

It is a great convenience to have two or three taps with hose connectors fitted at various points of the room, also a sink should be fitted wherein the attendant can wash boxes, sections, gloves, &c.

Attention should be paid to the electric lighting. A high standard of illumination should always be the rule, thereby considerably reducing the errors in hydrometer readings. A desk should always be provided, so that the records, thermometers, hydrometers, inspection lamps, cell voltmeter, &c., can be kept close to hand; this also saves time and temper, and will improve the legibility of the written records.

Inasmuch as badly designed and badly situated battery-rooms do in a very great measure react upon the performance of the battery, one can only wonder why the manufacturers do not include a department for the design and building of battery rooms. This, under careful management or a system of sub-contracting, could doubtless be made into a profitable feature of their business. In any case the ideal conditions it would assure would undoubtedly redound to the credit of the battery, whose successful operation so materially affects the manufacturer.

In conclusion, the author again strongly emphasises the following points in battery-room design:—Assure thorough ventilation; keep out all dust and dirt; arrange for ample but equal distribution of light; provide sufficient working space. Remember that the ideal temperature is 60° F.; therefore construct the battery room so that it rarely exceeds 65° F.

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NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

"Atmos" Street Lamps.

The accompanying view, fig. 1, illustrates the "Boro" type of lantern, containing an Osram "Atmos" type lamp of 300 or 500 watts, installed for the Kensington Borough Council on existing arc lamp-posts. The outside dimensions of this lantern are equivalent to those of the arc lamps displaced; the lantern contains an automatic cut-out and substitutional resistance to enable any number of lamps to be run in series. The resistance and

FIG. 1.—LAMP-POST IN KENSINGTON HIGH STREET, WITH OSRAM "ATMOS" LAMP IN "BORO" LANTERN.

cut-out are completely wired and connected up to the two terminals in the top crown. Special care has been taken to provide adequate ventilation. The lantern itself is made of vitreous enamelled steel, to withstand all weather conditions; and the globe and reflector, which are fixed together, are hinged and held by fly-nuts, so that they may be readily swung clear for cleaning or for replacing the lamp. The "Boro" lantern is one of the various types manufactured by THE GENERAL ELECTRIC CO., LTD., of London.

A New Ignition Magneto.

A new ignition magneto (figs. 2—4) for use on petrol motor cars, which embodies a number of interesting features, has recently been brought out by the Ziola Engineering Co. of America, of Madison, Wis., U.S.A. The machine, which is really a high-tension generator, has a soft laminated field throughout; the high-tension winding instead of being wound on the armature, is wound on a stationary side of the field on one spool, thereby increasing its insulation and making it possible to produce a higher voltage without taking chances in the leakage of the current. A very small amount of current from a battery is conducted into the winding of the rotor, which, while revolving, induces current in the high-voltage section. There is also a special winding in the stationary part of the field, which makes the inductive action uniform throughout the entire stator. By revolving the armature the magnetic circuit is continuously being broken, and thus alternating current of high intensity is induced in the high-tension winding. This type of high-tension generator does not depend upon stationary magnets, but builds up its own magnetism while running. It is designed for use on cars provided with an electric engine starter and a storage battery; when it is desired to employ the magneto to generate a spark without the intervention of a battery, a pair of permanent magnets can be added, these being excited with electric current during the whole of the time the engine is running. In other words, the magnetism will build up with the running of the engine, and the spark from the generator will not depend on the permanency of the magnetism.

Both types of the new magneto are provided with either a stationary or a movable distributor, in order to meet the varying ideas of car manufacturers, some of whom prefer fixed ignition, while others prefer variable ignition. Finally, it may be mentioned that the Ziola magneto is of the closed-circuit type, and that the magnetic leakage is claimed to be very low.

Measuring the Height of Acid in Tanks.

The method generally employed for determining the depth of acid in a tank consists of lowering an iron rod into the tank until it reaches bottom and then measuring the liquid depth on the rod. This method is crude and cumbersome. Mr. M. M. Samuels has worked out an electrical device for the purpose, several of which have now been in operation successfully for about a year. Two platinum wires are sealed into small glass tubes approximately 2 in. long. About $\frac{1}{16}$ in. of the wires projects at the bottom of the glass tubes for contacts, and insulated leads are attached to the top ends of the wires. These glass tubes are inserted in a $\frac{1}{2}$ in. iron conduit, which is then completely filled with paraffin. A lamp suitably protected by a wire guard is mounted on top of the pipe, and a flexible two-conductor deck cable is brought out from the side of the pipe with a strong marine plug attached to its end. A receptacle box furnishing alternating current and mounted on the tank, or near it, serves as the source of energy. When the outfit is inserted in the tank, the lamp lights up as soon as the platinum contacts touch the acid. The height of the acid can be read directly on a wooden scale attached to the rod.

The valve for feeding the acid tank is very often a great distance away from the tanks, and the man operating the tanks has no way of telling when they are filled up to proper depth. A signboard was therefore installed near the valves, with one lamp for each tank connected in parallel with the lamp on the measuring rod. As soon as the tank is full the lamp on the signboard will light up. For this purpose the plug has to be of the three-contact type and the cable made with three conductors. Bells can easily be added to the system to indicate either when the tank is full or when it is empty.—*Electrical World.*

"Trolley Shoe" for Tramways.

Our contemporary, the *Electric Railway Journal*, describes a trolley-shoe with a renewable steel contactor instead of a wheel, which, it is claimed, will run from 7,000 to 10,000 miles, and has been put on the market by the UTILITY SPECIALITIES CO., LTD., of Boston, Mass. The trolley harp is fitted with an oval-shaped

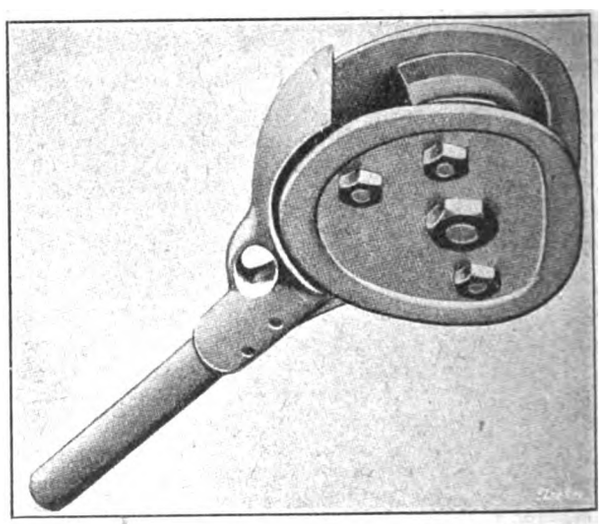

FIG. 5.—TRAMWAY TROLLEY SHOE.

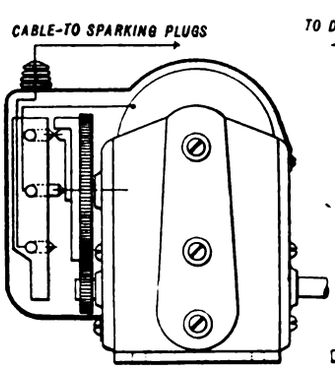

FIG. 2.—DISTRIBUTING DEVICE.

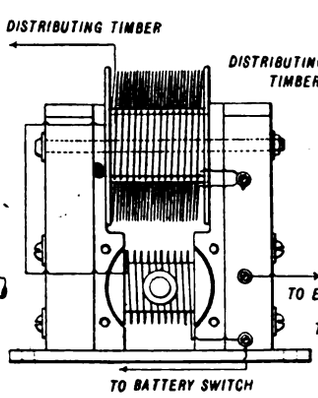

FIG. 3.—ZIOLA MAGNETO.

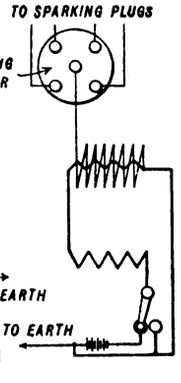

FIG. 4.—WIRING DIAGRAM.

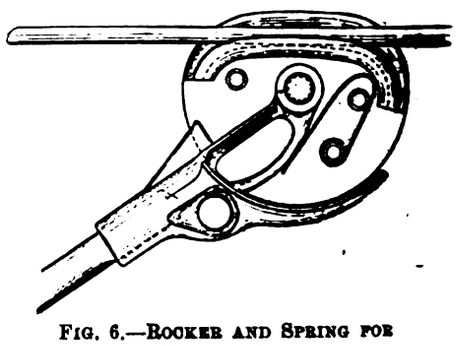

FIG. 6.—ROCKER AND SPRING FOR TROLLEY SHOE.

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shoe, pivoted and fitted with a strong spring, so that the contactor automatically assumes contact with the wire, regardless of the angle. It is claimed that the increased area, combined with the sliding contact, eliminates arcing, and that the shoe runs cool. The shoe has been found particularly adapted for use on heavy locomotives and high-speed cars. No lubricant is required, and the contactor is of special steel.

High-Tension Draw-Out Cubicles.

Fig. 7 shows a five-panel board for 3,300 volts, three-phase, of the draw-out cubicle type, designed and manufactured by MESSRS. JOHNSON & PHILLIPS, LTD., Charlton, S.E.

The board consists primarily of a sheet steel shell which contains the bus-bars, cable boxes and fixed contacts. The control apparatus for each cubicle is mounted in trucks, one for each circuit, these trucks, which run on wheels fitted with ball bearings, being made up of stout angle irons with sheet steel fronts.

Owing to the special construction, it is an easy matter to push in or pull out the trucks, and when any cleaning or repairs are necessary the truck can be wheeled away from the board and attended to in perfect safety.

In order to avoid the danger of pulling out the truck when current is on, a special interlocking device is fitted so that the oil-switch must be open-circuited first. The connections to synchroscopes or voltmeters are made by a system of pilot wires running behind the sheet steel front of each truck and the continuity of these pilot wires is maintained by small removable links on the front between each truck. This type of gear is very suitable for confined situations, as it can be placed close to a wall.

Great care is taken in the alignment of each truck so that the electrical contact between it and the bus-bar does not deteriorate by frequent removals of the truck.

This type of gear has been installed in many works and collieries

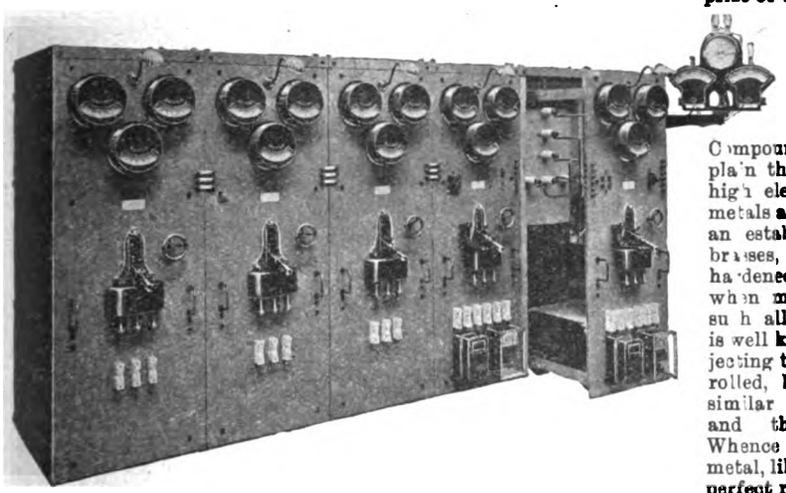

FIG. 7.—H.T. DRAW-OUT CUBICLE SWITCHGEAR.

in this country, and is well worth consideration for pressures of 2,000 to 11,000 volts where the space is limited and the greatest safety in operation is desired.

Mayfield's Sound Augmenter.

MR. C. MAYFIELD, of 31, Red Lion Street, London, W.C., has sent us particulars of a sound augmenter which he has devised, consisting of a special attachment, entirely self-contained, and electrically connected, for clipping on any ordinary telephone receiver, or, in the case of phonographs, gramaphones, &c., to the sound tube leaving the sound box; we are informed that it augments inaudible, or almost inaudible, sounds to such a degree that, in the case of ordinary telephone receivers, the sound or speech can be heard a dozen feet away from the telephone.

The device consists of a special microphone, sensitive to such a degree as to respond to sounds inaudible to the human ear, yet capable of carrying heavy currents and so reproducing sound by the aid of an ordinary Bell receiver, augmented in volume sufficiently to fill a large hall if necessary.

The essential features of the microphone comprise a circular elastic disk, covered with an electrolytic deposit of iron, from the periphery of which, electrically connected, radiate a number of elastic cords covered with metallic filings electrically in contact; the number of these cords and their diameters vary with the size of microphone and the current it is intended to carry. These cords are electrically connected to two half-plates of brass, whose distance apart can be adjusted by screw tension. The microphone is fitted in a small adapter which can be clipped in a moment on any ordinary telephone receiver, and is self-contained and electrically connected, requiring no interference with the telephone instrument, which, of course, would not be permitted by the authorities. The action of the instrument, in the case of the ordinary telephone receiver, is as follows: the faint sound is at once responded to by the delicate disk, which vibrates, setting up vibration of the elastic cords, which vary the resistance in a small dry battery and telephone receiver circuit (self-contained), and the sound is reproduced, augmented in volume to a degree depending upon the size of the microphone and the current used.

In the case of an ordinary telephone receiver the clip attachment will give audible speech 12 ft. from the telephone, and in the case of large apparatus with a specially constructed receiver and microphone, with currents of 3-12 amps., will yield sound sufficient to fill a large hall.

An essential principle of the apparatus is that when no sound is passing through the telephone receiver, the local microphone repeating battery shall be automatically switched out of circuit by the action of the microphone itself; the instant sound affects the diaphragm, current passes to the augmenter. The small instrument for clipping on an ordinary telephone receiver is entirely self-contained, measures only a trifle over 3 in. in dia., weighs under 4 oz., and can be clipped on a receiver in a few seconds. There is then, we understand, no need to hold the receiver to the ear; laid on the table, the sound or speech will be heard clearly in any part of the room.

Preparations are being made to place the attachment on the market at a very low price, and agents will be appointed all over the country.

THE STRUCTURE OF METALS.

AT the May meeting of the FARADAY SOCIETY a group of papers was discussed bearing on various physico-chemical problems in connection with the structure and properties of metals. Two of these were by MR. F. C. THOMPSON, of the University of Sheffield, to whom the PRESIDENT, SIR ROBERT HADFIELD, offered a prize of £50 as an incentive to him to continue his researches and present them to the Faraday Society, and further as an expression of his appreciation of the valuable work being done under Dr. Arnold in the Department of Applied Science at Sheffield University.

The first of Mr. Thompson's papers dealt with "The Properties of Solid Solutions of Metals and of Intermetallic Compounds." In this a suggestive hypothesis is put forward to explain the improvement in physical qualities—hardness, ductility, high electrical resistance, and so forth—that results when two metals are alloyed in such a way as to form solid solutions. It is an established fact that all the industrially useful alloys, the brasses, bronzes, nickel-silvers, strong aluminium alloys, even hardened steel, consist largely of one or more solid solutions; when metals combine to form definite intermetallic compounds, such alloys are generally useless for practical purposes. Now it is well known that metals may be considerably hardened by subjecting them to a state of strain, such as happens when they are rolled, hammered, or drawn. Mr. Thompson supposes that a similar state of strain is set up in solid solutions, and this is the cause of their superior properties. Whence arises this internal strain? The atoms of a metal, like those of any other crystal, are arranged in space with perfect regularity. In the case of an element A, to which a second B, which passes into a solid solution, is added, the atoms of A in the space-lattice are replaced progressively by those of B, and the lattice passes imperceptibly from that of one pure element to that of the other. This atomic replacement must react on the physical properties, and if the atom of A occupies a greater volume than that of B, there results an expansion of A and a contraction of B in the act of crystallising together. The resulting distortion gives rise to elastic strains, and it is to these that Mr. Thompson ascribes the increased hardness of this class of alloy. The strain will be greatest when half the atoms have been replaced by others, and it is considered valuable evidence in support of the theory that in the gold-silver and gold-copper alloys, which form a continuous series of solid solutions, the maximum hardness is found in the 50 per cent. alloys. Now that the Braggs' method of determining the space-lattice of crystals is available, a ready method of testing Mr. Thompson's suggestive theory presents itself, and it is hoped that it may be possible to isolate good crystals of, say, the gold-silver series, and apply to them the X-ray spectrometer.

Mr. Thompson's second paper gave a *résumé* of recent studies, here and on the Continent, on the "Annealing of Metals." This work is based on the views and experiments of Beilby, Ewing, and Rosenhain, who have shown that work-hardening in metals consists in, first, the internal shearing of the crystals along the planes of slip; and, secondly, the conversion near those cleavage planes of crystalline substance into a hard amorphous intercrystalline cement. This cement is not only itself extremely hard, but it is also essentially the seat of the internal stresses. Reheating or annealing has the effect of recrystallising the amorphous modification. There is an essential difference between the annealing of steel and that of alloys like brass or nickel-silver. In the former case the object is to refine a coarse-grain size resulting from previous exposure to high temperature, and it is essential to maintain the elastic limit as high as possible. In the latter the very reverse is aimed at. The object of annealing is to render the metal capable of again receiving changes in shape, and hence the process is designed to lower the elastic limit as much as possible, for mechanical work spent within the limits of elasticity is obviously useless. Mr. Thompson's paper, which is well worth careful study, after following in some detail the course of the annealing process in hard-worked copper, brass, and nickel-silver, deals finally with the influence of the temperature—here "burn-

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ing" is a factor to be considered—of the duration of annealing, and of impurities.

An allied subject was discussed by Mr. Zay Jeffries in a paper sent in from Cleveland, U.S.A., on "Grain-size Measurements in Metals and the Importance of such Information." The counting of the number of grains in a unit area, or, better, unit volume, of a metal affords a ready means of indicating many of its physical properties, such as tensile strength, hardness, elastic limit, life under vibration, or even corrodibility, and it is a method which deserves more attention from engineers than it has so far received. The value of such information is largely comparative, and it has to be taken in correlation with other physical properties, but it has the great advantage over mechanical tests, of not introducing any deformation into the specimen under examination. Unfortunately, in many metals, hardened steels for example, the grain is so fine as to defy measurement, unless again Prof. Bragg's wonderful X-ray instrument can be employed, as was suggested in the course of the discussion. Sir Robert Hadfield mentioned that whereas a 0·58 carbon steel as forged and annealed contained 4,500 grains per sq. in., the number rose to 333,000 when the steel was water-quenched and reheated. Mr. Jeffries has devised an improved rapid, convenient, and accurate method of counting grains. This consists in counting those completely included, and partly included, in the circular portion of an image of the specimen of standard magnification, and by means of an empirical formula determining therefrom the equivalent number of whole grains in the standard area.

Two papers on aluminium were presented: one by Dr. F. J. Brislee, on "The Changes in Specific Heat of Hard and Soft Aluminium," and the other by Dr. R. Seligman and Mr. Percy Williams, on the "Annealing of Aluminium."

Dr. Brislee has previously shown that the density of aluminium decreases with mechanical work. The tensile strength increases, but with a great deal of work the metal becomes exceedingly brittle. These changes are explained by an allotropic change of state, from a crystalline to an amorphous form, such as Prof. Ernst Cohen, of Utrecht, has shown to take place in so many other metals. The differences in specific heat noted support this theory, and they indicate the important fact that the amorphous phase begins to change into the crystalline even at 100° C. Dr. J. A. Harker, in the discussion, urged the importance of making more studies on the properties of metals at high temperatures. The melting point, and not room temperature, should be taken as the starting point. Dr. Seligman and Mr. Williams found that hard-worked aluminium which had been heated for 10 hours at 125° C. was less readily soluble in nitric acid than the same metal before heating, but that if the heating were continued for 80 hours, this comparative immunity from attack disappeared. Further, metal freshly annealed at 440° C. was less readily attacked than it was after 10 days' standing. These results, too, would seem to be explicable on the theory of allotropic modifications.

A paper by Mr. Emil Hatschek on "The Theory of Gels as Systems of Two Liquid Phases" shows that this accepted theory of the constitution of gels breaks down on mathematical analysis. Mr. Hatschek himself conceives gels as of an ultimate crystalline structure, with the crystals thinned and filled with liquid.

The meeting concluded with the consideration of a paper sent from the University of Melbourne, by Mr. E. J. Hartung, "A Contribution to the Theory of Solution."

ELECTRO-PLATING.

A paper by Prof. F. C. Mathers, E. H. Stuart and E. G Sturdevant on nickel plating, read before the American Electrochemical Society, gives an account of an extended research, the chief results of which are as follows:—

The purest nickel anodes obtainable should be used. Strips of electrolytic nickel cathodes, 98·8 per cent. pure, used directly as anodes, dissolve irregularly and with pitting, but no impurities are introduced into the bath. Very much of the trouble with badly coloured deposits and with sludge is caused by the iron from impure anodes. The addition of 2 per cent. of magnesium or nickel chloride makes the anode corrosion approximately theoretical. The nickel anodes, supported by lead hooks, may be completely immersed in the solution, thereby greatly reducing the amount of scrap metal from the anodes. The anodes should be placed in bags in order to catch loosened particles, which cause pitting if they reach the cathode.

The addition of 0·2 to 0·3 per cent. of ammonium citrate keeps the solution clear and free from sludge, whereby a shallower tank and a less volume of solution may be used. The bath should be stirred or mixed thoroughly at intervals, but not within 8 to 10 hours of the time of using if any solid particles from the anodes are present.

The greater the ratio of nickel sulphate to nickel-ammonium sulphate the brighter and more shiny the deposit. The more acid the solution (to the point of acidity to Congo red) the more shiny the deposits. Boric acid increases the current that can be used without blackening or burning the deposit.

The following bath seemed to be the best: nickel-ammonium sulphate 4 per cent., nickel sulphate 10 to 14 per cent., boric acid 1 to 3 per cent., magnesium chloride 2 per cent., and ammonium citrate 0·2 to 0·3 per cent. A current density of 1·6 amp. per square decimeter (14·8 amp. per square foot) which plates a thickness of 0·0025 cm. (0·001 in.) in 1·25 hours may be used.

A paper by Dr. Oliver P. Watts on rapid nickel plating sums up the advantages of a hot over a cold nickel solution as follows:—

Heating from 25° to 70° C. lessens the resistance of the solution one-half. The current density may be increased two-and-a-half to three-fold. The current efficiency, if less than 100 per cent. in the cold solution, is raised. Anode corrosion is greatly improved, and higher current densities may be used at the anode as well as at the cathode. The deposit is superior to ordinary nickel plate in toughness and freedom from peeling.

In the solution tested, plating may be done at 200 to 300 amps. per square foot, at which rate the same amount of metal is deposited in five minutes as requires one-and-a-half hours in the "rapid solutions" now in use at 10 amps. per square foot.

Prof. Frank C. Mathers and John R. Kuibler, in a paper on the electro-deposition of silver from silver nitrate solutions, state that in their experiments the ordinary addition agents such as glue, peptone, clove oil, aloin, &c., were found to be either without appreciable effect or to prevent only partially the formation of crystals, and in no case was a thick, smooth deposit obtained.

Tartaric acid is the most effective substance for producing solid, firm deposits of silver from the ordinary silver refining bath containing silver nitrate and nitric acid. A good composition of the bath is 3 per cent. each of silver as silver nitrate, nitric acid, and tartaric acid. The further addition of 0·01 per cent. of glue twice daily makes the deposit much smoother and of a darker, more shiny colour.

A current density of 22·4 amp. per sq. ft. in a vigorously stirred bath gave a firm, smooth deposit which was a little heavy on the edges. In a bath only gently mixed or stirred, 7·4 amp. per sq. ft. gave the best results.

The deposit is brittle, hence it is of no value in plating.—*Met. and Chem. Engineering.*

INDIAN NOTES.

[From Our Special Correspondent.]

The recent Indian budget imposed a Customs duty of 2½ per cent on all imported material above and beyond the duties levied hitherto. For instance, prime movers such as engines, motors, dynamos and electric fans, which were free of duty before, now carry a duty of 2½ per cent.; and such goods as copper wire and switchboards, which previously carried a duty of 5 per cent., now pay 7½ per cent. It is but a small increase and will, of course, be borne by the customer, and it is not anticipated that turnover will, to any extent, be influenced. The Indian Tariff Act of 1894 safeguards the importer on contracts made prior to the imposition of this new duty.

There is what may almost be called a fan famine in India just now. Prices have gone up about 33⅓ per cent., and Government are buying up all the fans obtainable. Several consignments of this very necessary commodity have gone down in various sunken boats. English-made fans are scarcely to be had; and American and Italian fans are particularly slow of delivery, although big stocks are on order for long periods.

Small self-contained oil-driven electric sets are also at a premium, and good prices are being obtained by firms who are fortunate enough to possess any. The military authorities are buying up all available stocks in this line.

LEGAL.

Prolongation of Patent Refused.

Mr. Justice Sargant, in the Chancery Division, gave his reserved judgment in the petition tried by him a week or two ago, which was presented by Rowe Bros. & Co., Ltd., of Runcorn Lead Works, and Mr. George Vincent Barton, of Liverpool, the inventor of improvements in the production of litharge. The petitioners asked for the prolongation of a patent granted in 1902 for the process.

His Lordship said the applicants had embarked large sums in the enterprise, but had been hampered by low prices and other causes, and they had made considerable losses in the working of the process. It was only recently that they had begun to make up some part of the loss, and there seemed to be a reasonable prospect of success in the future. On the question of degree of inventive merit, he could see nothing exceptional in it, and it had a limited scope, being merely an improvement, or improvements. If the process proved to be really valuable in the future, when worked on a large scale, the petitioners would have a start over competitors in the matter of building the new works necessary, and, he was glad to say, they would not go unremunerated. (It was stated at the hearing that the petitioners had acquired land at Liverpool for the building of larger works, and that the Government had assisted them to obtain the necessary materials.) But, on the whole, he had come to the conclusion that the petition fell short of the standard required to justify the prolongation of the patent, and the application must therefore be refused.

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MUNITION CASES.

AT the Oldham Munitions Court, last week, an armature winder employed in the Oldham tramway department, applied for a certificate enabling him to leave his present employment to take a position with a northern munition firm. He stated that he only took on his present employment while waiting for a place in a munition works, and when he got the offer of such a post, his leaving certificate was refused. He admitted that when he accepted the position in the tramway department he did so on the understanding that it would be a permanent one; he had been there only six weeks. For the tramway department, it was submitted that the man had been employed indirectly on munition work, and he could not be spared. The application for a leaving certificate was refused.

At the Glasgow Munitions Tribunal Appeal Court, John Reid, an electrician, who had been in the Army and discharged because of wounds, complained that he was dismissed from his employment with Alex. Anderson, electrical engineer, Glasgow, at three hours' notice. The Glasgow Munitions Tribunal held that Reid was entitled to 10s. compensation. His appeal now was based on the argument that 10s. was an insufficient award. Under the Act he was entitled to a week's notice or compensation to the extent of £5, and he maintained that he was entitled to receive £5. Lord Dewar pointed out that £5 was the maximum, and the Tribunal was entitled on the facts before it to award what was considered fair. He dismissed the appeal.

THE TRAINING OF MUNITION WORKERS.

THE extraordinary demand for labour to carry on the production of munitions of war on a colossal scale has led to the employment of hundreds of thousands of men and women in mechanical workshops who had no knowledge whatever of the processes which they were destined to conduct. These persons have had to be trained in the workshops at a considerable cost in space, plant, staff, and time, and many having proved unfit for the work, the expense incurred in training them has been worse than wasted. Obviously it were far better that the necessary training should be imparted to the candidates for such employment before their admission to the factories, thus reducing the loss and waste to a minimum, and saving the wages that would otherwise have to be paid to them whilst on probation. The Ministry of Munitions, therefore, obtained the assistance of the authorities in charge of secondary education—which was willingly given—and established 64 training centres throughout the country at which persons who desired to enter munition works could be trained free of cost. In London the normal course is six weeks, six days a week, four hours a day, 144 hours in all.

The general course consists of simple exercises in bench and vice work, and turning, drilling, and milling, the purpose being to give to the student an elementary "machine sense," and some preliminary idea of engineering factory conditions. In cases where definite "orders" can be obtained from employers, efforts are made to specialise the training, as far as the equipment of the schools allows, on the exact lines of the work which will have to be done in the factory. It is not pretended that a mechanic can be trained in so short a period, but, having regard to the necessity for introducing large numbers of outsiders into machine shops, the training is a valuable stage in the process.

Students who show aptitude for engineering work, and promise of becoming useful otherwise than as mere operators, are given special instruction to fit them for particular work. Large numbers of men and women have been trained in this way as shapers, slotters, drillers, and even as tool-setters and gauge-makers.

The general effect of the training scheme is to introduce a large body of persons from the professions and numerous other trades and occupations, thus helping to supply the increasing demand for labour. Approximately 18,000 men and women have been so trained, the majority of whom would probably not have entered munition works without some such preliminary instruction.

The training scheme has also had the effect of demonstrating the possibilities of unskilled labour, and many employers have been induced to inaugurate training in their own factories. By carefully selecting suitable workmen, by more closely dissecting operations, and by a greater degree of specialisation, it has been found possible to provide tool-setters, tool-makers, and charge-hands from the ranks of the unskilled. This is the only way in which the urgent demand for skilled workers can be met.

At a London County Council "School of Building," which was inspected on Monday last by a few representatives of the technical Press, a large hall has been equipped with benches, machine tools, &c., for this purpose by teachers drawn from the various L.C.C. technical schools, the Ministry of Munitions facilitating the purchase of plant, whilst in some cases special machines have been supplied by manufacturers who wished to have operators trained to work them. The school has accommodation for 100 pupils, and the work is carried on in three shifts—9 a.m. to 1 p.m., 2 to 6 p.m., and 6.30 to 10.30 p.m., six days a week—each pupil being required to attend for four hours a day. Some of the training centres are set apart for gauge-making, and here the pupils work 44 hours per week. A double teaching staff is provided, the members working 36 hours a week.

The hall measures 150 ft. × 70 ft., and is laid out complete with the necessary offices, stores, and refreshment rooms, machine, fitting, and blacksmith shops. The organisation follows as nearly as possible that of a munition factory, and the manufacture of actual details of munitions is undertaken.

There are three main lines of shafting, each about 100 ft. long, driven by four electric motors.

In July, 1915, the following equipment was installed: 30 lathes, 11 drilling machines, 3 power hack saws, 2 shaping machines, 1 punching machine, 1 shearing machine, 45 vices.

The following machines have since been added: 6 capstan lathes, 12 milling machines (including profiling machines), 3 lathes for 18-pounder cartridge cases, 2 turret lathes for 18-pounder shells, 2 tool grinders, 2 universal cutter grinders, 1 slotting machine.

The following machines are on order: 8 milling machines (including profiling machines), 5 lathes (including 3 capstans), 1 two-spindle drilling machine, 1 power hack saw.

Two definite classes of workers are trained: (a) Ordinary operators at the vice and machine tools; (b) tool-setters on lathes, milling and allied machines. Set schemes are worked to except where special requisition is made by individual firms for workpeople to meet specified needs.

All tool-setters, and nearly all the operatives, have been placed in munition factories. The following table illustrates the nature of the training and the results obtained (at five London centres):—

	General course.	Lead burning.	Tool setters.	Gauge makers.	Total.
Number in attendance during week ended May 20th, 1916	501	38	36	36	611
Number certificated up to May 20th, 1916	2,897	75	38	28	3,038
Number refused certificates and withdrawn	936	26	1	11	974
Certificated—					
Number known to have entered factories or H.M. Forces	2,564	75	37	27	2,703
Number unplaced	333	—	1	1	335
Uncertificated—					
Number known to have entered factories... ...	76	—	—	—	76

Students have been supplied to 338 individual firms, one of which has taken 344 students; 18 firms have taken over 20 students each. Included in the number of students placed in factories are 46 women who have been trained as tracers.

Some 10,800 applications have been registered, apart from those whose applications have been declined. It will be noticed that about 25 per cent. of the entrants are found wanting, and are refused certificates.

In addition to machining operations, the art of lead-burning is taught at the school on a practical scale, for the autogenous welding of the seams of lead-lined tanks; the limit gauges used in the workshop are made in the school, and the special form tools that are required for some processes also are made, of high-speed steel.

Following the inspection of the school, a munition factory where shell-cases are made was visited; the staff numbered 350, women being in the majority, and with the exception of a small proportion of skilled supervisors, the whole of the employés had been trained at the training centres. Every operation from the rough solid bar or forging to the finished shell-case was in progress, and, apart from the *personnel*, the shop presented no feature distinguishing it from a shop operated by skilled mechanics. The impression left on the minds of the visitors was that employers need have no hesitation whatever in availing themselves of the assistance of the Ministry's schools in staffing their works.

CHURCH LIGHTING WITHOUT FITTINGS.

AN article by Messrs. A. L. POWELL and R. B. THOMPSON in the *Electrical World* describes the methods adopted for lighting St. George's Episcopal Church, Newburgh, N.Y. The auditorium is rectangular in shape and measures 73 ft. long by 40 ft. wide. At the two sides and at the rear is a balcony with a sloping floor about 9 ft. wide. The front edge of this balcony is 9 ft. above the floor. The ceiling over the balcony is flat, while the central portion is slightly arched, rising to a height of 28 ft.

The posts which extend from the floor to the balcony and from this to the ceiling are cylindrical, with very plain bases and capitals. These and all the rest of the woodwork are painted a pure white. The pews are also white, with mahogany edging. The floor is of red and white tile, and the walls are finished in light cream. The ceiling is painted a flat white.

The system of electric lighting formerly installed employed brackets on the columns and along the front edge of the balcony, with carbon lamps, and shades which gave no diffusion, and did not conceal the lamp filaments.

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The lighting was not satisfactory; it was, moreover, costly for the effects secured, the fixtures were inartistic, and glare was extreme.

Last year it was decided to remodel the lighting system and to install something thoroughly up-to-date, which would make the church comfortable and bring out its full beauty.

After inspection of the building and taking the necessary measurements, a set of recommendations was drawn up for lighting the church with standard indirect fixtures; the report was presented to the committee having the matter in charge, but was rejected on the ground of want of harmony with the period of the church, and eventually it was decided that the building should be well lighted without any fixtures being visible.

Cove lighting was suggested, but abandoned; flood-lighting, using focus-type tungsten lamps with parabolic reflectors, directing their beams on the ceiling, was experimented with, but did not produce the desired effect. Since it was seen that projector units concentrated the light too strongly, the

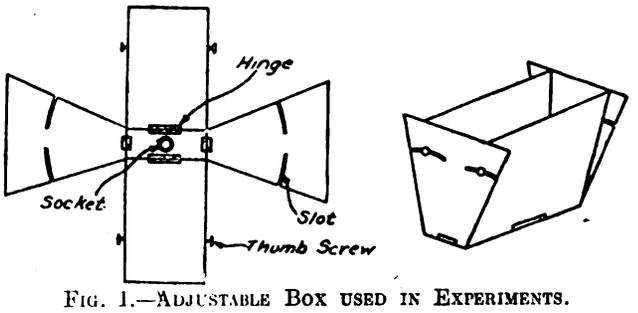

FIG. 1.—ADJUSTABLE BOX USED IN EXPERIMENTS.

next attempt was to use standard deep-bowl industrial reflectors, placed so as to illuminate evenly the central portion of the ceiling.

From this experiment it was evident that satisfactory effects could be produced with a very deep reflector designed to give the proper angle of cut-off. An adjustable box 3 ft. deep, of sheet iron, painted white inside, was made as shown in fig. 1. The sides, being hinged, could be set at any angle and held in place by thumb-screws working in the slots. It was then a very simple matter to find the exact shape of reflector desired. Six units of the design which gave the best results were constructed and installed; sections of the seats in the first row of the balcony were removed and the reflectors boxed in, as indicated in fig. 2. The boxes are so arranged that persons sitting behind or beside them are not annoyed

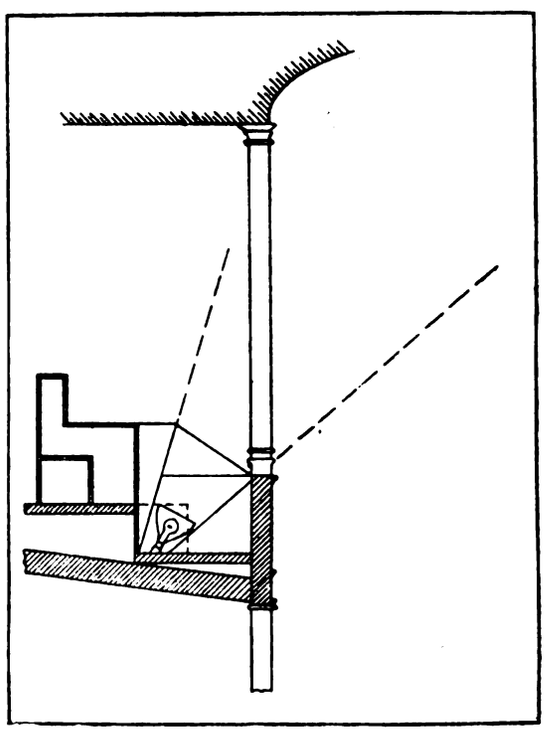

FIG. 2.—ONE OF THE REFLECTOR UNITS IN PLACE.

by stray light, and are deep enough so that when viewed from the opposite balcony no glare is visible. In the entire auditorium there are only two seats where a person, when standing, can see a lamp. Deep-bowl, porcelain-enamel, intensive distribution steel reflectors are placed about the lamps, which are 500-watt Mazda type C units. Below the balcony opalescent-glass deck lamps are fixed flush with the ceiling, with 60-watt lamps in recesses above them. In order to obtain a warmer tone of illumination than that given by the unmodified gas-filled lamps, gelatine screens of very light amber are available, to place across the mouths of the large reflectors. The sanctuary is illuminated by a row of lamps placed about the upper part of the arch, which are concealed by the moulding, and two small windows of art glass are illuminated from behind.

The church now presents a most attractive appearance; the illumination is even, very well diffused, and of a pleasing character. The ceiling is very evenly lighted, yet none of the light strikes the side walls. The direction of the light is the same at that of daylight, and the shadow effects produced by sunlight have been duplicated. The total power consumption has been increased somewhat, but the results warrant the slight additional cost.

In the *Electrical News* an account is given by Mr. G. J. BEATTIE of the lighting of the Timothy Eaton Memorial Church, of Toronto, which was recently completed, and is said to be the finest building of its kind in the Dominion. In this case the lighting is effected by means of large fittings, each of which contains eight 300-watt Mazda "C" lamps; the fittings are of Gothic design, in harmony with the architecture of the church, and are suspended from the ceiling, which is painted a light cream. The total power consumption for the main auditorium is 17.4 KW., the aggregate floor area being 9,270 sq. ft. It is estimated that a uniform intensity of illumination of 4 ft. candles is obtained on a 30-inch working plane. "X-ray" reflectors are used in the fittings, which also have white glass panels, softly illuminated, with excellent effect.

The large stained-glass memorial window is illuminated from without by a powerful searchlight mounted on a steel tower at some distance from the window; a large amount of experimental work was necessary before the proper height, distance, and intensity of light was determined, but the result is believed amply to justify the labour and expense incurred, many observers holding the opinion that the auditorium appears at its best at night.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Indnstrial Organisation and the Worker.

The columns of the technical Press, and especially those of the ELECTRICAL REVIEW, have recently been replete with references to the necessity of reviewing the many problems that are arising out of the war. Nowhere does it seem to be disputed that our present enemies will continue their activities against the Allied nations at the conclusion of a military peace, and everywhere is it recognised that the war, even though it was begun in the trenches, will be carried into the market-place. "Not prepared for war, let us at least be prepared for peace!" is a slogan that has a healthy ring in it, and one which commands the scientist, the business organiser, and the worker to review candidly the motives and principles, or the lack of them, that have decided their former relations and decided their efficiency.

Criticism has been active, and so far as it has exposed defects, useful, in regard to business organisation and scientific method and training. The elements of economic geography have been vividly brought to our notice when we have passed in review the supply of raw materials and their enemy source of origin. New light has been thrown on the specialisation of processes, and the economic determination of the situation. The Consular service has emphasised once again its own ineptitude when not recruited from home sources. The relations of the State to business enterprise and finance are also among the many points we have had to review. Among these, and not least in its significance, arises the problem of the worker. Will he be in the way? Judging by the opinions of recent speakers and writers there does seem to be some doubt whether the worker will rise to the occasion when new times will demand new methods and new men. It seems to depend primarily on the point whether any proposition will be a real departure from the practice of old mistakes, or the old mistakes in a new form.

The worker *has* an interest in his industry. It remains very much with external influences whether that interest is merely a *cash nexus* or a professional pride. So long as he is denied the latter he will pursue the former. The specialisation of processes and that inexplicably bad old economic law of demand and supply, when applied to his labour as a marketable commodity, have operated strongly, and have neutralised and dominated whatever inclinations he had in developing for himself his productive capacity. That is an indictment that the best friend of Labour ought to admit; the trade union official may even feel in it a source of satisfaction. But the essential point at the present moment is to take this as a basis for review. Half a century of trade union activity has shown the organisers of industry, and ought to have shown the workers of industry, that progress can now only lie in the direction of increasing the productive power of effort applied under the direction of organising ability to raw materials. No progressive employer now denies the necessity of a reasonable standard of living. The efficiency of well-paid

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labour is now an accepted economic axiom, and with the exit from the purview of debate of this, the real *raison d'être* of trade unionism, the time has now arrived when, both in the interests of employer and employed, attention should be focused on the problem of bringing all forces together in pursuit of a common end.

There seems some support for those who can only see progress in fighting trade unionism. This has in it the same essential error as the worker who is blessed with class consciousness and imagines progress follows further extractions from the profits of industry. Acrimony of this description blurs the real issue. In most industrial centres some sort of technical institute exists where young artisans get sufficient training to enable them to earn their living in the "shops." Does it never occur to anyone how it is that when they fall off from the technical school at the age of, say, 22, they cease to be interested in technical matters, and very often graduate to the public-house or become engrossed in trade union work? Most technical and trade associations fail lamentably in this respect, and even if a young artisan by dint of much exertion got access to some of these societies, he would find them engrossed chiefly in grinding axes of various descriptions. I doubt not that he would hear of more valiant feats of engineering in some local public-house. It is said that there are more guns and ammunition made and more coal drawn from the pits over pots of beer than in all the engineering works and coal mines in the country. And that is just the problem: How to bring into line with the new form of industrial organisation the undoubted interest and technical capacity of the worker, instead of leaving him to wallow into incapacity in idle and profitless company or brood over wrongs in trade union clubs.

Technical education should be more thorough, and the preliminary subjects more insisted on in our scheme of public education. A man's inventive capacity begins where the existing knowledge of laws and rules and formulæ ends, or where his imagination is such as to transcend all such bounds and start him on a train of thought and action purely original. More sympathetic treatment and greater encouragement financially and materially would do much to raise the worker who has capacity, and prove to him that his interest lies in that of his industry, in its development and scientific organisation.

Francis Shirley.

May 29th, 1916.

The Future in Russia.

I notice a reference in the current issue of the ELECTRICAL REVIEW to the desirability of encouraging the commercial, industrial, and technological development of Russia. One of the difficulties in the way to this end, so far as it depends on intercourse between the peoples of Great Britain and Russia, is the barrier of language. The heroic attempts now being made on the part of English people to master Russian are doomed to end in failure, except in rare cases where students have opportunities for a prolonged stay in Russia. Why should we persist in such a futile course? The language problem is capable of a fairly simple solution by the adoption of Esperanto for intercommunication between the two countries. We have recently seen the adoption of the Summer Time measure in one country followed rapidly by its adoption in others. In the same way, if Russia and Britain adopted Esperanto—a proposition as practicable as the Daylight Saving Bill—the whole of Europe would follow suit in a short time. One unanswerable argument in favour of Esperanto which should appeal to business men is the fact that, while it is quite efficient to express all international ideas, it can be learnt in any country in a few months. The writer has spoken in Esperanto with a number of Russians, some few of whom had learnt the language from a text-book without the assistance of a teacher.

The case for an international language for engineers was presented in a paper read before the Society of Engineers on March 2nd, 1914. The paper was reprinted separately from the transactions of the Society. May I add that anyone desiring information as to Esperanto may obtain it on application to the British Esperanto Association (Incor.), 17, Hart Street, W.C.?

P. G. Cameron,

Hon. Sec., London Esperanto Club.

London, E.C., *May 28th*, 1916.

Decimal Coinage.

What a pity the "Speso" should be an imaginary coin. It would be good business to buy them at 1,000 for a florin and sell them to Mr. Bridges at 20 a shilling. Is there a catch somewhere, or is it only that, like most decimalists, Mr. Bridges is weak in arithmetic?

W. M. M.

London, E.C., *May 26th*, 1916.

[Our correspondent of last week has obviously let himself in for it. But by what right, and on what evidence, does "W.M.M." cast a gratuitous slur upon the arithmetical capabilities of "most" decimalists? All civilised nations, except the British and some of their Oversea Dominions, employ decimal coinage.—EDS. ELEC. REV.]

Faults in Bitumen Cables.

In reply to the letter signed "Bitumen" in the current number of your valuable periodical, from the data given in this case my opinion is that the positive cable had sustained some mechanical damage, possibly when drawn into the earthenware ducts.

The effect of changing the polarity—making the faulty positive cable negative with an earthed neutral—would be to bring its life to a sudden termination.

In this connection I have recently experienced an unusual phenomenon on a power distribution system under my control, which may be of some general interest. The system contains some 25 miles of .05 V.B. cable laid solid with bitumen in wooden troughing. The cable is looped up every 10 ft., and connected to some 15,000 magnetically-operated switches with a bitumen seal between the trough and the switch boxes. Normally the cable is positive, and the negative return is through steel rails at earth potential. The system has been in operation 15 years, and has given very little trouble.

One day, for a short time—a few minutes—the polarity was reversed, with the result that alarming leakages developed at several switch boxes, ultimately necessitating the renewal of the bitumen and compound seal at about 200 points.

I must here explain that the normal voltage is 500 direct-current, and the leakage current registered on the morning of the breakdown on the sections affected was as follows:—

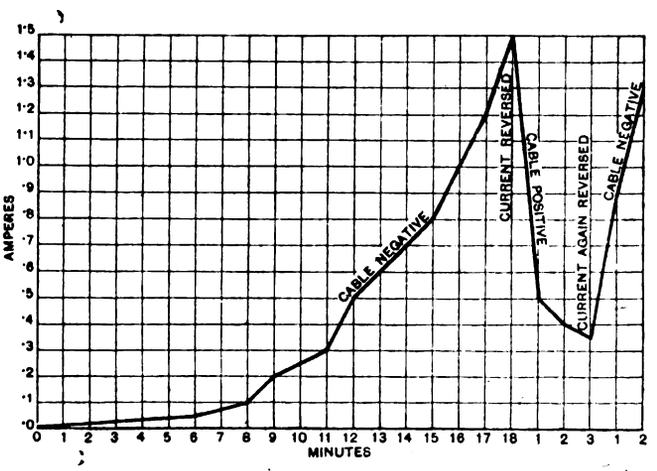
.026, .03, and .018 ampere.

In order to investigate the cause of the trouble, I carried out a series of experiments, including the following:—

1. A test was made on three different sections with about 30 switches on each.

Leakage current with cable positive: (*a*) 14 milliamperes, (*b*) 1 milliamp., (*c*) 1 milliamp. Leakage current with cable negative: (*a*) 23 milliamp., (*b*) 5 milliamp., (*c*) 2 milliamp.

2. The lengths of bare .05 cable were carefully insulated with bitumen tape and pierced with several pin-holes. Each cable was coiled up and placed in a metal box about 12 in. by



CATAPHORESIS EXPERIMENT.

8 in. The boxes were then filled with damp sand. No. 1 cable was connected to the positive terminal of the 500-volt supply, and the metal box it was in was connected to a negative terminal.

No. 2 cable was connected to the negative and box to positive. An ammeter was placed in circuit. Megger test on each registered over 50,000 ohms. Current was switched on, and after three minutes No. 2 cable registered .025 amp., and No. 1 50,000 ohms.

After six minutes, No. 2 reading 1.1 amps., No. 1 50,000 ohms, current was now reversed, and in a few seconds the leakage on No. 2 dropped to .2 amp. In three minutes a leakage of 1 amp. was registered on No. 1.

The current was again reversed to pass through as originally, and in ten minutes No. 1 registered .05 amp. and No. 2 was rising quickly from 2 amperes.

On opening up, I found No. 2 cable saturated with moisture, and, of course, steaming from the heat of current leakage, and No. 1 cable I found in a comparatively normal state.

The experiment was repeated with one box, and the result was plotted as shown on the accompanying curve. Other experiments were carried out, tending to show that the presence of coal, gas, or alkali salts was not necessary for the effect; also, that vulcanised bitumen was practically unaffected by coal gas, but ordinary bitumen was liquefied.

From the data collected I have formed the following opinions:—

1. That the dielectric of a well-made cable is not a "membrane" for practical purposes.

2. It is, therefore, misleading to speak of "electric endosmose" or an "osmotic effect" causing a breakdown on direct-current negative cables under the conditions here recorded.

3. At least an incipient mechanical fault is necessary before a leakage is observed.

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4. The flow of moisture down the current—from positive to negative—would be more accurately described by the electro-medical term "Cataphoresis."

5. In using vulcanised bitumen cables on the negative side of a direct-current system very great care should be taken, in order to prevent mechanical damage which causes incipient faults in the cable, which will with the presence of moisture cause faults to develop by "cataphoresis." Similarly, great care should be exercised in hermetically sealing the end connections.

6. All classes of cable would be similarly affected, but vulcanised bitumen is the least adapted to withstand rough mechanical usage.

Cosine.

WAR ITEMS.

Technical Men and the "Commercial War."—The *Liverpool Journal of Commerce* contains a summary of an address delivered in Liverpool on Empire Day by Mr. T. C. Elder (B.E.A.M.A.) on "Engineering for the Empire: The Way to Victory and Prosperity." The Lord Mayor of Liverpool presided, and in the course of the discussion Prof. Marchant was one of the principal speakers. He referred, among other things, to Germany's superior technical equipment for warfare, and expressed the opinion that after the waf we should be in the same position as now in regard to the commercial war unless we recognised that highly-trained technical men were the first necessity if progress was to be made. They were necessary not only to occupy technical positions, but as directors and leaders of industry, to know when and how to take advantage of new discoveries. If progress was to be made in manufacture, highly-trained technical men must be available both as leaders of industry and in the research laboratories. We felt the need of such men to-day in fighting the war, but it was of still greater importance in the industrial war of the future, and he hoped that every effort would be made to bring home to the public the enormous importance of this question, so that action might ensue. We learn from Mr. Elder that the following resolution was moved by the Chairman of the Liverpool Corporation Tramways and Electric Power and Light Committee (Mr. Councillor E. Russell-Taylor), and seconded by the Chairman of the Manchester Corporation Electricity Committee (Mr. Alderman W. Walker):—

That the indispensable military services rendered by the engineering industry and its fundamental importance in the future as a basis of defensive power and of prosperous economic development, entitle it to special State recognition in any reform of national and imperial commercial policy, and to the patriotic support of all public and private users of plant and machinery throughout the Empire.

The Supply of Light and Power for War Purposes.—The following addition has been made to the Defence of the Realm Acts:—

'8D. Any company, authority, or person supplying or authorised to supply water, light, heat, or power, shall, if so required by the Admiralty or Army Council or the Ministry of Munitions, supply water, light, heat or power to any factory, building, camp, or other premises belonging to or used for the purposes of the Admiralty or Army Council or the Minister of Munitions, and shall carry out such works and render such services as may be directed by the Admiralty or Army Council or the Minister of Munitions for the purpose of enabling such a supply to be given either by themselves or by some other such company, authority, or person:

'Provided that a company, authority or person shall not be required under this regulation to supply water, light, heat or power to premises within the area of supply of any other company, authority or person except with the concurrence of the appropriate Government Department, and if any question arises as to which Government Department is the appropriate Government Department the question shall be finally determined by the Treasury.

'If any company, authority or person fail to comply with a requisition under this regulation the company, authority or person shall be guilty of an offence against these regulations, and any director or officer of the company or officer of the authority who is knowingly a party to the default shall also be guilty of an offence against these regulations.'"

Women in German Industry.—The "Daily Telegraph," quoting from the "Vorwarts" regarding the employment of women workers in Germany, mentions the experience of one centre—Cologne, a fairly typical manufacturing city. Here in January, 1914, there were 46,634 working-class women registered as subscribers to the sick funds of the local trade unions. In January, 1915, the number had risen to 60,194, and in January, 1916, it was 75,319. This information was furnished by Herr Haas, secretary of the Cologne United Trade Union Committee, who added, "That means an increase of 28,685, or 60.1 per cent. The additional women and girls employed had fairly responsible and difficult work to do. There are many women, previously not employed at anything at all, who are now acting as chauffeurs, drivers of tramcars, navvies, and porters. Others are in charge of electric cranes, and several of the more intelligent are acting as "foremen" in charge of squads of roadmenders. Nor are the hours of work easy. It is not uncommon for these women to have to work 14 hours a day; and in a few cases I have known them work for 30, and even as much as 36, hours on end. In many instances this extra work is not paid for at all; in others the overtime rate is miserably small. In no case do the women earn as much as a man would earn for doing the same work; and in this respect, unfortunately, the State and municipal authorities are setting the worst example."

Exemption Applications.—At Lambeth, Messrs. Toy and Winslow, electrical engineers, applied for the exemption of Charles A. Winslow, aged 30, a brother of one of the partners. Mr. Winslow said his brother was indispensable to the business, being the only man who was really reliable. The application was refused, but, as it was stated the firm was engaged on Government work, the Tribunal suggested they should appeal to the Ministry of Munitions for a badge.

At Blackpool Tribunal, on May 25th, Mr. C. Furness, electrical engineer, applied for exemptions for 11 men in the electricity department and 12 in the tramways department. Coun. Fielding said there was a great deal of talk about the men kept at the electricity works. Mr. Furness should take the opportunity of replying to it. Mr. Furness said electricity was a young profession, and most men engaged in it were aged from 30 to 40 years. The electricity supply had to be continuous, and men engaged on the switchboards had to have their meals under the roof. Mr. Birkett (Military representative) said men in the electricity department were all engaged in exempted occupations. All the 11 men were conditionally exempted. When the tramway men were considered, Mr. Furness explained that 73 men had joined the Army from this department and 53 from the electricity department. Eleven men were granted conditional exemption, and one until July 1st.

Before the Ripon City Tribunal, a firm of mechanical and electrical engineers applied for the exemption of their costs clerk, aged 29, and married, who had taken the place of an unmarried man. It was stated that it would be impossible for a women to do the clerk's work. Exemption until July 26th.

At Stretford, exemption till June 30th was granted to an electrical wireman employed by a firm of electrical engineers.

Whitehaven Tribunal granted exemption until August 17th to a pipe fitter engaged by a local firm of electrical engineers, and whose service was claimed to be absolutely necessary.

Six months' exemption each has been granted by the West Kent Appeal Court to Mr. F. J. Quinnell, electrician, of Gravesend, and to Mr. H. C. C. Silver, electrical engineer, of Park Grove, Bromley.

Coventry Tribunal, on May 22nd, considered a request by Messrs. F. C. Brown & Co., electrical specialists and contractors, for exemption for Mr. R. A. Davies, their head electrical engineer, engaged on Government contracts. The case was put back for a month for Mr. Davies to be badged.—Messrs. H. W. Burbury & Co., electrical engineers, applied for three months' additional exemption for Mr. F. W. Thompson, electrician. It was stated that the firm, who had Government work in hand, had only four electricians left out of 14. Two months were allowed.—Mr. J. Hutt, electrical engineer and contractor, who appealed for himself, said he was chiefly engaged on war work, and it would mean financial ruin if he went. Exemption was allowed until August 20th.

Newmarket (Suffolk) Tribunal has refused exemption to the clerk and draughtsman of the electrical company.

At Stratford-on-Avon, the Electricity Co. appealed for a jointer and electrician. It was explained that in January, 1915, there were 10 men employed, and now there were only six men and two boys. On six months being allowed, Mr. Talbot, the manager, intimated that he might possibly appeal, and the Mayor replied: "Just so; but we consider the man is essential, as the company have to supply power and light."

Hull Tribunal has given until September 1st to an electrical fitter who has the supervision of the electric motors for a large number of local firms.

Three months' exemption has been granted to a contractor at Philadelphia (Co. Durham) engaged in repairing boiler furnaces at the power station. The manager of the latter said it was a specialist's work, and unless it was carefully done boilers might give serious trouble, and serious risks were possible. In the area current was being supplied to munition factories.

A Weobley electrician, who asked for absolute exemption, has been given until August 1st.

At Malvern, the U.D.C. has secured conditional exemption for the foreman at the electricity works and a shift engineer.

At Maidenhead, Mr. Bond appealed for temporary exemption for Geo. Lovegrove, his electrician, engaged in connection with contracts for the upkeep of private launches for the river. Exemption until October 1st was conceded.

Cheltenham Tribunal has exempted nine employés at the Corporation electricity works—two charge engineers, the works superintendent, the sub-station man and jointer, three stokers, and an engine-driver—whilst a clerk was given until July 31st. A motor-man with the Light Railway Co. has been

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given exemption on the ground that he was indispensable and in a certified occupation.

Bath Tribunal has granted conditional exemption, with the assent of the Military, to 20 members of the staff, including Mr. W. J. Targett, engineer, at the power station. No less than 171 men have left to join the Colours, and the present staff is only half of that before the war.

Before the Local Tribunal, exemption was claimed by the Surbiton Electricity Supply Co. for the head clerk and accountant. It was stated that two assistants and a junior clerk had enlisted, and that appellant was the only man left who could take the place of the engineer and manager in the latter's absence. Three months were conceded.

At Sevenoaks, an appeal was made for R. S. Terry, electrical engineer with Messrs. G. Humphrey & Co., who is engaged in the maintenance of electric plants in the district. Exemption granted for three months.

Hove Tribunal has granted three months' exemption to an electrician with a local firm who claimed that the business could not be carried on without him owing to the depletion of the staff.

Berkhamstead Rural Tribunal has granted two months' exemption to Albert V. Skinner, electrician.

An electrical fitter in business at Buxton has secured exemption until November 13th.

At Hastings, Messrs. Adams & Jarrett appealed for their only electrical wireman left for this branch of the business. Mr. Jarrett said that his two sons were in the Army, and the staff was very much depleted. Two months were allowed.—Mr. Fred Pillings (37), electrical engineer, appealing for himself, said that many of his staff had gone, and he had five contracts to supervise electric lifts. Two months were granted.

At Godalming, Mr. Geo. Jones sought exemption for A. P. Bowdler, the only electrician left in his business. A month only was granted.

At Southport, Messrs. Ashley, Ltd., electrical engineers, appealed for R. C. Jones, aged 23, on the ground that his work in connection with the manufacture of X-ray materials for use in the hospitals was of national importance. The appeal was disallowed.

At Oldham, an appeal for three electrical fitters was made by Mr. John Jackson, electrician. The men were stated to be engaged on electrical work at mills and waterworks, and the firm has also work in hand for Government controlled works. Exemption till August 1st.—Messrs. Caton & Sons, electricians, appealed for the manager and other men. Three brothers, all married, were in the firm, and the appeal for one was disallowed. The other appeals were put back to September 1st.

At Blackpool, exemption till October 31st was granted to an electrician employed at the Winter Gardens, and to a stoker at the Winter Gardens generating station; and exemption till October 15th was granted to a switchboard attendant at the Tower, the electrician at the Grand Theatre, and the electrician at the Palace.

At the Godalming Tribunal, the Urban Electric Supply Co., Ltd., of Godalming, applied on behalf of two men engaged at their works, one a stoker and cable jointer's mate and the other a switchboard attendant. Mr. R. S. Robertson, manager of the works, said it would be impossible to replace either man; 45 per cent. of the permanent staff had joined the Colours, and any further reduction would mean a serious risk of interrupting the supply. In the case of the switchboard attendant the military authorities agreed to three months' postponement, but dissented in regard to the other man on the ground that he appeared only to be an assistant. The Mayor remarked that both men were in certified occupations, and conditional exemption was given in each case.

The Urban Electric Supply Co. appealed at Grantham for a married stoker, aged 31. Mr. J. E. Edmundson stated that the staff was depleted, and the stoker was claimed under the certified list. A woman could not stoke, and the Board of Trade would not agree to it. Conditional exemption was allowed.

At Sandown (Isle of Wight), the Isle of Wight Electricity Co., Ltd., applied for exemption for Mr. S. H. Smith (34), works engineer in sole charge of the generating station supplying the town and Shanklin. Conditional exemption was allowed, with the consent of the Military.

Weymouth Tribunal has granted exemption until October 31st to Mr. T. H. Escott, manager for Messrs. Brooking & Co., electrical engineers, and until August 31st to the firm's wireman.

Grays Tribunal, on the application of the Urban Council, have given conditional exemption to the foreman stoker and a wireman at the electricity works, and until August 1st to two other employés. It was stated that all types of foreigners had been taken on in order to keep the works going.

Eastbourne Tribunal, on Monday, granted exemption until June 30th to an electrical engineer who said that his work was of a highly technical character, and that he supplied mechanical engineers and munition works.

Wallasey Tribunal on Monday granted exemption to 26 tram drivers appealed for by the Town Council.

British Capital in Russia.—The "Bourse Gazette" states that British capital has been used since the beginning of the war to finance 355 Russian companies for the exploitation of gold, platinum, iron, copper, and asbestos mines. During April three new mining companies, with an aggregate capital of £800,000, were formed with British and French money.—*Times.*

German-American Magnetos.—The Customs Department in Melbourne has stopped delivery from the wharves of a shipment of motor cars until the American Bosch magnetos with which they are fitted are removed by representatives of the Department. It is alleged that the firm manufacturing these magnetos is financed with German money, and refused to supply magnetos for American automobiles ordered by the Allies.—*Sydney Mirror.*

Restarting Belgian Works After the War.—A number of Belgian manufacturers recently met at Lyons under the presidency of M. Paul Theeuwissen to discuss what measures can be adopted at present to assure the resumption of work in Belgian metal works after the war, and especially the supply of sufficient tools. From information received from the industrial districts of Belgium, it appears that almost all the metallurgical works are stripped of their plant, which has either been destroyed or simply stolen and dragged off to Germany. The expulsion of the Germans will therefore leave Belgium with empty works, and immediate restocking would be difficult. To obviate this it is intended to place immediate orders for the necessary plant at Lyons and Saint-Etienne, and a Technical Committee has been formed at 4 Rue Sala, Lyons, under the presidency of M. Theeuwissen, who is a consulting engineer and was formerly a bolt manufacturer of Liége.—*Ironmonger.*

Tunnelling Commissions.—The president of the Institution of Mining Engineers has been advised by the Secretary of the War Office that the Army Council are desirous of obtaining the services of mining engineers for employment with the Tunnelling Companies of the Royal Engineers. Preference will be given to candidates between the ages of 25 and 35 years, and those found suitable will be appointed to temporary commissions and be required to proceed overseas at an early date. Mining engineers not members of the Institution, but possessing the necessary qualifications, are also eligible. Intending candidates for commissions, or those at present serving in the ranks who desire to be transferred to the Royal Engineers, are requested to communicate at once with the Secretary of their own Institute, who will supply a form of application. Only candidates who have already attested are eligible.

To be Wound-up.—The Board of Trade has ordered the following to be wound-up:—

Scorch Electrical Co., 35, Basinghall Street, London, E.C., electrical engineers. Controller: C. E. Barker, 21, Finsbury Pavement, E.C.

A. T. Speedometer Co., Ltd., 140, Long Acre, W.C., manufacturers of speedometers. Controller: F. G. Van de Linde, 4, Fenchurch Avenue, E.C.

Isleworth Rubber Co., Isleworth, manufacturers of and dealers in rubber goods and tires. Controller: S. W. Tubbs, 23, Basinghall Street, E.C.

Richard Klinger & Co., 66, Fenchurch Street, E.C., engineers. Controller: H. W. Dunn, 46, Queen Victoria Street, E.C.

Mining Engineers and Enemy Aliens.—The Institution of Mining Engineers has issued an official Order of the Council, dated June 10th, 1915, reading as follows:—"All Members, Associate Members, Associates, or Students of the Institution of Mining Engineers, of Austrian, Bulgarian, German, Hungarian, or Ottoman nationality, are hereby requested to abstain from attending any meeting, or from visiting the rooms of the Institution during the continuance of the war."

Copenhagen War Lighting.—It has been decided by the Town Council of Copenhagen that fewer lamps are to be lighted in the streets. In future gas and electric power will not be supplied by the municipal works for illuminated advertising signs.—*Times.*

Exports to China and Siam.—The "London Gazette" for May 30th contains additions to and revisions of the previously issued lists of persons and bodies to whom exports to China and Siam may be consigned.

BUSINESS NOTES.

Electrical Catalogues Wanted.—The new Public Works Engineer in Boma, Belgian Congo, who has in hand the construction of a new lighting plant and the laying of the necessary cables, is anxious to know the names and particulars of English firms who are able to supply electrical machinery and cables. Firms who are interested in the matter should forward catalogues direct to him at the following address:—Mons. Armaud Van Hool, Ingénieur aux Travaux Publics, Boma, Congo Belge.

Book Notices.—The Efandem Co., Ltd., of Fallings Park Works, Wolverhampton, whose enterprising activities have already been referred to in our pages, have now started for circulation among the employés a monthly magazine entitled *The Flashlight*, a name fully appropriate to the principal line of manufactures in which the company has made such excellent headway. The whole of the contents of the first number (May, price 3d.), which is now before us, have been contributed by members of the staff and employés at the works, and Mr. C. H. Stephenson, the works manager, is the editor.

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Cable Prices and Discounts.—Messrs. Pooley and Austin, of 28, Victoria Street, S.W., write stating that, owing to the somewhat complex nature of standard cable discounts at the present time, they have, for the convenience of contractors and other users of cables, got out a set of single multiplier figures, which will render the calculation of net cable prices quite a simple matter. They will be very pleased to send a copy to any user of cables who is interested. Until the supply is exhausted, they can also send a cardboard slide rule for getting a price per yard or per coil when the price per mile is known.

Their table is certainly short, convenient and simple, and applies to the discounts at present in force.

Copper-Clad Steel.—The Copper-Clad Steel Co. of Pittsburgh, recently incorporated under the laws of Pennsylvania, has erected a plant at Rankin, Pa., for the purpose of manufacturing copper-clad steel products. The mills are of the most modern construction, and are electrically driven throughout.

American Investigation of Foreign Electrical Markets.—The Bureau of Foreign and Domestic Commerce, Washington, held an examination in various cities, on May 19th, for a special agent to investigate the market for electrical goods in China, India, East Indies, Africa and Australia. The examination was to consist of practical questions on the subject of investigation, thesis on investigation methods, and a statement of the candidate's knowledge and experience. According to the American *Electrical Review*, the salary was not to exceed $10 per day and transportation and living expenses (the latter not to exceed $5 per per day. Applicants were to be able to address public gatherings, and were to submit in advance an unmounted photograph.

For Sale.—The Farnworth U.D.C. has for disposal two Lancashire boilers and accessories, one Green's economiser, and one feed pump. Full particulars are given in our advertisement pages.

British Bank for Russian Industry.—The Russian financial Press, according to the *Algemeen Handelsblad*, of Amsterdam, says that a group of leading English bankers has approached the Russian Government with a view to a concession for the establishment of a new bank exclusively devoted to lending money for the development of Russian trade and industry. The authorised capital of the bank is fixed at five million roubles.—*Financial Times.*

Empire Trade.—The British Imperial Council of Commerce is holding a luncheon at Cannon Street Hotel, next week, at which the delegates to the Empire Business Conference will be present. Mr. Asquith has accepted an invitation.

In the House of Commons, in reply to a question by Col. Norton Griffiths, who asked whether the Government proposed to take any action with a view to a preferential trading policy with the Dominions and our Allies being adopted before the termination of the war, Mr. Bonar Law said:—"The whole subject is now engaging the attention of the Government."

Bankruptcy Proceedings.—R. E. Connold, late electrician, Canterbury, now R.N.A.S..—First meeting, June 3rd; public examination, June 17th; both at Canterbury.

Trade Announcement.—For the convenience of their London customers, Messrs. Ward & Goldstone, of Manchester, are opening an office at Albion House, 59-61, New Oxford Street, London, W.C., as from June 1st, with Mr. A. W. Richards as their London representative. A collection of samples of their manufactures will be on view there, and, when exceptional war demands on the factory have passed, a stock will be held at the new branch.

Catalogues and Lists.—Messrs. Ward & Goldstone, Sampson Works, Salford.—Illustrated price circular of "Volex" dry batteries, multiple cells and single units, and adaptations of same.

British Westinghouse Electric & Manufacturing Co., Ltd., Trafford Park.—Two new publications—Control Catalogue, No. 91/2, containing a full description and list of prices, &c., of type P steel-clad motor-control pillars; descriptive leaflet, No. 71/5, giving an illustrated account of their type LH hand-operated liquid controllers. The company has also sent us a very acceptable wall calendar for the year ending March, 1917.

Liquidations.—Eureka Patent Gas Engine Starter Co., Ltd.—A meeting is called for June 30th, at 28, Deansgate, Manchester, to hear an account of the winding up from the liquidator, Mr. T. Forster.

British Graetzin Light, Ltd.—The Controller, Mr. Thomas Wise, Bassishaw House, Basinghall Street, E.C., requires creditors to send particulars of debts or claims, &c., to him by June 30th.

Jaeger Bros.—Mr. M. Jenks, 6, Old Jewry, E.C., the Controller in this case requires creditors to send him particulars of debts or claims, &c., by June 30th.

Maschinenfabrik Augsburg-Nurnberg, A.G., Caxton House, Westminster.—Creditors must send particulars of debts, &c., to the Controller, Mr. B. E. Mayhew, Alderman's House, Bishopsgate, E.C., by June 30th.

Richard Klinger & Co., engineers, 66, Fenchurch Street, E.C.—Creditors must send particulars of debts, &c., to the Controller, Mr. H. W. Dunn, 46, Queen Victoria Street, E.C., by June 30th.

Phœnix Electric Heating Co. (1914), Ltd.—Creditors must send particulars of their debts, &c., to the liquidator, Mr. A. E. Tilley, 8, Staple Inn, Holborn, W.C., by June 17th.

LIGHTING AND POWER NOTES.

Aberdeen.—The T.C. has decided to purchase additional ground in the vicinity of the Ferryhill Electricity Works, for the extension of the electricity department and for storage.

Argentina.—The following news items are extracted from *La Electricidad y la Maquinaria*:—A beginning has been made with the construction of the electricity station at Maldonado, and its completion is expected in July or August. Popular dissatisfaction is being expressed in Concepcion del Uruguay with the electric light service supplied by the Anglo-Argentine Electric Co., and some 300 subscribers have held a public meeting and decided to form a co-operative society to supply their own requirements. In the town of I de Julio also, the lighting service is being complained of, total interruption of the service having occurred for 15 days together, without either the company or the municipality having taken any action. Owing to the sustained and lengthy exertions of the Instituto Sud-americano de Electricistas y Mecanicos, the Municipality of Buenos Aires has now decided to draft a scheme, for presentation to the Intendente, for the creation of an Office of Inspection of Electric Installations. The staff will consist of technical experts, and its duties will embrace the testing of materials and parts, and the general working of all plants. No installation will be allowed to operate without the previous inspection and permission of the Office.

Australia.—Hydro-Electric Schemes.—With further reference to the proposed hydro-electric schemes mentioned in our issue of May 12th (p. 537), Mr. Cann, the N.S.W. Minister of Works, in moving to refer to the Public Works Committee the report for a Murrumbidgee scheme at Burrinjuck, stated that the estimated cost of £100,000 would provide plant, transmission lines and distributing stations; the power generated would approximate 8,000,000 units per annum, the annual expenditure would amount to £9,095, and the annual revenue to £11,686, leaving a net profit of £2,591. The scheme would serve the towns of Gouldburn, Yass, Harden, Cootamunda, Junee, Wagga, Gundagai and Tumut.

The Snowy River scheme which the Minister also submitted for reference to the Committee was far more costly and pretentious and had greater possibilities, but nothing definite had yet taken place, and the power generated would have to be distributed over a much greater area. The proposed dam on the Snowy River, about a mile above Jindabyne, would be 148 ft. high, and have a capacity for 26,000,000,000 cb. ft. of water.

The power house would develop an average load of 100,000 kw., with a maximum of 125,000, and there would be available at the point of delivery 750,000,000 units of electricity per annum, as compared with 8,000,000 in the Murrumbidgee scheme. A transmission line, 210 miles in length, would bring the power right into Sydney. It was anticipated, however, that a large amount of power would be used on the South Coast for electro-metallurgical and other processes. This would enable New South Wales, better than any other State, to compete with electric process manufactures in the old world, such as the treatment of ores, &c. The estimated capital cost was £5,000,000. The annual cost, including interest, would be £361,173, equal to £2 5s. 5d. per h.p. per annum, and if all the units were sold at ¼th of a penny per unit it would produce £390,625, showing a surplus of £29,452 over expenditure. Schemes of a like nature were also outlined in regard to hydro-electric developments on the Shoalhaven River, Cataract, and Cordeaux Rivers, Gilmore Creek, and the Tumut River, all of which were referred to the Public Works Committee. A motion was also carried for reference to the Committee of a scheme for hydro-electric development on the Nymboida River. The dam is already in existence, and it is proposed to develop the power for supplying electricity to Grafton and South Grafton. The estimated cost is £35,000. The total cost of all the schemes is estimated at £6,855,800.

Willoughby, on the north side of Sydney Harbour, is the first of the group of northern suburbs to have its streets lighted by electricity. The inauguration took place at the commencement of last month, and it was anticipated that electricity would be available in Lane Cove, a neighbouring municipality, on May 1st. The Fremantle Corporation Tramways and Electric Lighting Board has notified consumers that between July 1st, 1916, and January 1st, 1917, the following changes in the supply of electricity will be made:—For power, from two-phase, 220 volts, 50 cycles, to three-phase, 440 volts, 40 cycles; and for lighting, heating, and motors up to 2 h.p., from single-phase, 220 volts, to single-phase, 250 volts.

Belfast.—The Electricity Committee has had under consideration the matter brought before them by a recent deputation of electrical contractors in the city, in reference to the extension of the electricity undertaking, which had been deferred owing to Treasury restrictions on capital expenditure, and a deputation has been appointed to wait upon the L.G.B. on the subject.

Birmingham.—Year's Working.—The accounts of the Corporation electricity supply undertaking for the year ended March 31st last show a profit of £47,497, a decrease of £12,888 on the previous year. It was reported that the output amounted to 177 million units, as compared with 83 million units in 1914-15. Ald. Jephcott stated that the increased revenue had been more than absorbed by the extra expenditure, due principally to the rise in the price of fuel. The Electricity Committee has decided to carry £22,000 to a special fund, and allocate the remaining £25,497 to the relief of rates.—*Birmingham Daily Post.*

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Bo'ness.—Plant Extensions.—The T.C. has accepted the offer of the National Electric Construction Co., Ltd., to carry out the modified scheme of extensions to the existing electricity works, at a cost of £12,000. Mr. J. M. Munro, consulting engineer, of Edinburgh, has been appointed to supervise the work.

Christchurch.—Price Increase.—The B. of G. has received a communication from the Bournemouth and Poole *Electricity* Supply Co. with reference to the 10 per cent. increase in the charge for electricity which the company had added to the accounts for the last quarter, and which the Guardians refused to pay. It was stated, at a meeting of the Board, that the company was under a five-year contract with the Guardians to supply electricity for light and power at a fixed rate, and the Board had decided to hold the company to the contract.—*Bournemouth Guardian.*

Darwen.—Price Increase.—It is proposed that the charges for electricity for power purposes, which were last year raised 20 per cent., shall be advanced a further 5 per cent.

Eccles.—Generating Station Site.—The Corporation Electricity Supply Committee has secured a site at Monton for a new generating station.

Edmonton.—Price Increase.—The North Metropolitan Electric Power Supply Co. has asked the B. of G. to pay an increase of ·18d. per unit for electricity supplied, and a recommendation that the increase be paid has been referred back for reconsideration by the Finance and General Purposes Committee.

Grimsby.—Year's Working.—The report on the last year's working of the electricity department shows that, despite the difficult conditions of the period, a net profit of £1,851 was made. There was a net decrease in revenue of £2,058, the gross revenue amounting to £22,144, while expenditure amounted to £12,339, and financial charges to £7,954.

Horsham.—The electrical engineer reports that since the introduction of the Daylight Saving scheme there has been a saving in coal consumption at the works of from 17 to 25 per cent. per evening. Public lighting is to be abandoned during the summer months.

Ilford.—Loan Sanctions, &c.—The U.D.C. has received sanction to the borrowing of £6,098, part of £6,565, for mains, and £1,650 for the provision of the Goodmayes sub-station. The sum deducted from the original application for mains is in respect of new mains to provide current to private houses, which the L.G.B. is not willing to sanction at the present time.

The Electricity Committee has decided to pay the contractors half the extra cost of 6d. per ton for West Cannock slack coal, the increase in cost being due to the 5 per cent. advance in miners' wages.

An expenditure of £1,199 charged in the Council's accounts for the year ended March 31st, 1915, to which exception was taken by the district auditor, has been sanctioned by the L.G.B.

Kettering.—Year's Working.—The annual accounts of the Council's electrical undertaking show that the total revenue for the year ended March last was £18,260, while the working expenses amounted to £10,616, leaving a gross profit of £7,643. Including the amount brought forward, the balance of the net revenue account amounted to £12,136, and after meeting interest and sinking fund charges and transfering £2,000 to reserve, the balance carried forward to next year was £3,659. Increased cost of coal, rates, taxes, and loan charges accounted for £3,168 more than in the previous year. Increased revenue from sale of energy to private consumers amounted to £2,218. A total of 2½ million units were sold, an increase for the year of 540,655 units. The maximum load was 1,250 KW., showing an increase of 148 KW., and the net surplus on the year's working amounted to £1,272.

Llanfyllin.—Public Lighting.—The meeting of ratepayers held to consider the offer of Mr. R. A. Jones to light the town by electricity has referred the matter back to the T.C., and promised support in any action that would give the town cheaper lighting.

London.—Woolwich.—The L.C.C. has sanctioned the borrowing of £27,500, in respecting of the Globe Lane electricity works extensions.

Luton.—Plant Extension, &c.—The electrical engineer has reported generally as to the erection of a sub-station, the laying of the H.T. mains, and the erection of the new machinery and cooling tower at the electricity works. Since April 6th last, 1,230,853 units have been generated for general supply, and 30,335 units for traction purposes; a total of 1,922 consumers with 71,812 lamps, 1,131 motors of 6,652½ H.P., and 1,580¾ KW. in heating are now connected. Compared with the corresponding period last year, the units generated for general supply show an increase of 18 per cent.

New Zealand.—The proposal of the Thames B.C. to raise a loan of £5,500 for the extension of the electric lighting plant and mains was submitted to a poll of the ratepayers recently and carried by a large majority.

Nuneaton.—The T.C. has fixed the following scale of charges for current for power as from April 1st last:—First 5,000 units per quarter, 1d. per unit; the next 1,000, ¾d.; all after the first 6,000, ·6d. On account of restricted lighting, the same rebate as made by the gas company is to be allowed by the Electricity Committee.

St. Austell.—Street Lighting.—The U.D.C. has accepted the offer of the Electric Light Co. for public lighting for three years, at an increased price of £36 per annum.

Stafford.—Price Increase.—The T.C. has increased the price of electricity for power, as from July 1st, from 2½d. to 3d. per unit, the graduated discounts to remain as at present. It is anticipated that the increase will bring in an additional revenue of about £1,000 per annum.

Stalybridge.—Loan Application.—The Joint Tramways Board has adopted a recommendation of the Generating Station Committee to make application to the L.G.B., for sanction to borrow £39,000 for a turbo-alternator, cooling towers and boiler plant, &c.

Stoke-on-Trent.—Extension Scheme.—In order to meet the growing load and reduce production costs, it is proposed to add a 3,000-KW. turbine, with condenser, cooling tower, switchgear, and the necessary boilers at the central power house, at an estimated cost of £33,000. The following particulars as to energy generated last year at the various generating plants under the T.C. were submitted in a report on the subject:—

	Coal in tons.	Coal cost £	Units generated.	Cost per unit. in lb.	in pence.
Burslem	1,746	1,206	489,976	8	0·59
Hanley	4,584	3,383	849,332	12	0·96
Longton	365	235	37,920	21½	1·49
Stoke	423	296	68,356	13¾	1·04
Sub-works total ...	7,118	£5,120	1,445,584	11½	0·87
Power house ...	11,231	£8,612	9,096,796	2¾	0·23
Gross total ...	18,349	£13,732	10,542,380	3·9	0·31

It was estimated that by doubling the turbine capacity a saving of £2,640 per annum in coal would be effected, which would pay the new capital charges; moreover, there was 2,000 KW. of rotary and motor generator plant installed, and only about 1,000 KW. of turbine plant to supply it. A new 600-KW. rotary is being installed at Longton, and three-phase supply is being given from static sub-stations in Tunstall, Hanley, and Fenton, while there is a growing demand for bulk supply, which would be met if further economical generating plant were available.

The Electricity Committee recommended that application be made for sanction to the borrowing of £33,000, and the Town Clerk has been instructed to obtain the views of the L.G.B. on the matter.

The North Staffordshire Railway has inquired for a bulk supply on certain terms, while various other firms in Milton are also inquiring as to supplies of electricity.

The Wolstanton United U.D.C. has agreed to remove certain street lamps lighted by the Potteries Electric Traction Co. when the lighting restrictions have been withdrawn.

Tasmania.—Hydro-electric power matters continue to attract attention in Tasmania. It is said that a total of 130,000 H.P. is being negotiated for, which will require other developments in addition to the Great Lake scheme, which is expected to give 75,000 H.P. It is reported that the Mount Lyell Co. has come to terms for a supply of up to 50,000 H.P. for use in connection with electro-metallurgical processes in its zinc industry.

Walthamstow.—Turbine Loan Application, &c.—Having considered the report of the electrical engineer as to the advisability of installing additional plant at the works to meet present and future demands, the Electricity Committee has asked the Finance Committee (and that Committee has agreed) to apply to the L.G.B. for sanction to the borrowing of £11,240 for a 1,500-KW. Ljungström turbine and a 500 KW. motor-converter, the necessary switchgear, cables, foundations, &c. The engineer states that in order to install the above plant, it will be necessary to supersede gas engine No. 8. A tender for water-softening plant is recommended for acceptance, at £750. To cover this expenditure, application for sanction to borrow will be made.

Wolverhampton.—Price Increase.—From the date of the meter readings for the June quarter, the charges for current have been increased by 10 per cent. by the T.C.

TRAMWAY and RAILWAY NOTES.

Australia.—Melbourne Suburban Railway Electrification.—Mr. H. McKenzie, the Minister of Railways, stated last month that the consulting engineer and the Agent-General in London were trying to arrange for a transfer of contracts in connection with the suburban railway scheme, from Messrs. Siemens Bros. to some other firm, and preferably to one with an agency in America. The Minister stated that if the switchgear and certain other parts were available, the scheme could be put into operation in less than a year.—*Melbourne Age.*

The Melbourne Tramway Co.'s undertakings will be taken over by the new Government Tramway Board on July 1st next. The Board has been appointed for a period extending from January last to October, 1917; most of its work has been of a preparatory character, and the questions of revision of fares, and the advisability of electrification, will not be considered until the tramway undertakings have been taken over by the Board.

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Birmingham.—Last week the tramway service was again shut down for a short time, owing to the inability of the electric supply department to supply all the demands made upon it under existing conditions.

Blackpool.—Electric Vehicle.—The Cleansing Committee has decided to provide in its estimates for the purchase of another electric street sprinkler, estimated to cost about £1,000.

Bradford.—Tramway Fares.—Mr. C. J. Spencer, the Corporation tramway manager, has submitted his report on the question of fares in Bradford, with particular attention to the Great Horton route. He considers that circumstances are not favourable to the cheapening of fares, and states that had the war-time receipts been the same per car-mile as the average for the five years preceding the war, there would have been a loss of nearly a halfpenny per car-mile run (£12,900) owing to the increased working cost. The receipts per car-mile have been exceedingly good during the war period. He has made inquiries in other towns, and found that in 12 centres, including Birmingham, fares had been increased, and in only one case had there been a decrease.

Chile.—The municipality of Valparaiso has refused to accept the proposition made by the Compania de Tranvias Electricos de Valparaiso, which is the company now operating the electric street railways and furnishing the electric lighting of the city for an extension of franchise. The franchise was to be extended by 79 years, making the total life from date 99 years. The company was to give the city 8 per cent. of its gross receipts from the tramways, this percentage of gross receipts to be applied principally on the city debt, and secondarily on the indebtedness of the city to the traction company for municipal lighting (in June, 1915, the balance due for municipal lighting amounted to $383,045 U.S. currency). The company was also to double-track several lines, to do all necessary paving, and clean, repair, &c., such paving. The company was to cede to the city on certain conditions and in return for certain payments on part of its equipment, all its equipment, plants, lines, &c., on the expiration of its franchise.—*Electric Railway Journal.*

Hull.—Halfpenny Fares.—In reviewing the year's working of the Corporation tramways, the Lord Mayor stated that since the introduction of the halfpenny stages the income had increased from 8½d. to 9½d. per car-mile. There was a profit for the year of £12,469, in addition to paying £8,759 in allowances to men on service, £4,000 in war bonuses and £2,000 extra for coal; 4 million free rides had been given to soldiers.—*Manchester Guardian.*

Ilford.—The tramway manager reports that the working of the new system adopted a short time ago, of charging for the conveyance of parcels on the cars, has proved satisfactory.

Luton.—The B. of T. has issued an order prolonging the period from August 11th next to August 11th, 1918, for wholly completing the tramways authorised by the Corporation Order of 1905.

York.—The traffic returns of the Corporation tramways for April show receipts amounting to £3,033, as against £2,623 last year; passengers carried, 719,353, against 606,513; and receipts per car-mile, 10·47d., as compared with 9·49d.

TELEGRAPH and TELEPHONE NOTES.

Argentina.—Senor Al. Schwimer, representing a North American syndicate, has applied to the municipality of Buenos Aires for permission to install and to exploit a system of automatic telephones in the capital. The system is said to be in operation in more than 500 cities in the United States with a million and a half instruments installed.—*Review of the River Plate.*

Havana.—On the completion of the long-distance telephone line to Key West, Fla., by the American Telephone and Telegraph Co., steps will be taken to lay a submarine cable between that point and Havana, Cuba.—*Telegraph and Telephone Age.*

Improvements in Submarine Telegraphy.—According to the *Telegraph and Telephone Age*, recent experiments intended to increase the speed of working on submarine cables have proved successful, and a much higher speed is now attained on some of the Atlantic cables. Patent considerations prevent the publication of details at present.

Post Office Servants.—A further report has been presented by the Committee appointed, under the chairmanship of Sir George Gibb, to examine the issue with regard to the wages and conditions of employment of Post Office servants, raised by the Holt Committee's report. The Committee proposes that the Holt Committee's recommendations shall be adopted, with modifications in certain cases, in regard to the transfer to other duties of persons suffering from telegraphists' cramp, travelling expenses of telephonists, increment of assistant engineers, credit for telegraph work, and other items.—*Daily Telegraph.*

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdeen.—June 8th. Electricity Committee. Small steam coal for one year. Mr. J. A. Bell, City Electrical Engineer.

Australia.—Perth.—August 16th. P.M.G. Telegraph and measuring instruments. Schedule No. 498, W.A.*

Melbourne.—July 26th. Victorian Railways Commissioners. 400 signal lighting transformers.*

June 27th. Deputy P.M.G. 18,551 Stalloy telephone receiver diaphragms.*

Sydney.—August 24th. P.M.G. Automatic switchboard and apparatus for North Sydney Exchange. Schedule No. 511.

Brisbane.—July 31st. P.M.G. Power board and accumulators. Schedule No. 381.

Barking.—June 9th. U.D.C. Six or twelve months' supply of coal, slack or beans. Engineer and Manager, Electricity Works.

Belfast.—June 7th. Corporation. Supply of coal (40,000 tons), for 12 months, for the Electricity Works. Mr. T. W. Bloxam, City Electrical Engineer.

Dublin.—June 8th. Corporation. One, two or three years' supply of coal for the Electricity Works (approximate amount 40,000 tons per annum). Town Clerk, City Hall.

Glasgow.—June 5th. Six or twelve months' supply of electrical stores for the Trustees of the Clyde Navigation Superintendent of Stores, 16, Robertson Street.

London.—St. Pancras.—June 13th. B.C. Twelve months' supply of steam coal for the Electricity Department. Borough Electrical Engineer.

Manchester.—June 7th. Electricity Committee. Electric capstan for Stuart Street station. See "Official Notices" May 26th.

New Zealand.—Pahiatua.—July 10th. Borough Council. Overhead wires, poles, street lamps, gas engines, producers, dynamos, auxiliary apparatus and accumulators. Specifications from Borough Offices or Mr. E. J. Fenn, Consulting Engineer, Auckland.*

Invercargill.—September 28th. Borough Council. Steam turbo alternator, condensing plant and switchgear. Specifications from the Tramway Office.

Torquay.—June 19th. Corporation. 5,500 tons of coal for use with mechanical stokers for the Electric Lighting Committee. Mr. F. S. Hex, Town Clerk.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Eccles.—Corporation Electricity Supply Committee. Superheater and accessories: T. Sugden, Ltd., £85 10s.

Glasgow.—Electricity Committee. Recommended tenders, the first for three months, and the remainder for a year:—

Cast-iron boxes, section pillars, &c.—Carron Co.; W. Lucy & Co.; Parkhurst Iron Co.; D. King & Sons; J. Allan, Sen., & Sons.
Cotton waste and dusters.—Easson Bros.
Single cables, concentric and triple-concentric cables.—Callender's Cable Co., Ltd.
H.T. cables.—W. T. Glover & Co., Ltd.
E.H.T. cables.—Callender's Cable Co., Ltd.
Rubber-covered cables and flexibles.—Craigpark Electric Cable Co., Ltd.
Electricity meters.—Ferranti, Ltd.; Chamberlain & Hookham, Ltd.; British Westinghouse Co.

London.—Metropolitan Asylums Board. To install an internal telephone system and overhaul the existing electric bell installation at the Children's Infirmary: J. W. Gray & Son.

Walthamstow.—The following tenders have been accepted:—

Paterson Engineering Co., Ltd.—Water-softening plant for the electric works, at £750.
Cammell, Laird & Co.—18 tramcar axles, at £5 16s. each.
P. R. Jackson & Co., Ltd.—24 commutators, at £5 10s. each.

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FORTHCOMING EVENTS.

North of England Institute of Mining and Mechanical Engineers.—Saturday, June 3rd. At 2 p.m. At the Wood Memorial Hall, Newcastle-on-Tyne. General meeting.

Royal Institution of Great Britain.—Tuesday, June 6th. At 3 p.m. At Albemarle Street, Piccadilly, W. Lecture (II) on "Optical Research and Chemical Progress," by Mr. T. M. Lowry, F.R.S.

Friday, June 9th. At 5.30 p.m. Lecture on "Eyesight and the War," by Dr. E. Clarke, F.R.C.S.

Rontgen Society.—Tuesday, June 6th. At 8.15 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Paper on "Homogeneity of Visible Radiation," by Prof. J. W. Nicholson.

NOTES.

Scientific Research.—By Order in Council, the Secretary of State for the Colonies for the time being has been added to the Committee of the Privy Council for the organisation and development of scientific and industrial research.

Interconnection of Electric Supply Undertakings.—In our last issue we published, and warmly welcomed, a letter addressed by the Board of Trade to Electricity Supply Authorities, drawing attention to the very considerable saving that could be effected by the adoption of arrangements for the interconnection and joint working of electricity supply undertakings, and stating that the Board was prepared to assist in securing the agreement of all parties interested in any such proposed scheme. This letter was well-timed, in view of a movement which had just been started in Lancashire, in the same direction. In the discussion at Manchester on Mr. E. T. Williams's paper recently read before the Institution of Electrical Engineers, Mr. Robertson, the chief electrical engineer of Salford, whilst maintaining that a national bulk supply scheme such as was proposed by Mr. Williams was not feasible at the present time, threw out the suggestion that a scheme for interconnecting the principal supply undertakings in the industrial districts would be of enormous benefit, and referred particularly to the advantages of such a scheme for the Lancashire and Cheshire districts.

The matter was taken up forthwith by the Municipal Electrical Association of Lancashire and Cheshire, and at a meeting held in the School of Technology, under the chairmanship of Mr. S. L. Pearce, on May 9th, and attended by a large majority of the chief engineers of the electricity supply undertakings (municipal, company, and railway) interested in the matter, a committee was formed to prepare a scheme for the interconnecting (where possible from an engineering point of view, and commercially feasible) of the principal supply stations of the two counties. The committee consists of the following gentlemen:—Mr. S. L. Pearce, Manchester, chairman; Mr. B. Welbourn, Prescot Electric Light Co., vice-chairman; Mr. J. A. Robertson, Salford, hon. secretary; Mr. C. C. Atchison, Rochdale; Mr. S. E. Britton, Chester; Mr. H. Dickinson, Liverpool; Mr. E. H. Elwardes, South Lancashire Tramways Co.; Mr. R. Blackmore, Stalybridge; Mr. J. Purrett, Lancashire Electric Power Co.; Mr. S. J. Watson, Bury; Mr. P. P. Wheelwright, Blackburn; Mr. Aspinall, Lancashire and Yorkshire Railway.

The area of supply coming within the scope of the Committee has been divided into the following districts:—Manchester Inner district; Manchester Outer district; Stalybridge and Oldham district; Liverpool district; North Lancashire district; Cheshire district.

Sub-Committees have been allocated to the various districts to obtain the necessary technical data, which will be compiled and tabulated at an early date. The central Committee will then be in a position to review the whole question and to present its report, including estimates of cost, to the various municipal committees and supply companies. The sympathetic consideration of the Board of Trade being assured, there should be no difficulty in carrying out the scheme without additional Parliamentary powers, and in view of its importance at the present time, it is hoped that the Local Government Board will also lend its assistance to enable the financial difficulties to be overcome.

We hope to see similar steps taken in other districts in which suitable conditions obtain—there are many such. As we pointed out in our last issue, the matter is of urgent importance, and energetic action should be taken *at once*.

We congratulate the M.E.A. of Lancashire and Cheshire on its promptitude—it will be noticed that the first meeting was held on the 9th ult., long before the Board of Trade letter was circulated—and hope that its action will be rewarded with equally rapid success.

Fatality.—The *Daily Telegraph* reports that a Sheffield electrician, named John Silvester, while engaged in repairing an electric motor, on Saturday afternoon was killed through his right hand coming in contact with a live wire.

Appointments Vacant.—Station engineers, fitters, wiremen, and engine drivers (steam and oil), for the Western Command, Chester; switchboard attendants (30s.), for the Faversham Corporation sewage pumping station; shorthand typist (male or female), for the chief engineer, Southern Command, Salisbury; steam engine driver (45s.) for the County of Middlesex War Hospital, Napsbury. See our advertising pages to-day.

New Testing Institution.—The Istituto Elettrometrico Italiano has lately been formed in Turin in connection with the Polytechnic of that city, with the object of carrying on and extending the electrical measuring-instrument testing department of the last-named institution.

Institution Notes.—Institution of Electrical Engineers.—On Thursday last week a special meeting of Corporate Members was held to consider the resolution, already recorded in this column, for altering the articles of association so as to exclude alien enemies from membership. After a brief discussion, the resolution was put to the vote, and carried by a majority of 41 to 1. A meeting to confirm the resolution will be held on June 15th, at 5.15 p.m.

Volunteer Notes.—BIRMINGHAM ELECTRICAL ENGINEERS.—The Birmingham Electrical Engineers (V.) has supplied and maintained a batch of skilled engineers for experimental and constructional work in connection with coast defence since the beginning of the year. More than 50 men, representing 17 branches of the engineers' profession, have joined the Navy for this work, and take duty on H.M.S. *Vernon*, for periods of two weeks or more, as and when such periods of duty can conveniently be arranged. Their services have been so useful to the Admiralty that a request is being made to the Birmingham Electrical Engineers to supply and maintain twice the original number of men.

To cope with this new demand an appeal is being made to draughtsmen, fitters, toolmakers, turners, mechanics, wiremen, and others with engineering knowledge, to offer themselves as volunteers for this work. Applicants should possess good health, and be between the ages of 18 and 50. Arrangements have been made for the transfer of specially selected "Derby" men to this scheme.

There are also vacancies for fitters and turners who wish to join the full-time service for the period of the war. Details of pay and allowances may be obtained from the Commandant of the Birmingham Electrical Engineers (V.), 56, Digbeth, each Friday, between 7 p.m. and 7.30 p.m., or from the Adjutant, Mr. S. T. Pemberton, 8, Church Street.

The following letter from the Secretary of the Admiralty shows that the services of the Volunteers are highly appreciated:—

"With reference to the arrangements made by which assistance has been rendered to the staff of H.M.S. *Vernon* by the Birmingham Electrical Engineers (V.), I am commanded by my Lords Commissioners of the Admiralty to inform you that a report has now been received from the Commander-in-Chief, Portsmouth, stating that the scheme has proved very satisfactory during the first three months of its working. The men's services have been of great value, and they have been uniformly well reported upon by the Departments of H.M.S. *Vernon* to which they have been attached.

"I am to add that their Lordships, who have received with pleasure this excellent report, have approved of the scheme being continued during the period of the war."—*Birmingham Despatch.*

1ST LONDON ENGINEER VOLUNTEERS.—Orders for the week by Lieut.-Col. C. B. Clay, V.D., Commanding.

Saturday, June 3rd.—Uniform Parade, 2.45, for Ceremonial Drill. Every Member is urged to attend.

Monday, June 5th.—Technical for Sections 1 and 2, No. 3 Company, 46, Regency Street, S.W.; Squad and Platoon Drill, Sections 3 and 4, No. 3 Company; Signalling Class and Recruits.

Tuesday, June 6th.—School of Arms, 6 to 7; lecture, "Bridging," Company Commander E. I. Castell; Recruits, 7.15 to 8.15.

Wednesday, June 7th.—Platoon Drill, No. 1 Platoon, No. 1 Company.

Thursday, June 8th.—Platoon Drill, No. 5 Platoon, No. 2 Company; Shooting for Sections 3 and 4, No. 3 Company, Miniature Range; Recruits, 5.45 to 7.45; Instructional Class, 5.45.

Friday, June 9th.—Technical for Sections 3 and 4, No. 3 Company, 46, Regency Street, S.W.; Squad and Platoon Drill, Sections 1 and 2, No. 3 Company.

Sunday, June 11th.—Entrenching duties: Parade, Victoria Station (S.E. & C. Railway Booking Office), 8.35 a.m.

MACLEOD YEARSLEY, *Adjutant.*

3RD BATT. (OLD BOYS) CENTRAL LONDON VOLUNTEER REGIMENT.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, June 1st, 1916:—

Week-End Parades.—Saturday.—The Battalion will Parade outside Baker Street Station, at 2.30 p.m., and proceed by train to Wembley Park for Drill under the Commandant.

Sunday.—The Battalion will Parade at Richmond Green, at 11.10 a.m., the 4th inst. Dress: Marching Order.

In the afternoon a Parade will be held by the Regimental Commandant, Brig.-Gen. the Hon. F. C. Bridgeman.

It is most important that every man should attend these Parades.

Bridgeman Cup Competition.—This competition will be fired at Runemede Range on Saturday next, June 3rd.

A. G. JOINER, *Major and Adjutant*, O.B.C.

The Diesel Auction at Ipswich.—Messrs. Wheatley Kirk, Price & Co. have issued a catalogue of the "Diesel" engines, &c., that are to be offered for sale by auction at Ipswich, on Wednesday next, under the liquidation of the Consolidated Diesel Engine Manufacturers, Ltd., and Diesel Engine Co., Ltd.

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Inquiries.—Makers of the "Vulcan" ammeters, &c., and tin cans from ½ pint to 1 gallon, are asked for.

Increasing Production.—In reply to a House of Commons question the other day, Mr. Pretyman said that no Committee had yet been appointed to advise specially on the problem of increasing the output of British industry, but no doubt the subject would be considered in connection with special groups of trades by the various Committees formed to study the state that those trades might be in after the war, especially in relation to international competition.

Engineering Wages.—Arising out of the refusal of the Committee on Production to grant any increase in wages to the Clyde allied engineering trades, a national movement has been set on foot to press for an advance of 2d. an hour to all sections of engineering workmen. It is stated by a prominent Trade Union official that this effort has come into being solely as a result of the great increase in the cost of living, and that a restriction of food prices on the lines of the limitation of prices of coal exported to France will stop any further efforts to secure increased wages from different sections of workmen.—*Morning Post.*

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—The Marylebone Electric Supply Committee recently reported respecting the permission granted last July to Mr. A. HUGH SEABROOK, the general manager, to undertake certain duties in connection with the Metropolitan Munitions Committee, as follows:—"The work is now nearly completed, and the general manager has applied to us for permission to take up a commission in a special branch of the Army where his general mechanical engineering experience, and the special experience he has gained on munitions work during the last ten months, will be utilised. We are satisfied that the undertaking will in no way suffer during the absence of Mr. Seabrook, and our Chairman, Mr. Alderman Duncan Watson, has promised to give even more of his time in the interests of the Council. We recommend that the Council do grant leave of absence to Mr. A. H. Seabrook, general manager, during the period of the war on the terms of the Council's resolutions."

The St. Marylebone B.C. is recommended to further extend the sick leave granted to Mr. RICHARDSON, station superintendent at the electricity works, until the end of July.

A sub-committee of the Stalybridge, Hyde, Mossley and Dukinfield Joint Tramways and Electricity Board has been appointed to consider and report on the question of the salary of Mr. R. BLACKMORE, chief engineer to the Board.

General.—We are glad to read in the *Journal* of the Tramways and Light Railways Association that Mr. A. L. C. FELL, who was taken seriously ill in January, is now making satisfactory progress, and hopes to resume his duties in a few weeks' time.

Axbridge Board of Guardians has appointed Mr. A. T. MARSHALL, of Dawlish, as resident electrical engineer at the workhouse.

Mr. J. H. BUTTERS, chief engineer and general manager of the hydro-electric department, Tasmania, has been appointed a member of the advisory council constituted by the Federal Government in connection with the scheme for a scientific research bureau for the collection and dissemination of industrial scientific information. The first meeting of the council was held in April.

London Gazette notices:—Territorial Force. Royal Engineers: *Tyne Electrical Engineers.*

Captain G. A. BRUCE to be Major. February 5th, 1915, and to remain seconded.

Lieutenant (temporary Captain) N. H. FIRMIN to be temporary Major. October 23rd, 1915, instead of as notified in *Gazette* of January 18th, 1916.

Lieutenant (temporary Major) N. H. FIRMIN to be Captain (temporary Major). February 5th, 1915.

Second-Lieutenant (temporary Captain) W. G. WARD to be Lieutenant (temporary Captain). February 5th, 1915.

Roll of Honour.—Lieut. E. M. MARVIN, A.M.I.E.E., of the Royal Engineers, only son of Mr. E. J. Marvin, of Maidstone, has been awarded the Military Cross for bravery in rescuing a wounded man under fire. He was articled with Messrs. Chapman & Co., and when he enlisted he was with the Electrical Equipment Motor Co.

Private FRED HILL, of the Grenadier Guards, formerly engaged at the Siemens Dynamo Works, at Stafford, has been killed in action.

Private DAVID J. ROBERTS, of the King's Shropshire Light Infantry, who has fallen in action, was, before enlisting, engaged at Ferndale, South Wales, as a colliery electrician with Messrs. D. Davis & Son. He was 27 years of age.

Private J. POWELL, of the North Staffordshire Regiment, who was on the staff of the Hanley Municipal electrical works when he enlisted, has died at the Front from the effects of gas poisoning. He was 23 years of age.

Private ALBERT F. BROWN, of the Loyal North Lancashire Regiment, formerly employed at the works of Messrs. W. T. Glover & Co., Trafford Park, has been killed in action, aged 21 years.

The D.C.M. has been awarded to Lance-Corporal HARRY MCBRYDE, of the 5th Signal Company, Royal Engineers, who was, until war broke out, a cable jointer in the postal telephone department at Huddersfield. He was thrice recommended for the award for devotion to duty in repairing wires under fire.

News has reached Openshaw, Manchester, of the deaths in action of four former employés of Electromotors, Ltd.:—Rifleman J. C. ABBOTT, of the Rifle Brigade; Private G. W. HUDSON, 1/9th East Lancashire Regiment; Private CHAS. B. HARDY, of the 8th Gordon Highlanders; and Private D. DAVIES, of the Royal Army Medical Corps.

Obituary.—MR. J. W. SMITH.—The death took place on May 26th of Mr. John Wm. Smith, for over 40 years associated with the business of Messrs. Taylor & Parsons, Ltd., electricians, of Bradford. He was in his 72nd year.

MR. WILLIAM HUTCHINGS.—Mr. William Hutchings, whose death at the age of 49 is announced, was formerly general manager of the St. Helens tramway service. He left eight years ago to take up a commercial position at Liverpool.

MR. J. E. M. STEWART.—The death took place on May 23rd, at Bournemouth, of Mr. J. E. M. Stewart, late chief assistant engineer of the Leicester Corporation electricity works, to which position he was appointed in 1899. Deceased, who was only 45 years of age, resigned at the end of last year for health reasons.

MR. CHARLES FOWLER BALDWIN.—Our monthly American exchange, *The Electrical Age*, reports the death, in Pittsburg, of Mr. Charles Fowler Baldwin, aged 41 years. Mr. Baldwin was associated with the Western Electric Co. for 19 years, and served as chief engineer for that company in Antwerp and London.

NEW COMPANIES REGISTERED.

Electrical Accessories Association, Ltd. (143,940).—Registered May 26th, by Holder & Wood, 40, Cheapside, E.C., as a company limited by guarantee, with not more than 500 members, each liable for £10 in the event of winding-up, to afford pecuniary, legal, and other assistance to members, to co-operate with kindred associations, to promote and assist the home, colonial, and foreign trade in, and the manufacture of, electrical accessories, to examine any patent, trade mark, concession or charter which, in the opinion of the Association, may tend towards the creation of an undesirable, oppressive, or unreasonable monopoly in electrical accessories, or which the Association may deem otherwise objectionable, and to bring or defend any proceedings in relation thereto, to support and promote the status and interests of the electrical accessories trade generally, to diffuse information amongst members, to carry on the business of a mutual trade protection association, to assist members in collecting debts, &c. The income of the Association is to be applied solely towards the promotion of its objects. Any person or firm engaged in the electrical accessories trade, or allied trade, whose place of business is situated in the United Kingdom, the Channel Islands, or the Isle of Man is eligible for membership. The Council is to have absolute discretion as to the admission or rejection of any candidate. The entrance fee is five guineas, and the annual subscription two guineas. The management is vested in a Council, the provisional members of which are the subscribers to the Memorandum of Association, viz.: C. S. Giddins, 15, Tichfield Terrace, Regent's Park, N.W., solicitor and J.P.; E. N. H. Spicer, 41, Red Lion Street, Clerkenwell, E.C., factor of electrical accessories; F. Watkinson, of J. & W. B. Smith, 15-23, Farringdon Road, E.C., general lighting merchants; F. Stanley Smith 218, Mortlake Road, Ilford, buyer; C. G. L. Holme, 74 Pepys Road, New Cross, S.E., electrical accessories factor; B. R. Agazar, 2 Colville Gardens, W., of the A. & A. Electrical Co., Ltd., factors of electrical accessories; W. A. Bradshaw, 1, Tewkesbury Terrace, New Southgate, N., manager; F. Summers, Trafalgar House, Regent Street, S.W., merchant; W. G. Hellyer, 11, Gamage Buildings, Holborn, E.C., merchant. Solicitors: Holder & Wood, 40, Cheapside, E.C.

British Electrolytic Zinc Co. (Isherwood Process), Ltd. (143,918).—Registered May 24th, by Spyer & Son, Austin Friars House, E.C. Capital, £62,500 in £1 shares. Objects: To adopt an agreement with the Venture Trust, Ltd., to carry on the business of refiners, reducers, crushers, purifiers, separators, and amalgamators of and dealers in zinc and other ores, matters, base bullion, slag, metals, minerals, and other substances and compounds, including tailings, residues, and other materials containing metals or minerals, metallurgists, assayers, metal workers, iron founders, copper smelters, dealers in gold, silver, zinc, copper, iron, tin, lead aluminium &c. The signatories (with one share each) are: E. Fairweather, Pinner's Hall, Austin Friars, E.C., secretary; F. W. Ellis, 19, Deanville Court, Clapham Park, S.W., secretary; A. J. Aldis, 10 & 11, Austin Friars, E.C., F.C.I.S.; A. W. Whitehead, 3, Throgmorton Avenue, E.C., clerk; W. F. Fisher, 4, Copthall Court, E.C., clerk; G. F. Weston, 3, Throgmorton Avenue, E.C., clerk; J. Rosen, Austin Friars House, E.C., clerk. Private company. The directors are to number not less than three or more than five. Three of the first are to be appointed by the signatories. The Refractory Zinc Ore Treatment Co. have the right so long as they hold 15,000 shares, to appoint two directors. Qualification, 100 shares, except in the case of the first directors, who shall not be required to hold such shares until completion of purchase agreement. Remuneration, £100 each per annum (chairman £150) and 10 per cent. of the surplus profits remaining after 10 per cent. dividend is paid, divisible.

Strand Electric & Engineering Co., Ltd. (143,933).—This company was registered on May 25th, with a capital of £750 in £1 shares, to carry on the business of manufacturers of and dealers in machinery, gas, steam, and oil or petrol engines, motor cars and accessories, pumping apparatus, electric motors and lamps, electrical accessories and apparatus, and all kind of electrical, mechanical, or automatic apparatus for the production of electrical stage effects, kinematographs, phonographs, sewing machines, vacuum pumps, electrical or mechanical fans, and air intractors and extractors, electrical and mechanical engineers, &c. The subscribers (with 250 shares each) are: A. T. Earnshaw, 50, Verdant Lane, Hither Green, S.E., electrical engineer; J. M. Woolnough, 125, Finfarms Road, Goodmayes, electrical engineer; P. Sheridan, "Monalee," 151, Culverley Road, Catford, S.E., electrical engineer. Private company. The number of directors is not to be less than two or more than five. A. T. Earnshaw signs documents as managing director. Registered office: 66a, St. Martin's Lane, E.C.

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OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

New Era Signs, Ltd.—Particulars of £2,000 debs., created May 1st, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £1,300. Property charged: The company's property, present and future, including uncalled capital. No trustees.

Carville Site & Power Co., Ltd.—Issue on May 19th, 1916, of £10,000 debs., part of a series of which particulars have already been filed.

CITY NOTES.

Peel-Conner Telephone Works, Ltd.

The net profit for the year ended March 31st, 1916, was £21,749, out of which £5,000 has been put to reserve for depreciation and £4,000 to general reserve, leaving £12,749, plus £4,201 brought forward. The dividend on the preference shares for the year absorbs £5,000, and a dividend of 2s. per share on the 1s. ordinary shares requires £8,000, leaving £3,950 to carry forward. The directors expressed themselves as satisfied with the result, more especially as during the past year the cost of labour and raw materials showed considerable increases. The annual meeting was held on Wednesday.

West London and Provincial Electric Supply Co., Ltd.

MR. H. KAHN, in addressing the annual meeting recently, referred to the difficulties of the year. Everything seemed to have conspired to make the lot of those conducting an electric light concern an unhappy one. On the one hand, owing to the Defence of the Realm Act, one of the most profitable sources of revenue—namely, shop window and outside lighting—had been practically done away with, and in Aberystwyth, where the Chiswick Corporation supplied the street lamps on the front, that source of revenue was for the time being extinct, and, on the other hand, coal and oil had gone up in price tremendously. Coal, for which the corporation used to pay 18s. per ton, now cost 28s., and for oil fuel, which used to range from 60s. to 70s. per ton, it had now to pay 124s. to 140s. To meet the situation, the Corporation had been compelled to raise its price for current by 10 per cent. and to fix a minimum payment per quarter of 13s. 4d. per consumer, and unless in the near future some reduction occurred in the prices of fuel—which seemed very unlikely—the Corporation might be forced to make a further increase in its charges. The second Diesel engine was working satisfactorily at Aberystwyth, and the Corporation was now installing a new one at Chiswick, as its reserve power there was becoming dangerously small. This engine would be ready for use in about a fortnight's time. Mr. W. B. ESSON (managing director) seconded the adoption of the report.

The Electric Construction Co., Ltd.

The annual meeting was held on Tuesday. Mr. P. E. BEACHCROFT, who presided, said that again he had to submit a report which showed an improvement upon that of the preceding year. The gross profits for the year had amounted to £88,500, with net profits of £43,200, an increase of £16,000 in the gross profits and of £7,700 net. From these figures it would be seen that of the increase of £16,500 in gross profit from manufacturing and contracting, £8,800 had been absorbed in additional expenditure. This was accounted for by (*a*) additional income-tax, rates and insurances, £3,500; (*b*) additional maintenance on plant and buildings, £2,800; and (*c*) additional provision for depreciation, £2,500. The increase in maintenance was chiefly due to an extensive overhaul of the factory roof, which had to be taken in hand, and which was still proceeding. The increase in depreciation they considered necessary, as the plant and machinery had been in more or less constant use during the past financial year, and the provision for depreciation must be correspondingly increased. They must, however, be prepared for some increase in general charges this year, but the amount would not be serious. It was extremely gratifying, in view of the abnormally high prices of materials, the higher rates of wages, the difficulties of transport, and several other factors which had contributed to increased cost of production, that they had been able to increase the net profit by 21 per cent. The improved results were due principally to a larger volume of business having been handled. There was a balance to be carried forward of £16,839, subject to excess profits duty and assessment under the Munitions of War Act, 1915. They were liable for excess profits duty for the year ended March 31st, 1915. They were also, he presumed, liable for this duty from April 1st to August 18th, 1915 (when their works were declared a controlled establishment), and from that date to March 31st, 1916, to an assessment under the Munitions of War Act, 1915. The amount of their indebtedness had not been finally determined, but they had carried forward more than sufficient to meet the demands of the Government. It had afforded the Board very great satisfaction to be able to recommend a substantially increased dividend, which they considered fully justified. An increase of £1,450 was shown in shares in other companies, which was represented by a holding that they had acquired in an allied concern, and which yielded a good return. On previous occasions he had emphasised the strong financial position of the company. Their financial position to-day was stronger than ever. Regarding their assessment for excess profits duty and assessment under the Munitions of War Act, 1915, two years' assessments had to be provided out of the sum of £16,839 carried forward. The Chancellor of the Exchequer required from non-controlled establishments 50 per cent. (now 60 per cent.) of the excess profits earned over the average of two of the three years prior to the war. Under the Munitions of War Act a pre-war standard was fixed of the average of the net profits for the two financial years completed before the outbreak of war. A controlled establishment was allowed to retain 20 per cent. over the pre-war standard, and anything in excess of that was to be paid to the Minister of Munitions. The last Budget, however, provided that unless the assessment paid to the Ministry of Munitions represented 50 per cent. or 60 per cent., as the case might be, of the increased profits, the Chancellor of the Exchequer would claim part of the 20 per cent. appropriated to the employer under the Munitions of War Act. He realised that the Munitions of War Act was in the nature of an arrangement with the workmen, who represented that they should not be expected to modify their rules and work longer hours to put extra profits into the pockets of the employers. He concurred, but as matters now stood controlled establishments were suffering to a larger extent than non-controlled. He did not wish to be misunderstood, as he had no fault to find with the excess profits duties in principle, but while recognising that certain privileges were enjoyed by controlled establishments, he hoped that something would be done to put matters on a more equitable basis. Moreover, an allowance of 20 per cent. on the pre-war standard was inadequate for the electrical manufacturing industry, which had just emerged from a long period of acute depression. He endorsed what was stated in the report regarding unexecuted orders at the beginning of the new financial year. Indeed, they had never begun a year so well provided with work, and as far as judgment could be formed in these days, there was every prospect of their meeting next year under favourable auspices. Many people had said that after the war there would be a period of depression. He did not share that view entirely, and with regard to the electrical industry, in his judgment they had only touched the fringe of the trade in this country. There were so many things which would come under the industry in the future that he did not see why it should be limited in its operations. There were such things as the electrifying of agriculture and other interests, and there was no reason to suppose that in years to come they might not be able to harness all the coal fields. He felt confident that the electrical industry would not suffer from any falling off in demand after the war. Therefore he was an optimist, and he believed that their company would benefit materially in the future.

MR. JAMES GRAY (managing director) seconded the motion, and the report was adopted without discussion.

West India and Panama Telegraph Co., Ltd.

SIR ALEX. F. KING, presiding at the annual meeting on May 17th, said that at the half-yearly meeting they foreshadowed a great falling-off in traffic receipts concurrently with increased expenses due, to a large extent, to the hurricane which visited the West Indies in August last. Their prognostications had proved to be correct. Several circumstances had combined to militate against obtaining a more satisfactory record, but they could not at the very best of times hope to emulate the prosperity of the larger telegraph companies, owing mainly, if not entirely, to the narrow field of their operations. The population of the whole of the British West Indies was only about 2,000,000—less than one-third the population of London. Further, the productive area of those Colonies was very limited, and as there was little sympathy of trade between the several islands, traffic receipts must be comparatively small. Under arrangements with the Government they reduced their charges from October, 1914. The loss from so doing was estimated at £26,000 a year, but, as a set-off, the Imperial and Canadian Governments granted subsidies amounting to £16,000 a year for 10 years—leaving £10,000 a year to be made up by the increased traffics which they were told would result from the stimulation the lower rates would induce. Certainly the volume of words had increased, but some part of this was certainly due to circumstances not connected with the question of rates. For instance, war conditions, the difficulty and uncertainty of steamer communications, the favourable crops and the higher prices obtained for them, were factors to which much of the increase in their work could be attributed. Under conditions which had ruled

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for very many years, the staff had had to be kept down to a minimum strength; and, owing to the Government requirements that the offices should at times be kept open day and night, the working costs had been higher than in previous years. They had, however, formulated a claim for a modest proportion of the extra cost entailed by the special services rendered, and that claim was at present under the consideration of the departments concerned. In the hurricane referred to, the Island of Jamaica suffered most severely. The deficit in the Jamaica Budget for last year was £62,000, and the estimated deficit for this year was £115,000—both largely due to the hurricane and to war conditions. But they were not without some hope for the future. Their Canadian friends seemed to feel that there was something better in store for their West Indian Colonies. Banking interests were being pressed forward by the establishment of branches of a Canadian bank, and the Dominion was apparently alive to the fact that, given transport facilities, it could offer a market for all the sugar their colonies could produce. Reciprocity of trade relations between Canada and the West Indies ought in the natural order of things to bring about better results for the company. Indeed, the traffic receipts to the end of March showed an appreciable increase over the corresponding period of 1915, but at present the expenses were not likely to decrease. Some of the articles supplied to their repairing ship had increased in cost from 100 to 200 per cent. They hoped that circumstances would produce a more satisfactory account for the current half-year.

Argentine Tramways and Power Co., Ltd.

The report states that the year ended September, 1915, was largely one of construction. About 20 miles of track are now constructed. The supply of electricity for light and power was commenced in May, 1915. Until the eighth month of the financial year the company was only deriving its revenue from a part of the system, while the expenses charged to revenue covered the whole year. Notwithstanding this, the revenue was nearly sufficient to provide the full year's interest on the whole issue of £200,000 debenture stock. The development of the business had not been so rapid as was anticipated, owing principally to the depression in the Argentine accentuated by the war. The revenue was, however, gradually increasing, but no marked improvement must be looked for until more normal conditions prevail.

Indo-European Telegraph Co., Ltd.

Owing to the continued interruption of the company's route during the whole of 1915, the actual receipts were confined to local traffic. It has been impossible to make final arrangements for the re-establishment of the route. Under the existing arrangements with other companies and administrations the company's receipts have not been prejudicially affected, but the directors foresee a diminution in the receipts for 1916. They hope shortly to conclude an agreement for the acquisition of a substantial interest in a prominent manufacturing firm under which that firm will manufacture and develop apparatus for radio-telegraphic transmission and reception covered by the several patents now owned by the company; these will under the proposed agreement be transferred to that firm. The revenue amounted to £204,190, an increase of £14,806 over 1914. The expenses were £82,218, a decrease of £6,177. Including £20,592 brought forward, £122,297 is available. Deducting £35,000 provided for investment fluctuations, £15,000 provided towards excess profits duty for 1915, and the interim dividend of £10,625, there remains £61,672. An interim dividend of £2 12s. 6d. per share, free of income-tax, was recently paid, amounting to £44,625. This will be confirmed in the form of a final dividend and a bonus of £1 17s. 6d. per share, free of income-tax, amounting to £31,875, with a special distribution of 15s. per share, free of income-tax, amounting to £12,750, will be paid. The latter sum is derived from interest on unappropriated investments and advance accounts. It is proposed to provide a further £10,000 for wireless and other technical development work, carrying forward £19,797 to the credit of 1916. The annual meeting was held on Tuesday.

Kalgoorlie Electric Power and Lighting Corpn., Ltd.

Mr. E. Pope presided at the annual meeting in London, on May 23rd. He said that the position of the company had been maintained, though costs and taxation were higher. More power was sold, but the total net profit was a fraction less. The amount of liquid assets showed a substantial increase. The question of debenture redemption had to be dealt with next year, but in the meantime they would continue to buy debentures offered at a reasonable market price. They held larger stocks of firewood in anticipation of trouble with the firewood cutters, many of the workers being alien enemies, this meaning a shortage of labour and a demand for higher wages. This demand was made in January, 1916, and whilst it was being adjusted many of the users of their current, who also used firewood for steam plant, closed down and ceased operations for many weeks, so that the profit fell to about one-third of the normal in January and for February it was also decreased. Ultimately extra wages were agreed to, and the price of fuel was increased by 1s. per ton, which meant an extra cost of .055d. per KW. to produce their power. The cost of all engineering supplies had been greatly raised, some as much as 100 per cent., but notwithstanding the higher expenses they still expected to have a fairly prosperous year. It was not likely that the gross profit would be equal to that of last year, but if they could reduce expenditure the cash balance might be as large. Mr. Pope referred to the change of managers at Kalgoorlie, Mr. Crocker, who had been there for 16 years, desiring a change. His duties had been assumed by Mr. Marmion, who had always acted as manager when Mr. Crocker was absent. Mr. Crocker, as consulting engineer, would be at hand to advise him.

Callender's Cable and Construction Co., Ltd.

Sir J. Fortescue Flannery, Bt., M.P., presided over the annual meeting, held at Hamilton House, on May 25th. He referred to the comparatively favourable nature of the report in the face of the difficulties of the year. The Government and the circumstances of the war were more responsible for the difficulties that had arisen than any cause inside their own organisation. They had lost a large number of their workmen who had volunteered for the war; they had had most serious difficulties arising from the restriction of British tonnage, which had caused delay in the delivery of their raw materials and had enormously increased the cost of raw materials and coal; and they had also had to contend with the cancellation of orders—perhaps he had better say the postponement of orders, because they hoped to resume them after the war The inroads on their earnings, first by the Minister of Munitions, because they were a controlled establishment, and, secondly, by the Chancellor of the Exchequer, especially under the new legislation now before Parliament, were amongst the difficulties they had had to encounter. And yet they claimed to have overcome those difficulties without resorting to any means of which the shareholders would disapprove. They had made no undue profit out of the nation's need. He desired to emphasise that fact, because so many allegations were made at the present time that traders were making profits by excessive charges. They had carefully avoided doing anything of the sort, and all the work they had done for the Government had been done in full confidence with them, with open hands, and with the full approval of the Government officials in respect to every department for which they had worked. The interruption to their ordinary trade due to the war had enabled them to make very considerable changes—some of which, perhaps, would be of advantage after the war—both at Erith and Leigh. They had set as good an example as they could to their brethren in the electrical trade, and, broadly speaking, the electrical trade had not been behind any other trade in its patriotic exertions since the war broke out. In these circumstances, there had been difficulty in maintaining their commercial work, both at home and abroad, and in the Colonies and neutral countries, but they had been able to execute such orders as were urgent, and they had been at great pains to keep alive all the world-wide connections which they possessed, because they realised that whilst doing their duty to their country, yet a duty also rested upon them with regard to their shareholders to see that when the war was over they were able to resume their ordinary business with full advantage, and they believed the measures they had taken were such that after the war the company would be able to continue its ordinary business as advantageously as before, both to customers and shareholders. Indeed, they had reason to believe that their friends were storing up reservoirs of orders for their requirements which would be opened very fully to their advantage after the war was over. The chairman proceeded to deal at some length with the question of transport, and said that whilst the German submarine menace had failed absolutely upon the whole, still the losses which had been incurred, coupled with the demands of the Government in regard to the construction of ships of war, had caused embarrassment. He saw little hope for relief in the near future, but he suggested that the situation might be relieved by the authorities making more careful use of ships requisitioned, and also by a still further restriction on the import of articles not absolutely required by the nation. Continuing, he said the company had added a great deal of new plant and buildings at the factories both at Erith and Leigh. They had done that at the request of the Government, and he desired to put on record their appreciation of the very businesslike manner in which the Government had met them and co-operated with them in these extensions. In addition to adding new plant, they had kept the existing plant up to the fullest state of repair and efficiency. They worked overtime at both factories, and at Leigh they worked practically continuously night and day. The chairman next referred to the erection of canteens and hostels for the workers. The developments of women's labour were quite astonishing, and he could assure them that in the case of their factories the adaptability of women, the quickness with which they learned technical handicrafts, the steadiness with which they applied themselves, and their utility and efficiency generally, were beyond all praise, and he himself thought that after the war this general recognition of the utility and adaptability of women labour would not be thrown away. Dealing next with the balance sheet, the chairman called attention to the very considerable sum carried forward. On January 1st, 1914, the sum carried forward was £124,000. On January 1st, 1915, it was £163,000, while on January 1st, 1916, they commenced the year with £207,000. That was a reserve against the future. They did not know what the war would bring forth, and it was well to have something laid by in case they had some unexpected difficulty. Their profit was substantially in-

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creased through causes which were perfectly legitimate. Stocks both of raw materials and manufactured goods had increased, and now they were £267,000, compared with £145,000. The general expenses at the London office were £41,789, as against £44,600. The saving was due to the fact that as they were not doing so large a commercial business they had re-arranged their agencies in the direction of economy. It might be that when they resumed their full commercial operations they would again have to spend more money in this direction. The allowances to the members of the staff on active service came to £2,554, as compared with £867 last year. The item of £2,405 for samples, experiments, and advertising compared with £1,960 last year. It was important that both at Erith and Leigh the scientific research and investigation of all matters relating to the electrical industry as concerned in their manufactures continued without abatement during the war period. They claimed to be in the first rank of manufacturers of electrical apparatus, and they could only maintain their position by thorough research and by keeping up a special branch for laboratory experiments and for investigation, and they were very satisfied with the result and very grateful for the scientific services of the gentlemen who served them in that capacity. They had a long roll of honour, which included Mr. Tom Callender's own son, who, he believed, would be a credit to the company to which his father belonged. The prosperity of the company was dependent on the skill of the management and the loyalty of the staff of workers. In their managing director, Mr. Tom Callender, they had a man who was known to every shareholder and every worker, and who was appreciated for his extraordinary combination of scientific knowledge and business capacity. He was splendidly supported by Mr. Petersen and Mr. James Callender, who shared with him the responsibility of the management, and in Mr. Walter Allnutt, their secretary, they had a financier who, if opportunity arose, could give points to the Chancellor of the Exchequer.—Mr. TOM CALLENDER, who seconded the motion, referred to the employés who were with the Forces, making special mention of Flight-Lieutenant Reed, who, in the Schleswig-Holstein raid, descended from the comparative security of the air to render assistance to a comrade, and, failing to rise, was taken prisoner. A shareholder had referred to the fact that the accounts contained no information as to income-tax, but they did not wish to say anything at present. Certain particulars were given them under the Munitions Act, but they did not know what they meant, and as to what was before them under the Finance Act, it was too bad for words. Mr. McKenna said it was his intention to tax every person to the extent of 60 per cent., and that those taxed under the Munitions Act would be called on to make dual returns, and he would take whichever was the largest. This, in their opinion, was a most unfair basis, and they were trying all they could to combat it. In addition, it was a distinct breach of the bargain, because when they were made a controlled establishment they, with others, entered into a three-party bargain between the workers, the employers, and the Government, and they held that it was not competent for one party to break the bargain without the consent of the others. Whether they would be successful in obtaining what they considered their rights was not yet settled, but they would do their best to protect the interests of the company. The difficulties during the past year had been very great. The price they had had to pay for most of the commodities they used they would a short time ago have considered ridiculous. In the early days of the war copper was between £50 and £60, and was now over £150, and, with such a fact before them, it did not need many words of his to show how serious the position might become unless it was handled with considerable care, and they had endeavoured to do that. They had done some overseas trade—not as much as they would have liked, but they had been prevented by the action of the Government, and he thought the action they had taken had been quite correct. No one could have any fault to find with most of the regulations which had been issued. Some had hampered them and restricted their business. Still, they had endeavoured as far as possible to consolidate the fields they had already entered, and he was glad to say they had with them that day Mr. Wadham, one of the partners of a firm in Sweden with whom they were in very close touch, and who was doing most excellent work in connection with them. Wherever possible, they were extending their business and doing the best they could. As to the future of the trade generally, he was afraid he could not make any particular remarks. The Government had done him the honour of nominating him as one of the members of the trade on the Committee dealing with the electrical business after the war, and in view of the fact that he was getting information from various sources on which the Committee would eventually have to make a report, it would not be right for him to say anything. He hoped next year they would meet under circumstances which would justify him in wishing the shareholders their share of prosperity in the future.

Delhi Electric Tramways and Lighting Co., Ltd.

The gross receipts during 1915 were: Tramway undertaking, £9,604; electricity supply undertaking (including £2,590 for current sold to tramways), £20,199. The last-named figure represents an increase of 7 per cent. over the figures for the previous year, while the tramway revenue shows a reduction of 1½ per cent., due to decreased mileage. The net revenue of the combined undertakings was £10,300, as compared with £8,163 in 1914 and £6,252 in 1913, which is considered satisfactory in view of present conditions. After charging general expenditure in London and Delhi, the debenture and loan interest, the profit and loss account, including £78 brought forward, shows an available balance of £6,113. Of this, £2,218 is devoted to writing-off part of the preliminary expenses, £2,000 to depreciation reserve account, £1,000 to renewals reserve account, and £896 is to be carried forward. The cost of upkeep of cars and permanent way is still heavy, largely due to the increased cost of spares of all kinds. A larger battery has been installed in the power house, and the loss on realisation of the old battery (£750) has been charged to renewals reserve account. Owing to the increasing demand, further generating plant must be provided as soon as funds are available, and new tramway rolling stock is required. The cost of these and of new feeder cables will be met out of surplus revenue, as it will probably be impossible to place the contemplated issue of second debentures for some time.

Rangoon Electric Tramway & Supply Co., Ltd.—The report for 1915 states that the cars carried 10,815,613 passengers, a decrease of 323,335, the total receipts being Rs.8,60,664, a decrease of Rs32,252, or 3.61 per cent. In the private lighting and power department the gross receipts for current amounted to Rs7,32,172, an increase of 13.77 per cent. The gross profits for the year were £63,,347, and transfer fees and interest on deposits and investments in London yielded £1,307, making £64,654. From this has to be deducted, among other items, depreciation on sundry assets in Rangoon £1,847, transfer to reserve for renewals account £12,500, to special reserve for cables, &c., £2,500, leaving £20,327, plus £2,766 brought forward, making £23,093. The directors recommend a dividend on the ordinary shares of 3 per cent. for the year, tax free, leaving £2,783 to be carried forward.—*Financial Times.*

Russian Electrical Companies.—*The Russian Wireless Telegraph & Telephone Co.* (capital 3,000,000 roubles) made a net profit of 1,016,018 roubles in 1915 (against 1,304,988 roubles in 1914), and is paying a 15 per cent. dividend.

The United Cable Factories (capital 6,000,000 roubles) made a gross profit of 3,586,486 roubles in 1915 (against 3,872,154 roubles in 1914), and a 25 per cent. dividend is being paid.

Reduction of Capital.—*Browett, Lindley & Co., Ltd.*—A petition for confirmation of the reduction of the capital of the company from £120,000 to £107,500 is to be heard on June 6th.

R. W. Blackwell & Co., Ltd.—The Courts have confirmed the reduction of capital from £250,000 to £50,000 by cancelling 200,000 shares held by Mr. Blackwell, the chairman and managing director.

Victoria Falls & Transvaal Power Co.—Ten months' dividend at the rate of 6 per cent. per annum, less tax, on the preference shares, bringing the dividend payments down to December, 1915.

Lima Light, Power & Tramways Co., Ltd.—The report of the Empresas Eléctricas Asociadas states that the total profits during 1915 were £p183,715, less bond service £p60,030, interest, discount and exchange £p17,508, European expenses £p1,858, provision for bad and doubtful debts £p3,000, leaving a net profit of £p101,318; balance brought forward, £p50,077. There is put to reserve and redemption fund £p29,000, to reserve for bad and doubtful debts £p13,000, to amount written off value of shares owned by Empresas Eléctricas Asociadas in other companies £p29,000, leaving £p80,396 to carry forward.—*Financier.*

Stock Exchange Notice.—The Committee has been asked to allow the following to be quoted in the Official List:—

Consolidated Gas, Electric Light & Power Co., of Baltimore.—Further issue of $3,329,300 common stock.

North Metropolitan Electric Power Supply Co.—The accounts of this company for the year ended December, 1915, appear in the *London Gazette* for May 30th.

Held Over.—Pressure upon our space compels us to hold over reports of several company meetings.

STOCKS AND SHARES.

TUESDAY EVENING.

The calling-up of the penultimate Derby Groups on Monday certainly had its effect upon Stock Exchange business; but, as a City factor, Sir Edward Grey's cold douche to the peace optimists has been the principal market consideration of the past week. The strength of the markets gave way appreciably

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after the pronouncement of the Foreign Secretary; but, all the same, there is plenty of money about for investment, and the gilt-edged securities are once more beginning to move up.

This movement will be assisted by the Treasury's drastic steps for compelling holders of American dollar securities to sell their stocks, or to deposit them on loan with the Government. The prospect of paying 7s. in the £ income-tax has had the effect of dislodging already an unexpectedly large number of such securities; and as the Government's list of bonds and shares which it is prepared to purchase runs to nearly a thousand stocks and, even so, is not exhaustive, it is obvious that there will be a lot of money before long seeking investment in home securities.

The industrial sections of the Stock Exchange are certain to feel the benefit of this re-arrangement of capital, because, although the bulk of it will no doubt go into Exchequer Bonds and other war loans, some portion, at any rate, will percolate through to more commercial investments, if only from the fact that the latter give a higher yield and make a good mixture with the gilt-edged security offered by the Government at lower rates of interest.

Various electrical stocks and shares are included in the list published by the Treasury which the latter wishes to buy. For instance, the Consolidated Gas & Electric Co., of Baltimore, general mortgage 4½ per cent. of 1954 is fairly well known in our markets, though the Edison Electric Illumination bonds are nothing more than a name on this side of the pond. New York Telephone bonds have been in the list, of course, for some time past. Georgia Electric first mortgage fives are wanted, but we are rather surprised that Shawinigan Water & Power is not to be found in the published list. Nor are Calgary bonds included.

Holders of such securities, however, might well consult their brokers as to whether the bonds would be acceptable to the Government, under the scheme, because there is a charming uncertainty at present as to what dollar securities will have income-tax deducted from their dividends at the rate of 7s. in the £.

The London electric lighting companies have received quiet hints as to the advisability of seeing whether something further cannot be done in the way of linking-up the services, with a view to increased economies in labour and material. The idea seems to be that, in spite of the various arrangements between some of the companies, there is still a certain amount of overlapping and that much might be done by a comprehensive scheme for London as a whole.

The only change in the market for electricity supply shares is a rise of 5s. in Charing Cross ordinary, which has lifted the shares to 3½. The yields to be obtained from this market are worth noticing in our tables. They compare well with many other industrial sections in the Stock Exchange, and, as we have said before, the likelihood of further reduction of dividends cannot be very great.

In one or two districts, the price for electric current has been raised in consequence of the Daylight Saving Bill; and users of electricity in other parts will feel something more than curious to see whether this innovation will spread.

The Telegraph market is good. Anglo-American preferred put on another point, and the rise in Eastern ordinary is not yet over. The rest of the stocks and shares in this department hold the rises that they have established during the past week or two. Nor are there many shares about, as buyers find when they endeavour to pick up cheap stock.

At the Eastern Telegraph's meeting, last week, the chairman stated that the gross revenue constituted a record. The company set aside £300,000 for income and excess profits taxes, and, even allowing for this, there was £114,000 more to divide than in 1914. An interesting sidelight upon the company's working was afforded by the chairman's reference to the facilities offered by the company for cheap, and occasionally gratuitous, cabling to soldiers and sailors and nurses.

The Indo-European Telegraph profit of £122,000 showed an improvement of £21,000, as compared with 1914. The board, however, hint that there may be some shrinkage in the revenue in respect of the current year, in consequence of the fact that some of the arrangements with other companies will run out or be modified this year. The through route of the company traverses Germany, so naturally the Indo-European has had to rely upon local traffic for its revenue, plus its share in the arrangements already referred to.

The railway market is a little easier, except as regards the prior charge stocks, for which there is an increasing demand. Underground income bonds lost ½, and there are small falls in Metropolitans and in Districts. Keen interest is, of course, aroused by the publication of the electrification of about 50 miles of single track on the mineral line between Shildon and Newport. Three electric locomotives are now ready. The company has the advantage of operating in a district where cheap electric current is plentiful; and it is calculated that the scheme will be a most important factor in reducing costs. That it will be extended to other parts of the system, and also followed up by other Trunk lines will come about as a matter of course if it is anything like the success which it seems certain to be; and its operation will be watched with lively attention by the community at large.

Brazil Tractions have gone back a little, after their rise of 8 points in the previous week; but Mexican issues are slightly better as regards the first mortgage bonds. The Brisbane Electric Tramways Investment maintained its ordinary dividend of 8 per cent., although its receipts have fallen off pretty considerably. The special allocations this time last year, however, were on a sufficiently liberal scale to render their repetition this year unnecessary; and the carry-forward of £10,400 is £7,000 better than it was in 1915.

One of the features in the manufacturing group is a rise of 2s. in British Aluminium ordinary. The iron and steel group, too, is exceedingly firm. Babcock & Wilcox are ½ better. Castner-Kellners, in the chemical list, are 1/16 harder. The rubber share market is quiet, because of a steady dwindling in the price of the raw material, which once more is sinking towards the half-crown per lb. level. At the latter figure, big profits will still be available to the good concerns; and if rubber were to drop to a florin per lb., dividends good enough to satisfy most people could be counted upon. More activity is noticeable in the armament group; and, as before, the industrial market of the Stock Exchange shows conspicuous activity.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price May 30, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	63½	—	£7 6 2
Charing Cross Ordinary	5	5	3½	+ ½	7 2 10
do. do. 4½ Pref.	4½	4½	3½	—	6 18 6
Chelsea	5	4	2½	—	6 8 1
City of London	9	8	12	—	6 13 4
do. 6 per cent. Pref.	6	6	10½	—	5 14 8
County of London	7	7	10½	—	6 16 7
do. 6 per cent. Pref.	6	6	10⅜	—	5 15 8
Kensington Ordinary	9	7	5	—	7 0 0
London Electric	4	3	1 7/16	—	7 11 0
do. do. 6 per cent. Pref.	6	6	4½	—	7 1 2
Metropolitan	8½	8	2⅜	—	6 6 4
do. 4½ per cent. Pref.	4½	4½	3	—	7 10 0
St. James' and Pall Mall	10	8	6	—	6 13 4
South London	5	5	2⅞	—	8 13 10
South Metropolitan Pref.	7	7	1 7/16	—	6 14 6
Westminster Ordinary	9	7	5⅜	—	6 4 5
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	102 xd	+1	5 18 0
do. Def.	80/-	83/6	22	—	7 10 9
Chile Telephone	8	8	6⅜	—	6 5 6
Cuba Sub. Ord.	5	5	7½	—	6 13 4
Eastern Extension	7	8	14⅜	—	*5 11 4
Eastern Tel. Ord.	7	8	147	+1	*5 8 10
Globe Tel. and T. Ord.	6	7	12⅜	—	*5 14 3
do. Pref.	6	6	10½	—	5 17 5
Great Northern Tel.	22	22	36⅛	—	6 0 7
Indo-European	13	13	49	—	6 12 9
Marconi	10	—	2 7/16	—	4 19 4
New York Tel. 4½	4½	4½	100⅜	—	4 9 4
Oriental Telephone Ord.	10	10	1½	—	6 10 4
United R. Plate Tel.	8	8	6⅜	+ 1/16	*6 5 6
West India and Pan.	1	Nil	19/-	—	9 6 1
Western Telegraph	7	8	14½	—	*5 10 4
Home Rails.					
Central London, Ord. Assented	4	4	70	—	5 14 6
Metropolitan	1½	1	25½	— ½	3 19 0
do. District	Nil	Nil	19	— ½	Nil
Underground Electric Ordinary	Nil	Nil	1⅜	—	Nil
do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	6	6	86½	— ½	*6 18 9
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4⅜	—	6 6 4
Anglo-Arg. Trams, First Pref.	5⅜	5⅜	8¼	—	7 17 3
do. 2nd Pref.	5⅜	5⅜	3⅜	—	8 9 3
do. 5 Deb.	5	5	79	+1	6 6 7
Brazil Tractions	4	4	62½	—2½	6 8 6
Bombay Electric Pref.	6	6	10⅜	—	5 15 8
British Columbia Elec. Rly. Pfce.	5	5	59	—	8 9 8
do. do. Preferred	—	Nil	40	—	Nil
do. do. Deferred	—	Nil	38	—	Nil
do. do. Deb.	4½	4½	62	—	6 17 1
Mexico Trams 5 per cent. Bonds	—	Nil	43	+1	Nil
do. 6 per cent. Bonds	—	Nil	35	—	Nil
Mexican Light Common	Nil	Nil	20	—	Nil
do. Pref.	Nil	Nil	32	—	Nil
do. 1st Bonds	Nil	Nil	43	+1	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	2⅜	+ ½	6 9 1
British Aluminium Ord.	5	7	24/- xd	+2/-	5 16 8
British Insulated Ord.	15	17½	10½	—	7 2 10
British Westinghouse Pref.	7½	7½	44/-	—	6 16 6
Callenders	15	20	11½	—	6 10 5
do. 5 Pref.	5	5	4½	—	5 17 6
Castner-Kellner	20	—	8⅜	+ ⅛	5 6 8
Edison & Swan, £3 paid	Nil	—	10/-	— 6d.	Nil
do. do. fully paid	Nil	—	1⅜	—	Nil
do. do. 5 per cent. Deb.	5	5	57	—	8 15 8
Electric Construction	6	7½	17/-	—	8 16 6
Gen. Elec. Pref.	6	6	9⅜	—	6 4 5
Henley	20	—	14½	—	*6 18 0
do. 4½ Pref.	4½	4½	4	—	5 13 4
India-Rubber	10	10	10½	—	*9 10 8
Telegraph Con.	20	20	87	—	*6 16 0

* Dividends paid free of income tax.

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THE SHILDON-NEWPORT RAILWAY ELECTRIFICATION.

(*Concluded from page* 607.)

The motor equipment of each locomotive consists of four totally-enclosed motors, each driving an axle through single reduction twin gearing. The gears are machine-cut with straight teeth of the involute pattern, the face dimensions of the spur wheels and pinion being nearly 4 in.

A pinion is mounted on each end of the armature shaft and meshes into a corresponding gear-wheel mounted on the running wheel axle, the gear ratio being 1 to 4.5.

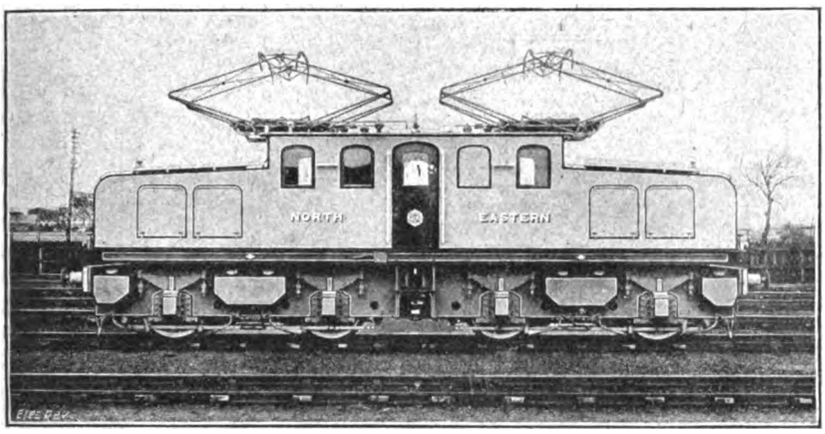

FIG. 11.—ELECTRIC FREIGHT LOCOMOTIVE, N.E. RAILWAY.

The motors are suspended by means of a cross beam suspension bar with bearings and re-action springs. These, with the motor suspension bearings on the axle, provide the motors with four points of suspension.

The four main motors are fitted two in each bogie, and are each wound for 750 volts, the pair of motors in each bogie being connected permanently in series, and the two pairs or units being controlled on the usual series-parallel system.

Each motor is capable of developing 275 B.H.P. at a speed of 20 miles for one hour with forced ventilation. The motor equipment is capable without injury of exerting a torque sufficient to skid the wheels under any conditions of rail, and will exert an average pull of 28,000 lb. at the tread of the wheels when starting under normal conditions of rail. The maximum pull at the tread of the wheels is, of course, considerably greater than this.

The motors and gearing are designed so as to run at a speed of 45 miles per hour without exceeding the limits of safety, but the normal speed on the level when hauling a train of 1,400 British tons is 25 miles per hour. The equipment is so designed that each locomotive is capable of performing four round trips in 12 hours, each consisting of a trip from Shildon to Newport with a train of 1,400 tons, followed by a trip from Newport to Shildon with a train of 800 tons, the distance of each trip being about 18 miles. The locomotives are able to start a train of 800 tons from rest on a grade of 1 in 100, and accelerate to normal running speed.

A novel feature is the ring lubrication on the motor shaft. The gearing is enclosed in a welded sheet-iron case fitted with a siphon wick oil lubricator.

The air supply for ventilating the motors is supplied from fans driven by the dynamotors; in order to avoid the use of a flexible pipe between the fan air duct in the base of the cab structure and the motors, a special form of spring sliding gland is employed. The normal quantity of air passed through each motor case is 700 cu. ft. per minute.

Two master controllers are fitted in the cab, fig. 12, one at each end. Notching up can either be carried out by hand or automatically. The automatic arrangement consists of a spring which is wound up by the controller handle, the speed at which the controller drum follows the handle being governed by a step-by-step escapement movement.

The maximum current taken at each step is limited by a switch fitted in the sloping ends of the cab, which, on the current rising beyond a predetermined

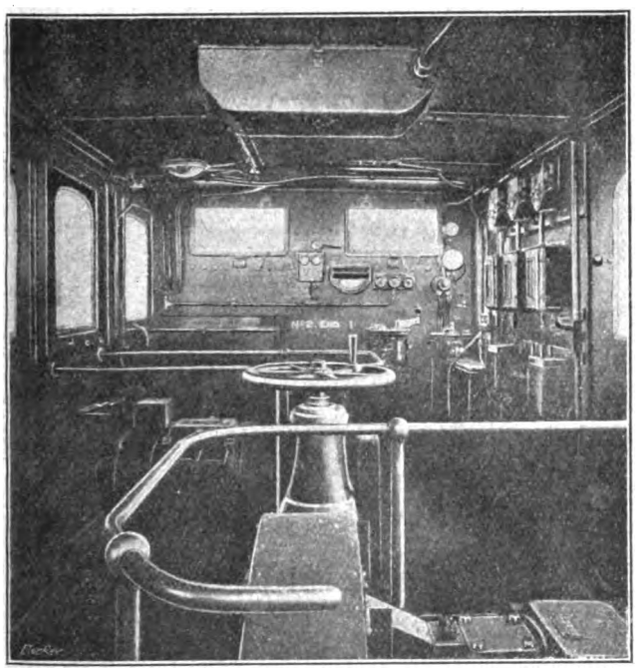

FIG. 12.—VIEW IN THE LOCOMOTIVE CAB.

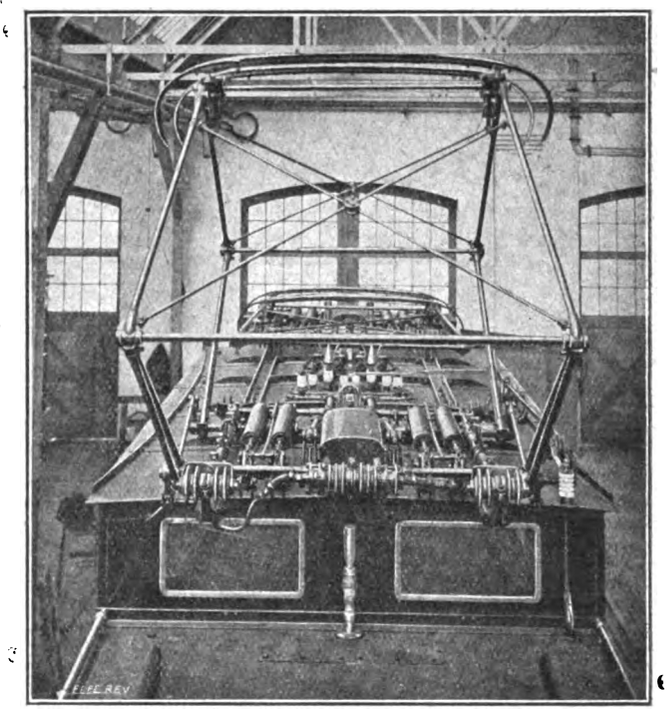

FIG. 13.—ROOF OF LOCO. CAB, SHOWING BOW COLLECTORS, &C.

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point, closes the circuit of a small magnetic interlock, which locks the escapement mentioned, holding the drum of the controller until the current has fallen to the required value.

In addition to the above, by means of a catch inside the controller, which when lifted disconnects the spring and escapement action, the automatic arrangement described can be thrown out of action and notching performed by hand.

An acceleration switch is also provided so that, in special circumstances, the adjustment of the limit switch mentioned can be altered by short-circuiting some of the turns of an opposing coil, thus allowing of a larger current for accelerating under special conditions.

Each master controller is fitted with the usual reversing barrel, the handle of which can only be removed when in the "off" position; when left in this position, the reversing handle locks the main handle. There is also fitted on the master controller a small spring switch by means of which the automatic circuit breaker on the locomotive can be tripped or set. This switch is also locked by the reversing handle in the "off" position.

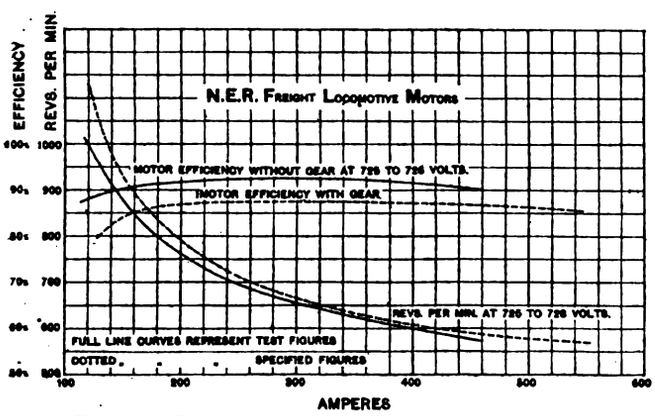
EFFICIENCY
REVS. PER MIN.
N.E.R. Freight Locomotive Motors
MOTOR EFFICIENCY WITHOUT GEAR AT 725 TO 735 VOLTS.
MOTOR EFFICIENCY WITH GEAR.
REVS. PER MIN. AT 725 TO 735 VOLTS.
FULL LINE CURVES REPRESENT TEST FIGURES
DOTTED . . . SPECIFIED FIGURES
AMPERES

Fig. 15.—Performance Curves of Loco. Motor.

Current for operating the whole of the control circuits and the lighting and heating in the cab is supplied from either of the dynamotors at a pressure equal to half the line voltage.

The contactors are electrically operated and are also fitted with auxiliary interlocking contacts to ensure their operating in the correct order. The resistances of the usual cast-iron grid type are fitted in the sloping ends.

The main automatic circuit-breaker on the roof of the cab is fitted with horned spark gaps which project through the roof. The circuit-breaker is operated either by means of the set-and-trip switch on the master controllers, as mentioned, or by means of a mechanical hand trip, but can only be closed by the set-and-trip switch; red and green lamps are provided to indicate whether the circuit-breaker is set or tripped, and an illuminated dial ammeter is provided at each end of the cab in front of the driver.

As mentioned above, two independent dynamotors

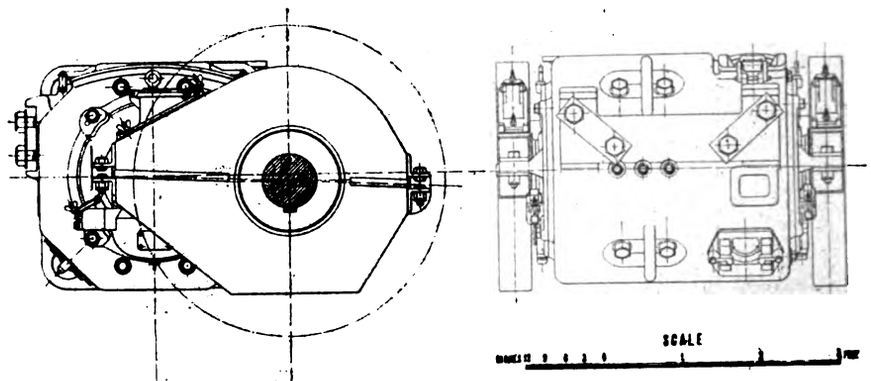

Fig. 14.—Main Locomotive Motor and Gear.

are fitted in the cab of each locomotive. The armatures of these machines are double wound and fitted with two commutators connected in series across the full line voltage. The control circuit is tapped off between the centre point and earth, so that current is obtained for these circuits at approximately half-line voltage. The actual voltage when supplying the control circuits and about 1 kw. for lighting is about 710 volts. The speed is 1,500 r.p.m.

The shaft of each dynamotor is extended and fitted with a fan for supplying ventilating air to the pair of main motors on one bogie. The rated continuous output with a 50 deg. C. temperature rise is 4.5 kw.

Each dynamotor is controlled by an ironclad circuit-breaker and a No-ark fuse. A starting resistance is in circuit with each machine, the resistance being automatically short-circuited by a relay a few seconds after the circuit-breaker is closed.

A motor-driven air compressor is fitted in the cab of each locomotive for supplying air for the Westinghouse brake equipment, air sanding, raising the bow collectors, and for air whistles. The machine is capable of dealing with 50 cu. ft. of free air per minute, and of raising this to 100 lb. per sq. in. pressure.

The machine is run at full line voltage and is

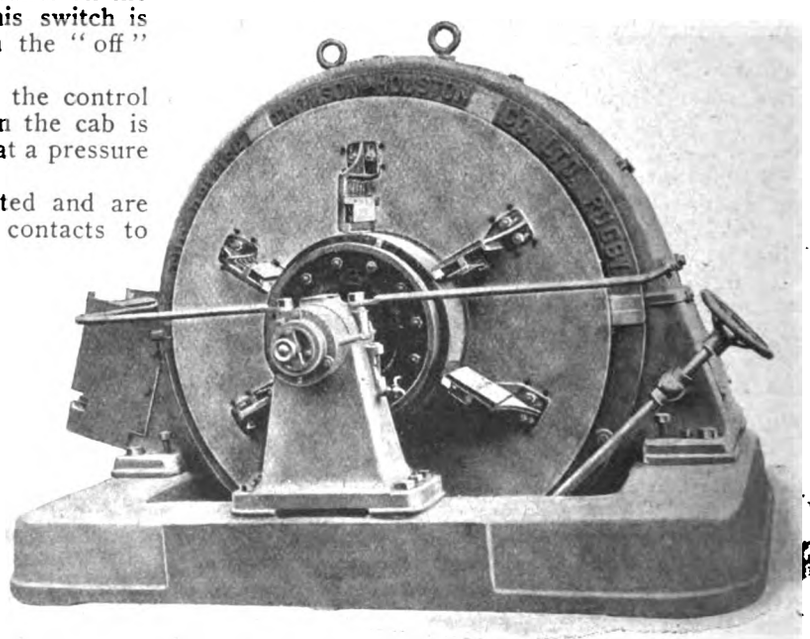

Fig. 16.—View of Shield on Sub-Station Rotary Converter.

coupled direct in the circuit of the collector bows on the line side of the main circuit-breaker, so that immediately on the bows being raised by the hand-

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pump the compressor starts pumping the air in the reservoir up to full working pressure. It is controlled by a circuit-breaker similar to those controlling the dynamotor circuits, a starting resistance being provided and short-circuited by an automatic relay in the same manner, but in this case the relay is fitted with a time-limit arrangement to extend the starting time.

An automatic governor is provided for the compressor, and is so arranged that the motor circuit is opened when the air pressure rises to 100 lb. per sq. in., and closes again when the pressure falls to 80 lb. per sq. in.

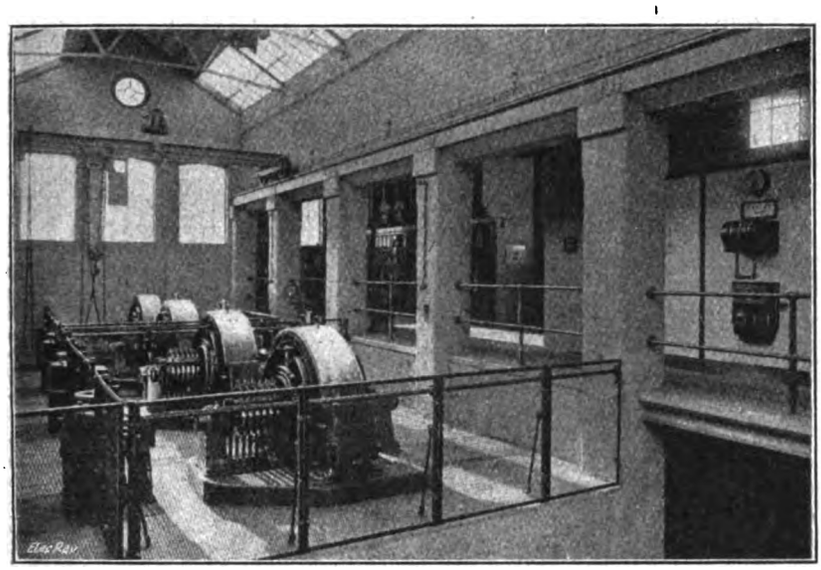

FIG. 17.—INTERIOR OF AYCLIFFE SUB-STATION.

Two bow collectors, fig. 13, are provided on each locomotive. Each consists of a hinged pantograph built up of steel tubing supported off the cab structure by strong corrugated insulators. Each collector has two bows, each fitted with an aluminium rubbing strip; there are thus four rubbing strips per locomotive, which with the double contact wire makes eight points of contact. The bows are attached by leaf springs to provide for small irregularities in level independently of the movement of the pantograph.

A hand-pump is provided by means of which the bows are raised if no pressure is available in the reservoir.

The pantographs are held in position by air cylinders, so that in the event of a failure of the air pressure the bows are automatically lowered.

Tests have been carried out recently with one of the electric locomotives. Several journeys were made between Shildon and Newport, a train of 1,400 tons of laden wagons being taken down from Shildon to Newport, and a train of 800 tons, consisting of 92 empty wagons, hauled from Newport up to Shildon with stops on certain of the heaviest grades. The 800-ton train was stopped and started on a gradient of 1 in 103. The maximum drawbar pull during the tests reached 16 tons, the average speed on the run up from Newport to Shildon being 18.3 miles per hour, the maximum speed being 26 miles per hour. Up a grade of 1 in 230, which is 4½ miles long, the 800-ton load of empty wagons was hauled at an average speed of 23 miles per hour. The locomotive also proved capable of hauling the 1,400-ton train on the level at 26 miles per hour. The general operation of the locomotive proved satisfactory in all respects throughout the test, and a regular night service is now established, the day service being postponed for a few weeks to enable the overhead work to be finished off.

Two rotary converter sub-stations are provided; that at Aycliffe contains two 800-KW. rotary sets, each set consisting of two 400-KW. rotary converters in series (figs. 16-19).

The series arrangement enabled the machines to be designed with a reasonable commutator speed and a conservative voltage between commutator parts.

The machines, which are of the six-phase commutating pole type, operating on 40-cycle three-phase current, were designed to operate normally at 95 per cent. leading power factor, and to withstand overloads of 50 per cent. for two hours and 200 per cent. momentarily. As a precaution against flashover occasioned by short circuits on the system, the operating parts of the brushgear were entirely enclosed, and the commutator was screened from the armature and machine frame.

It will be noticed that, this being a high-tension sub-station, the machines are enclosed by expanded metal screens. The rotary converters were built by the British Thomson-Houston Co., Ltd., who were the main contractors for the sub-station plant, including the transformers and switchgear; part of the work was sub-contracted, the transformers being of the British Westinghouse Co.'s make. The rotaries are of the self-synchronising type, and are started by oil-immersed drum-type starting switches.

The Erimus sub-station is generally similar, and two rotary sets are also fitted, but in this case one is of 1,200-KW. capacity. Two auxiliary transformers are installed in each sub-station, connected directly across the high-tension terminals of the main transformers.

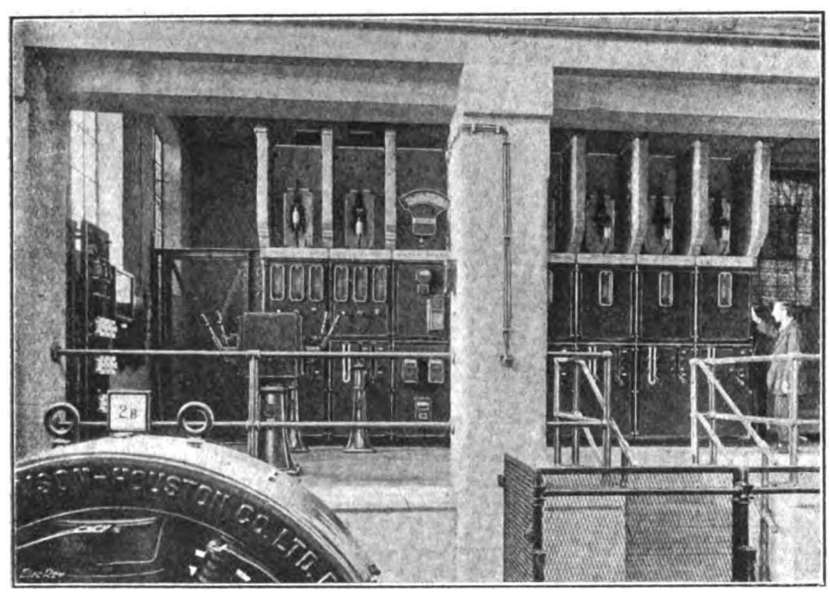

FIG. 18.—1,500-VOLT DIRECT-CURRENT SWITCHGEAR, AYCLIFFE.

A feature of interest is that they are fitted with a double secondary winding, one section being used exclusively for metering, and the other for supplying lighting and auxiliary power in the station for portable air compressors, &c. The sub-stations are supplied from the interconnected mains systems of

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the North-East Coast Power Companies, through the Cleveland and Durham Electric Power Co.

The Aycliffe sub-station is supplied at a pressure of 20,000 volts between phases through two overhead three-phase 40-cycle lines; the 20,000-volt switchgear is of the Reyrolle ironclad wall-operated type.

The Erimus sub-station is supplied at a pressure of 11,000 volts between phases through underground three-phase 40-cycle cables, the alternating-current switchgear being of the same type as that at Aycliffe. The direct-current switchgear at both sub-stations is of the brick-cell type, being designed somewhat on the lines usually adopted for high-pressure A.C. boards, and of the remote-controlled cubicle type. Special compartments are provided for the bus-bars and isolating switches; circuit breakers; and operating mechanism for those switches, &c.

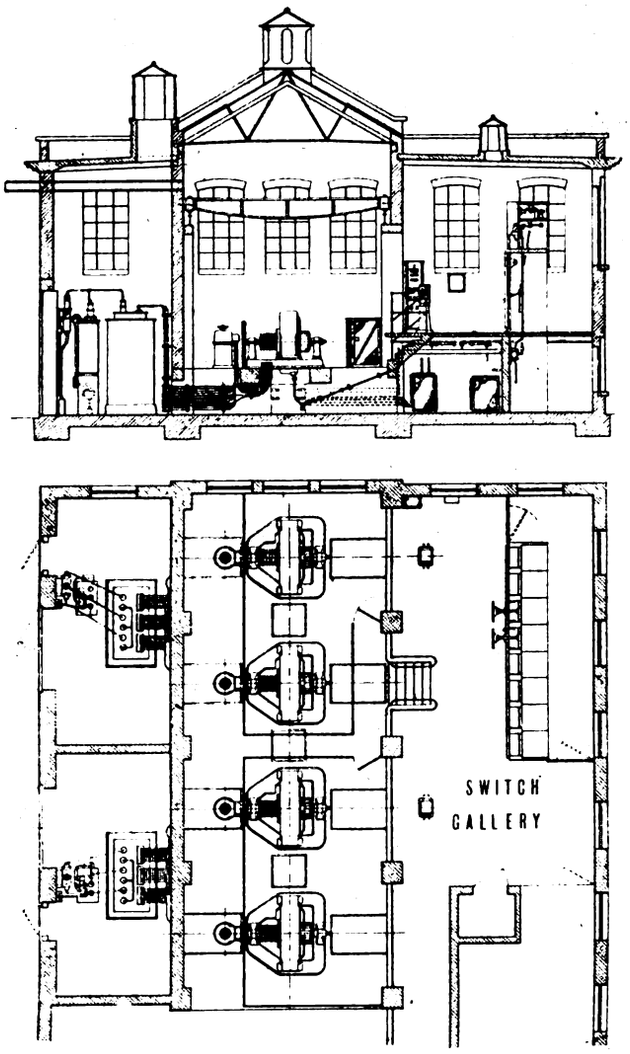

FIG. 19.—PLAN AND ELEVATION OF THE AYCLIFFE SUB-STATION.

The bus-bar isolating switches are of the H.T. rotary type; the machine circuit breakers are fitted with a differential relay which, in the event of the rotary coming up of the wrong polarity, renders it impossible to close the circuit-breaker on the bus-bars.

In connection with the 800-KW. rotary sets, field splitting switches are provided of the remote-controlled type, operated from the switch gallery. The sub-station lighting is on a 110-volt circuit, the lighting boards being of standard type.

Each sub-station is connected to the overhead contact wires by four paper-insulated bitumen-sheathed single-wire armoured cables (.5 sq. in. section) laid in wood troughing run in with bitumen.

There are two negative cables of similar type and size at each sub-station connecting the track rails to the negative bus-bar. The overhead transmission lines and cables supplying the sub-stations were supplied by the British Insulated & Helsby Cables, Ltd.

A hand-operated travelling crane, by Herbert Morris, Ltd., is fitted in each sub-station.

In conclusion, we are indebted to the countesy of Messrs. Merz & McLellan, the consulting electrical engineers for the work, for the foregoing particulars and illustrations. The line is the first in this country specifically designed for heavy freight haulage by electrical means, and the North-Eastern Railway Co. is to be congratulated on its enterprise in regard to what is undoubtedly a coming development in connection with railway working in this country.

THE NATURE OF ELECTRICAL INSULATION.

At the annual meeting of the NEWCASTLE-ON-TYNE LOCAL SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS, on April 10th, Dr. W. M. THORNTON gave an address on "The Nature of Electrical Insulation." He said that electrical engineers were chiefly interested with the direct results of tests on specific insulating materials. When collections of these were made and compared, there were found to be certain general relations which showed clearly the nature of the electric polarisation and of the effects which accompanied its change.

The case of transmission of electric waves through an insulating medium with which they were most familiar was the passage of light through window glass. According to Maxwell's electromagnetic theory of light, the specific inductive capacity, or dielectric coefficient, K, of an insulating medium should be equal to the square of its refractive index n. This held for many substances, such as the following:—

Substance.	K	n^2
Air	1.000590	1.000588
Petroleum spirit	1.92	1.92
Petroleum oil	2.07	2.07
Carbon disulphide	2.67	2.69
Paraffin wax	2.32	2.28

But for many it did not, of which the following were examples:—

Substance.	K	n^2
Dense flint glass	10.1	2.92
Quartz	4.60	2.39
Alcohol	25.0	1.85
Distilled water	76.0	1.78

That discrepancy had been completely explained on the electron theory of matter. The electrons which were contained in a dielectric molecule could not be torn from it, but could be displaced within it. These loaded the ether and retarded the passage of an electric wave, such as light, through the medium. It could be shown that the differences between K and n^2 were "due to the presence in the medium of electrons having free periods of oscillation coinciding with the frequency of light in the ultra-red part of the spectrum." They were justified in saying that the behaviour of a good electrical insulator, such as quartz, was that of a perfect insulating medium loaded with electrons anchored elastically in each molecule of the substance, whose movement to and fro, as the electric field reversed, gave rise to the value of the dielectric constant observed in low-frequency fields.

In addition to the displacement just considered, there was at frequencies lower than those of light, a secondary effect of great practical importance. The range of movement of the electrons under the influence of light waves was exceedingly small, but when, as in practical working, the frequency was low, the amplitude of movement was relatively so great within the molecule that the electrons in any one molecule were strongly influenced by electrons in neighbouring molecules. Even at the frequency of light there was interattraction, the force of which was nearly one-third of that caused by the applied field. The displacement in low-frequency fields was no longer a simple elastic effect. It had two clear stages, the instantaneous polarisation just considered, which occurred at the velocity of light, and a secondary interattraction, started by the first polarisation, elastic in the sense that when the field was released the electrons returned to their original position. That was familiar in the residual charge of a condenser left standing after being charged and discharged. The first spark at discharge was the release of the first stage, the residual spark arose from the interattraction between opposite electrons dying down. The dependence of the residual charge on the original polarisation was made clearer by the fact discovered by Hopkinson, that the total residual charge was proportional to the original charging voltage. It might be remarked that since a cable was at a constant voltage, the quantity obtained from the insulation by discharging it on short circuit was twice the quantity which it received at charge. One result of this interattraction was loss of energy by hysteresis. In engineering, the movement of the electrons was forced, for even where there was resonance in a cable system the free period was much below that of the electrons.

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Referring to polarisation in steady fields, the speaker said that when a steady field was applied to a dielectric, interattraction had full scope. In moderate fields it proceeded to a *limit* independent of the intensity of the field, and might take days to complete. The polarisation was then in most materials many times greater than for rapid reversals, so that the dielectric coefficient corresponding to the slowest possible polarisation was much higher than even for one minute's electrification. On switching-off and insulating a cable which had been under continuous voltage for a few days, the interattraction slowly relaxed, and the total quantity released, which corresponded to the above high dielectric coefficient, might be sufficient to raise the insulated conductor to a dangerous potential. Rubber cables might have from four to five times their original charging voltage. Quartz and glass reached over 100 times their starting values. The danger in the case of a cable left standing was that the charge which had soaked out was not bound, but free, so that the shock from it would be much greater than from a charge—discharge spark. It was common knowledge that the best way to release the residual charge was to short-circuit the conductors for several days after use.

The interattraction between the polarised atoms or molecules in a dielectric had great influence on its electric strength. It could be shown, in fact, to take complete charge of the material after a certain voltage had been reached, and to determine the electric strength. The action was found in solids, liquids, and gases. When there was absorption caused by interattraction, the polarisation increased to a value independent of the strength of the applied field, and depending only on the structure of the atoms or molecules. Referring to experiments on the influence of time of application on breakdown voltage, the speaker said that the fact that it had a finite value when v (voltage) and t (thickness) were exceedingly small, showed that the thinnest possible substance required a definite time to break down. This, when worked out, showed that there was a thickness which could not be broken down, for it would take an infinite time to establish the state of failure. The speaker referred in some detail to the breakdown voltage of liquids and solids, and added that it could be stated as a general law for solids, liquids, or gases, that their failure under electric stress had two stages. In the first stage the work done on the material up to the point of failure was independent of the thickness of the specimen or length of spark gap. In the second stage, interattraction was in one sense more important than the applied field. Beyond the point of transition, the work of breakdown was not independent of thickness, but was a linear function of the voltage. Summarising the work on polarisation and on breakdown strength, Dr. Thornton said that most of the phenomena of dielectrics were brought into line by considering the interattraction of electrons in adjoining molecules to play the chief part in polarisation.

TRADE STATISTICS OF SWITZERLAND.

IMPORTS.

THE following figures of the imports of electrical and similar goods into Switzerland in the year 1914 are taken from the recently-issued trade statistics; the figures for 1913 are added for purposes of comparison, and notes of increases or decreases are given. The poor participation of Great Britain is apparent:—

Electric cable not insulated.—	1913. Francs.	1914. Francs.	Inc. or dec. Francs.
From Germany	42,000	19,000 –	23,000
,, France	17,000	1,000 –	16,000
,, Other countries ...	1,000	200 –	800
Total	60,000	20,200 –	39,800
Electric cable insulated with rubber or paper.—			
From Germany	139,000	90,000 –	49,000
,, Great Britain ...	3,000	— –	3,000
,, Other countries ...	16,000*	23,000† +	7,000
Total	158,000	113,000 –	45,000

*Includes Belgium 5,000 fcs.

†Includes France 20,000 fcs.

Cable ditto covered with lead.—			
From Germany	4,000	3,000 –	1,000
Cable insulated with rubber or paper and covered with textiles.—			
From Germany	194,000	171,000 –	23,000
,, Other countries ...	15,000*	30,000† +	15,000
Total	209,000	201,000 –	8,000

*Includes Italy 9,000 fcs.

†Includes Great Britain 16,000 fcs.; Italy 6,000 fcs.

	1913. Francs.	1914. Francs.	Inc. or dec. Francs.
Cable ditto covered with lead.—			
From Germany	14,000	12,000 –	2,000
,, Austria	188,000	187,000 –	1,000
,, Other countries ...	15,000	1,000 –	14,000
Total	217,000	200,000 –	17,000
Cable ditto covered with lead and iron-armoured.—			
From Germany	25,000	165,000 +	140,000
,, Great Britain ...	25,000	1,000 –	24,000
Total	50,000	166,000 +	116,000
Dynamo-electric machines and electric transformers.—			
From Germany	1,341,000	1,224,000 –	117,000
,, France	81,000	90,000 +	9,000
,, Italy	89,000	34,000 –	55,000
,, Great Britain ...	15,000	8,000 –	7,000
,, Other countries ...	17,000	19,000 +	2,000
Total	1,543,000	1,375,000 –	168,000
Accumulators, batteries, electrodes.—			
From Germany	342,000	222,000 –	120,000
,, Austria	45,000	70,000 +	25,000
,, France	33,000	31,000 –	2,000
,, Other countries ...	9,000	8,000 –	1,000
Total	429,000	331,000 –	98,000
Insulators, mounted.—			
From Germany	149,000	78,000 –	71,000
,, France	2,000	2,000	—
,, Other countries ...	1,000	2,000 +	1,000
Total	152,000	82,000 –	70,000
Electric meters.—			
From Germany	963,000	697,000 –	266,000
,, France	78,000	85,000 +	7,000
,, Italy	12,000	10,000 –	2,000
,, Great Britain ...	7,000	3,000 –	4,000
,, United States ...	6,000	— –	6,000
,, Other countries ...	5,000	7,000 +	2,000
Total	1,071,000	802,000 –	269,000
Telegraph and telephone apparatus.—			
From Germany	515,000	474,000 –	41,000
,, Belgium	224,000	277,000 +	53,000
,, Great Britain ...	24,000	318,000 +	294,000
,, Sweden	55,000	90,000 +	35,000
,, Other countries ...	54,000	53,000 –	1,000
Total	872,000	1,212,000 +	340,000

NOTE.—25 francs = £1.

EXPORTS.

THE following figures show the exports of electrical and similar machinery from Switzerland in 1913 compared with 1914. The diversity of Switzerland's growing export trade is noteworthy:—

Dynamo-electric machines and electric transformers of all kinds.—	1913. Francs.	1914. Francs.	Inc. or dec. Francs.
To Germany	3,471,000	2,257,000 –	1,214,000
,, Austria	1,125,000	525,000 –	600,000
,, France	4,174,000	3,002,000 –	1,172,000
,, Italy	934,000	1,158,000 +	224,000
,, Belgium	882,000	401,000 –	481,000
,, Great Britain ...	1,234,600	2,014,000 +	780,000
,, Russia	3,278,000	2,019,000 –	1,259,000
,, Spain	2,080,000	738,000 –	1,342,000
,, British India	182,000	30,000 –	152,000
,, Mexico	79,000	65,000 –	14,000
,, Brazil	1,255,000	308,000 –	947,000
,, Argentina	231,000	950,000 +	719,000
,, Other countries ...	1,428,000	2,111,000 +	683,000
Total	20,353,000	15,578,000 –	4,775,000
Steam engines, cranes, pumps, turbines, &c.—			
To Germany	2,206,000	941,000 –	1,265,000
,, France	888,000	673,000 –	215,000
,, Belgium	1,152,000	575,000 –	577,000
,, Russia	3,244,000	1,104,000 –	2,140,000
,, British India	84,000	49,000 –	35,000
,, Japan	590,000	97,000 –	493,000
,, Great Britain ...	651,000	577,000 –	74,000
,, Other countries ...	1,679,000	1,884,000 +	205,000
Total	10,494,000	5,900,000 –	4,594,000

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Electric meters.—	1913. Francs.	1914. Francs.	Inc. or dec. Francs.
To Germany	629,000	437,000 –	192,000
,, Austria-Hungary ...	184,000	197,000 +	13,000
,, France	635,000	371,000 –	264,000
,, Italy	355,000	276,000 –	79,000
,, Great Britain	181,000	332,000 +	151,000
,, Other countries ...	323,000	424,000* +	101,000
Total	2,307,000	2,037,000 –	270,000

* Includes Russia 137,000 fcs.

*Steam, benzine, and electric locomotives.**—			
To France	405,000	1,013,000 +	608,000
,, Algeria and Tunis ...	350,000	436,000 +	86,000
,, Dutch E. Indies ...	41,000	247,000 +	206,000
,, Other countries ...	637,000†	273,000 –	364,000
Total	1,433,000	1,969,000 +	536,000

*Electric locos in 1914, 146,000 fcs.; in 1913, none specified.

†Includes Turkey in Asia 158,000 fcs.

Electric cable, not insulated.—			
To Germany	3,000	6,000 +	3,000
,, France	5,000	5,000	—
,, Other countries ...	1,000	4,000 +	3,000
Total	9,000	15,000 +	6,000

Electric cable, insulated with rubber or paper.—			
To Germany	25,000	28,000 +	3,000
,, France	80,000	89,000 +	9,000
,, Italy	38,000	7,000 –	31,000
,, Other countries ...	47,000	153,000* +	106,000
Total	190,000	277,000 +	87,000

* Norway 12,000 fcs.; Turkey 11,000 fcs.

Cable, ditto, covered with lead.—			
To Germany	8,000	8,000	—
,, Great Britain	43,000	57,000 +	14,000
,, Spain	7,000	— –	7,000
,, Other countries ...	4,000	3,000 –	1,000
Total	62,000	68,000 +	6,000

Cable, ditto, covered with lead and iron armoured.—			
To Germany	303,000	44,000 –	259,000
,, Great Britain	398,000	156,000 –	237,000
,, France	14,000	3,000 –	11,000
,, Egypt, ...	12,000	2,000 –	10,000
,, Other countries ...	11,000	105,000* +	94,000
Total	733,000	310,000 –	423,000

* Roumania 5,000 fcs.

Cable, insulated with rubber or paper, and covered with textiles.—			
To France	24,000	9,000 –	15,000
,, Italy	123,000	56,000 –	67,000
,, Great Britain	224,000	124,000 –	100,000
,, Other countries ...	14,000	106,000 +	92,000
Total	385,000	295,000 –	90,000

Cable, ditto, covered with lead.—			
To Germany	9,000	3,000 –	6,000
,, Great Britain	8,000	— –	8,000
,, Other countries ...	6,000	6,000* –	—
Total	23,000	9,000 –	14,000

* Roumania 5,000 fcs.

NOTE.—25 francs = £1.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

6,893. "Electrical fuseboards." A. CRAWFORD, W. SANDERS & Co., AND W. PRESTON. May 15th.

6,897. "Electric alarm." E. H. CLARK & J. E. GIBBINS. May 15th.

6,945. "Telegraph systems." C. J. BAUMGARTNER & J. F. PARRIS. May 15th.

6,962. "Intercommunication telephones." J. W. DUNGEY & C. B. KERSTING. May 16th.

6,977. "Electrical connecting devices." SIEMENS SCHUCKERTWERKE. May 16th (Germany, May 22nd, 1915.)

6,982. "Terminal seal for batteries, &c." E. W. JEFFERSON. May 16th. (U.S.A., May 21st, 1915.)

6,998. "Systems of wireless telephony and telegraphy." W. A. SOLOMON. May 16th.

7,009. "Combined electric lampholder and lamp lock." A. H. SHORT. May 17th.

7,014. "Electric furnaces." M. M. KOHN. May 17th.

7,026. "Means for locking electric lamps in holders." J. R. CLAY. May 17th.

7,061. "Electrical signalling and telephone systems." W. C. DAVEY AND J. W. DUNGEY. May 17th.

7,062. "Magneto-electric machines, &c." H. ROBINSON. May 17th.

7,064. "Electrically-controlled clutches." W. LANGDON-DAVIES & NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON MAATSCHAPPIJ AND A. SOAMES. May 17th.

7,074. "Air-inlet attachment for sparking plugs for internal-combustion engines." J. KNIGHT. May 18th.

7,088. "System of radio-telegraphy for multiple simultaneous transmission." F. ROSSO. May 18th (Italy, May 18th, 1915.)

7,091. "Electro-magnetic sound receivers and producers." S. G. BROWN. May 18th.

7,100. "Automatic telephone systems." AUTOMATIC TELEPHONE MANUFACTURING Co. May 18th. (U.S.A., July 19th, 1915.)

7,121. "Dynamo-electric generators and systems connected therewith." A. H. DARKER & J. STONE & Co. May 18th.

7,156. "Electrical signalling or telegraphing systems." T. MCLEOD. May 19th.

7,178. "Electrical rotary switches." SIR W. G. ARMSTRONG, WHITWORTH AND Co., J. H. THAIN & W. H. WADDINGTON. May 19th.

7,186. "Insulation of electrical machinery, &c." C. J. BAKER & C. H. KLINE. May 19th.

7,187. "Electric heating devices." E. J. BRUNNING & F. C. E. BURKETT. May 19th.

7,214. "Electric motors with reduction gearing." C. A. ATHERTON. May 20th.

7,230. "Systems for telegraphic and telephonic communication." J. H. CLAUS. May 20th.

7,235. "Apparatus for laying subterranean electric wires or cables." J. LOWSON. May 20th.

7,236. "Electrical condensers." M. A. CODD. May 20th.

PUBLISHED SPECIFICATIONS.

1915.

3,530. ELECTRIC SIGNALLING. International Electric Co., H. E. R. Rose and R. G. le Noir. March 4th.

6,362. AUTOMATIC SIGNALLING ARRANGEMENT FOR TRAMWAY LINES OR ELECTRIC RAILWAYS. D. Samaia. April 28th. (Patent of Addition not granted.)

6,469. CONTROLLING MECHANISM FOR AUTOMOBILES. British Thomson-Houston Co. (General Electric Co., U.S.A.). April 30th.

6,495. ROTARY FIELD MAGNETS. Svenska Turbinfabriks Aktiebolaget Ljungström. April 30th. (June 22nd, 1914.)

8,466. ELECTRICAL INSTALLATIONS, PARTICULARLY APPLICABLE FOR USE IN MOTOR VEHICLES. Soc. Anon. des Etablissements L. Bleriot. June 8th. (July 25th, 1914.)

12,671. IMPULSE TRANSMITTERS FOR AUTOMATIC TELEPHONE SYSTEMS. G. A. Betulander. September 3rd. (January 26th, 1915.)

12,995. ELECTRIC ARC LAMPS. J. A. Orange. September 10th. (September 12th, 1914.)

13,555. INCANDESCENT ELECTRIC LAMPS. W. J. Hermges. September 23rd.

14,881. SPARKING PLUGS. R. Colin. October 21st.

16,614. MAGNETO ELECTRIC GENERATORS. Etablissements de Dion Bouton (Soc Anon.). November 24th. (June 17th, 1915.)

17,333. JOINT BOXES FOR ELECTRIC CABLES. W. Cairns & J. Steel. December 10th.

Breakdown of Governors in Hydro-Electric Station.

The importance of testing at frequent intervals the correct working of governor gear on alternators operating in parallel is emphasised by the report (in *E.T.Z.*) of wholesale destruction in a generating station due to neglect of this simple precaution. The plant concerned was comparatively small, and consisted of three 310 K.V.A., 6 700-volt, 60-cycle alternators, driven by Girard turbines through elastic couplings. At the time of the mishap the machines carried three-quarter load, and the speed of water-flow in the 400-yard pipe line was only about 3 ft. per second, so that the plant was in no sense overloaded. The supply system included a 1 000-K.V.A. transformer, a 16-mile 20,000-volt transmission line, and 13 sub-stations, supplied from a distributing centre at 2 600 volts. A very heavy short-circuit on one of the sub-station lines brought out the instantaneous circuit-breaker in the main distributing station, and the governors on the generating sets began to operate at once. Now the governors were operated by oil at 110 lb. per sq. in., supplied by an oil pump common to all three machines, and though the governors acted satisfactorily till the generators were nearly unloaded, they then failed—partly owing to the oil pressure not being sustained, but chiefly owing to the leather cups on the control pistons being hardened and seizing. As a consequence, the generator at the end of the oil pump line fell out of step with the others, double-frequency currents and pressure-surges were developed, and very extensive damage was done to generators and connected circuits before the time-relay breakers operated. It is unnecessary to detail the damage done, which consisted of numerous breakdowns and burn-outs. The important point is that the leathers of oil-governor gear should be inspected and cleaned several times a year; the bronze or cast-iron pistons themselves should be kept free from a hard crust which is apt to form on them; only oil of the same kind and quality should be added to that already in the governing system; and the correct working of the governors over the whole of their travel should be tested frequently, whilst the generators are in service.

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THE

ELECTRICAL REVIEW.

VOL. LXXVIII. JUNE 9, 1916. No. 2,011.

ELECTRICAL REVIEW.

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THE ELECTRICAL REVIEW.

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READY.

H. ALABASTER, GATEHOUSE & CO.,

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LINKING-UP.

THE announcement made in our last issue, too late for editorial comment, that the engineers of Lancashire and Cheshire were actively developing a scheme for the purpose of interconnecting the principal supply stations of those counties, formed a most appropriate and well-timed supplement to the circular issued by the Board of Trade in the previous week. It showed that those engineers were fully alive to the possibilities and importance of the proposal, which indeed was not entirely new, but was brought within the scope of practical politics by the war, and they had anticipated the action of the Board of Trade by several weeks; already they had divided up the area into districts and appointed sub-Committees to investigate the conditions obtaining in each district, and no doubt we shall shortly be in a position to report further progress. The immediate credit for the local movement is due to Mr. J. A. Robertson, of Salford, who, in opening the discussion on Mr. E. T. Williams's paper, outlined the policy which is now being pursued; but the greater includes the less, and it must be acknowledged that the idea of interconnecting existing stations formed one of the fundamental and essential features of the more elaborate scheme described by Mr. Williams, to whom, therefore, the thanks of the industry are especially due. It is obvious that if each of the districts in which the conditions favour interconnection independently proceeds to carry out the policy, we shall eventually have a small number of organised areas in which the principle of mutual assistance and support is recognised and adopted, and then there should be far less difficulty in advancing further towards the national organisation so powerfully advocated by Mr. Williams—in fact, it amounts to commencing at the bottom and working upwards, instead of the reverse; and that is the best way to erect a substantial and enduring edifice.

A suggestion has been put forward by Mr. Williams that the Council of the Institution of Electrical Engineers, in view of the trend of opinion disclosed by the discussions, should take energetic action towards the development of the scheme, and we cordially endorse this view. Whether the matter be held by some to be of a "political" nature, or by others to involve "grave difficulties," we care not a jot; we are at war. This is no time for mincing words or splitting hairs; there is general agreement amongst the members of the Institution that the co-ordination of our electricity supply undertakings ought to be carried out; the Board of Trade is anxious to see it done; the engineers themselves—at any rate, in one area—are pushing on with it; and the Council, which is armed under the Memorandum of Association with the widest possible powers to take any lawful action in respect of legislative or industrial matters which may conduce to the advancement of the applications of electrical science, in 1914 pledged itself to take such action. Here is an excellent opportunity for the Institution to take the lead, which, at the outbreak of the war, was passing to other hands. There may never be such another opportunity for it to regain the prestige which it has lost, and to demonstrate its ability and determination to act with promptitude and energy.

We do not suggest that the Lancashire and Cheshire movement is in need of assistance; we are thinking rather of the districts in which no action has yet been taken, but which offer similar possibilities, and only await the initiative. The Council might well communicate with the Board of Trade, and undertake to organise conferences in those areas, with a view to carrying out the Board's proposal.

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Support Home Industries.

Most of us are agreed that in the future we should give British engineering manufactures a very decided preference when the expenditure of British public money is involved. Whatever the national policy may be, the municipalities will have to be prepared to reckon with the anti-enemy feeling of the community for a time. But what about that vast number of semi-public undertakings owned by companies and by private parties whose transactions need never be divulged to the public gaze? Can these—railways, collieries, mills, factories, &c.—be relied upon to patriotically support home industries if the Teuton, with his wily way, extends the tempting bait? If we were to judge from what occurred in pre-war days we might despair of reformation in connection with the policy of some of these concerns. Consider the case of British collieries—what a tale could be unfolded regarding the installation of German plant! What chances the British electrical manufacturer has been deprived of by the readiness of owner and adviser to buy elsewhere! But *autres temps, autres moeurs*, and we will indulge the hope that directors and shareholders, owners and advisers, will see that, as we have pointed out in another case, German cheapness may be purchased at too high a price. Pending the declaration of anything definite in regard to a national policy in this connection, we must have faith in the loyalty and determination, and the educational influence, that individual engineers and organisations can exercise. But among the signs of the times which are very welcome is the example of the Oxcroft Colliery Co., Ltd., which is giving out its contracts upon the distinct understanding that the company, firm, or individual to whom they are sent is not in any way under the influence or control directly or indirectly of any German, whether naturalised or otherwise, and that none of the payments or profits arising from the execution of the contracts will pass into the hands of Germans as shareholders, partners, or otherwise. In all probability as time passes we shall hear of all kinds of efforts which private concerns are prepared to make in order to secure the benefit of their contracts to British firms and British investors. The Oxcroft decision will be difficult to apply, for it will not permit even a small proportion of the capital to be held by any naturalised or unnaturalised German, nor may the business be even indirectly influenced or controlled by anybody of German taint. The Oxcroft spirit is willing and most commendable, but perhaps it will be found that the flesh is weak. Such a sweeping decision must, however, make the blood of the purely British electrical and engineering firms flow fast in their veins!

Lead.

The chief feature in the market for pig lead in recent weeks has been the fact that the authorities came to the rescue of consumers by placing at their disposal in the open market large quantities of metal that was held under their control out of the supplies that came from Australia and Spain. Consumers who had run rather short of stock thus availed themselves pretty freely of this opportunity of replenishing in a constantly falling market, under well sustained offerings from that quarter. Some thousands of tons were thus taken care of for prompt delivery. Prices fell to about £31 7s. 6d. a ton, but there has been since some recovery with a very irregular tendency, while offers of Government lead have come to a standstill.

The action of the Government came rather as a surprise to consumers and dealers, who undoubtedly under-rated the importance of this factor. Apparently the authorities were not immediately in need of the metal disposed of, but the fact remains that considerable quantities continue to be absorbed for war munitions, so that it is rather doubtful whether experience will repeat itself in that respect. However, it is generally assumed that developments are for the time being in no small degree subject to the policy pursued by the authorities, who, moreover, seem resolute in keeping down prices. Indications are now towards a further recovery, although no important developments are looked for, this view being based on the assumption that consumers have been recently pretty well filled up, while export trading has remained almost a negligible quantity as licences are difficult to obtain. The withholding of permits for months past is largely accounted for by the fact that allied countries have been enabled in the last few months to fill their requirements direct from producing centres, such as Spain and Australia. The importance of the London market, therefore, as an international centre is nothing like what it used to be.

The receipts from Spain have this year fallen off, and they are likely to continue comparatively light. During the first quarter of this year, France imported no less than 21,500 tons, or about 14,000 tons more than in the previous year, the great bulk of which came from Spain. It is difficult to form any idea of the true merits of the position, while there are no reliable particulars having regard to the progress of production, yet it is probable that in view of the abnormally high prices, operations in most mining districts, except Spain and Mexico, have been well maintained. The price is now in the neighbourhood of £32 for near delivery, with forward metal at a discount of about 12s. 6d. a ton. Whereas the two extreme points recorded in the past year were £18 6s. 3d. and £30 5s., the price this year rose as high as £36 10s., in spite of the new regulation. There is certainly plenty of lead to go round without resort to importations from America, where prices still stand at a very high level.

The Wire-Drawing Industries.

As the war continues the position in the wire-drawing industries, particularly in the copper section, in common with most other controlled trades, appears to be experiencing increasing difficulties as regards supplies of raw materials. While wire manufacturers do not by any means expect their trade to be immune from the difficulties under which other industries are labouring at the present time, there appears to be some just cause for complaint at the somewhat loose manner in which the Government is handling the freight problem in regard to the supplies of raw metals, particularly copper.

Whereas, on the one hand, the demands from the Government upon wire manufacturers for goods are practically unlimited, and tend to increase as time goes on, the supplies of raw material, the delivery of which now depends entirely upon the authorisation and good organisation of the Government, become more lean and precarious every day. The department under the nominal control of the Ministry of Munitions, which was instituted for the purpose, among others, of ensuring manufacturers a necessary supply of copper, &c., when the freight difficulties otherwise threatened a stoppage of supplies from the normal source, has hardly come up to expectations, and, in most cases, where manufacturers have appealed to this department, they have obtained no satisfaction or sympathy.

The Government officials, apparently, do not sufficiently realise the gravity of the situation, which threatens a serious curtailment of output by wire manufacturers in the near future unless a more sympathetic attitude is manifested towards the vital needs of these trades. It is not improbable that the Minister of Munitions, personally, has not been made sufficiently to realise the gravity of the situation; in which event, an explanation from the High-Conductive Copper Association would, perhaps, prove of considerable weight towards instituting an improvement in the situation.

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ELECTRIC VEHICLE PROGRESS.

This year's annual meeting of the (American) Electric Vehicle Section of the National Electric Light Association —our old friend the Electric Vehicle Association of America under a new guise—was held in Chicago during the fourth week in May, and judging by the shoal of papers and reports, for which we are indebted to the Association and to Mr. Jackson Marshall, secretary of the Section in question, it appears to have been as prolific as usual in these matters.

As mentioned previously in our pages, the Electric Vehicle Association recently affiliated with the N.E.L.A., and its annual proceedings now constitute a Section of the annual convention of the larger Association, which incidentally has increased its membership by 948 new members through the amalgamation.

Some of the Committee reports of the Section are of considerable interest to engineers on this side; one of them dealing with federal and municipal transportation, which recalls Mr. Ayton's paper before our own Electric Vehicle Committee last year, contains a comprehensive survey of this particular class of transport service, referring particularly to fire, ambulance, street cleaning and postal uses. As regards the last-named branch of vehicle work we cannot claim much progress in this country, but in municipal circles there appears to be evidence of a growing interest in the "electric," which promises well for the future. We notice in the report a view of the G.V. electric street-watering vehicle in use at Blackpool (which, by the way, our American friends refer to as "a suburb of London"!); 60 of these vehicles are stated to be in use in American and European cities. Judging by the somewhat dangerous economies in scavenging and street watering which many of our municipal authorities are stated to be practising at the present time, owing to shortage of horses and men, an opportunity has undoubtedly arisen for introducing modern labour-saving street appliances, amongst which the battery-driven vehicle, in view of the conditions, should take a leading position.

A brief reference occurs to battery-driven road-rollers. Somewhat similar motor-operated rollers are stated to have been used with great success in the Middle West, served with energy from central station lines by means of flexible cable.

On the subject of postal vehicles, it appears that the "electric" has been specified by the Chicago authorities, while both the Boston and New York Postal Departments have fleets of 2-ton and other vehicles in service; the battery exchange system is in use in both cities, and some of the New York trucks are kept in service practically day and night, only returning to the service station for two 15-min. periods each 24 hours to change the batteries and drivers.

Another report dealing with insurance shows that an effort is being made to obtain regular preferential treatment for electric vehicles, and that special reduced rates are being accorded by various companies. The difficulty appears to be that the vehicle user does not make a point of dealing with the companies offering preferential rates.

A joint report of Committees dealing with operating records, garages, and rates presents some graphic illustrations of data already established regarding the cost of operating electric vehicles, energy consumed for charging purposes, and garage space required for various sizes of vehicles, together with a chart showing an analysis of the cost of garaging commercial electric vehicles.

The cost data summarised in Curve No. 1 (page 641) are derived from the *Electrical World* investigation of groups of installations, published in May last.

Curve No. 2 (page 641) is based on the experience of a number of electric vehicle operators, and will, it is hoped, serve as a means of definitely establishing the question of rate-making for normal energy supply.

The detailed analysis of garaging costs will, no doubt, be useful for reference in this country, although the actual figures have only a comparative value. The total costs for garaging electric vehicles per month are given as follows:—Capacity, 700 lb., \$37·8; 1,000 lb., \$42·3; 2,000 lb., \$47·9; 4,000 lb., \$60·1; 7,000 lb., \$70 9; 10,000 lb., \$81·1.

One paper, on central-station promotion of electrical vehicle use, seems to indicate that station engineers have adopted a non-committal attitude on the question up to now, and, further, points out the serious competition of the petrol passenger and freight vehicles, the latter, in particular, having to be faced as soon as the abnormal export business falls away. The author, Mr. W. P. Kennedy, however, believes that the electric vehicle would unquestionably obtain the preference if a flat price per annum were offered for garage service covering upkeep and maintenance in constant working condition.

A paper on greater garage service, by Mr. Salvat, deals, in breezy language, more especially with the grievances of the Chicago garages and the misdeeds of the electric-vehicle manufacturers, who, according to this writer, are playing into the hands of the gasoline car makers. This paper gives one a glimpse of the "human nature" side of business, and is well worth reading on that account alone.

A paper on battery service, by Mr. Wagoner, refers to the Hartford Electric Light Co.'s battery service system, some particulars of which have already appeared in our pages; it appears that the General Vehicle Co. co-operated in establishing the system—in which an essential feature is the purchase of electric power by "the mile run"—and has since established similar service in Spokane, Boston, Baltimore, Harrisburg, San Francisco, Los Angeles, Worcester, Fall River, and Wichita, while many other cities are prospective users.

A paper on the electric passenger vehicle problem, by Mr. Chalfont, is a plea for a more rational understanding of the present scope of this type of car. The author points that the electric passenger car is capable of performing fully 95 per cent. of the demands made upon the gasoline car, "but that little 5 per cent. stands up in the sky like a steeple on a church," and is responsible for the sale of a million gasoline cars a year. The writer proceeds to show that this small percentage represents problematical advantages, and to demonstrate how users can be educated as to the true state of affairs.

Other papers deal with the industrial truck and its troubles, and the relation of tires to efficiency, and all of them contain something of interest to electric-vehicle men.

Tilling-Stevens Petrol-electric Fire Escape.

Through the courtesy of Messrs. Tilling-Stevens, Ltd., of Maidstone, we are able to illustrate one of the petrol-electric fire-escape ladders which they have supplied to the London Fire Brigade.

The Tilling-Stevens petrol-electric drive has been referred to on several occasions in our pages, but we may point out that this equipment consists of a 40-H.P four-cylinder engine, direct-coupled, through a flexible coupling, to a generator which energises a series-wound motor, the latter driving the back axle through a propeller shaft and worm gearing. The generator, by means of simple switchgear, is used to supply the power requirements of the ladder for elevating and training it, when not required for propulsion.

The generator is capable of an output of up to 30 KW., at speeds varying from 350 to 1,400 R.P.M., and pressures varying from 0 to 300 volts; the machine has a falling characteristic, so that any increase in the current taken by the motor is accompanied by a corresponding reduction in voltage. Thus on the level the demand for current is small, and the voltage high and favourable to high vehicle speed, while on an up-grade, opposite conditions prevail—the motor speed decreases, but the torque increases.

The diagram on page 641 shows the whole of the electrical connections and controlling devices.

Reversibility is obtained by change in the direction of the current in the motor field through the controller-switch. The speed of the vehicle is controlled by means of the throttle-pedal in conjunction with the generator and motor field resistance.

The output of the generator can be reduced practically to zero by lowering the engine speed on the throttle and inserting resistance in the field by means of a resistance lever.

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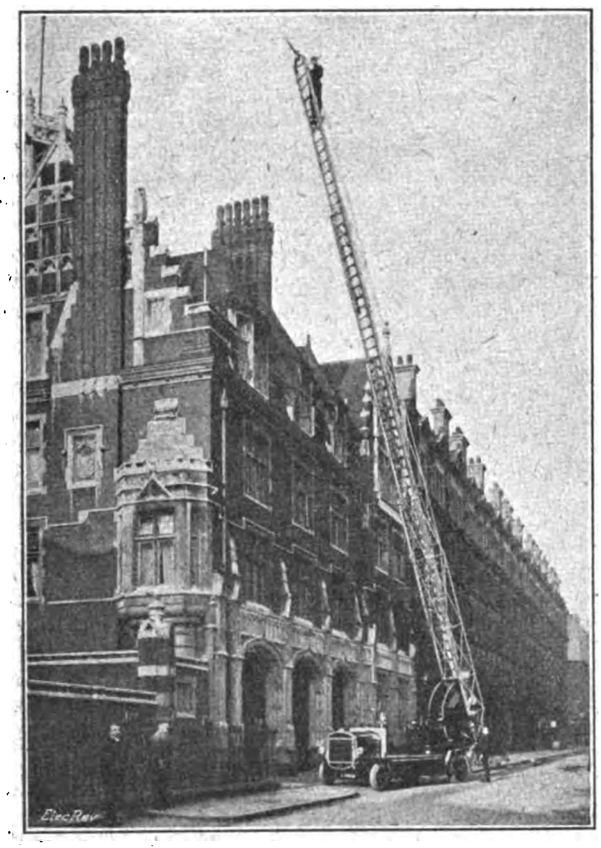


Tilling-Stevens Petrol-Electric Fire Escape; Ladder Extended.

Forward movement of the lever causes the contact drum to cut out resistance until the full field is obtained, and further movement puts in circuit a graduated resistance which shunts the motor field. A two-way shunt switch enables the field winding to be connected directly across the dynamo armature when it is required to supply current for the ladder; when current is required for propelling the vehicle, the shunt circuit is completed through the controller and motor field to the other side of the generator, and in this position when the controller is in the neutral position, the shunt circuit is broken. This prevents the motor from being started up suddenly.

When it is desired to operate the ladder, the controller is placed in the neutral position, the shunt changed over to the ladder position and the S.P. main switch closed. This energises an electrical solenoid governor which regulates pressure to the desired voltage independently of the load. The D.P. switch for the ladder motor circuit can then be closed and the ladder raised, elevated and trained by means of the motors and regulators contained in the base of the ladder turn-table.

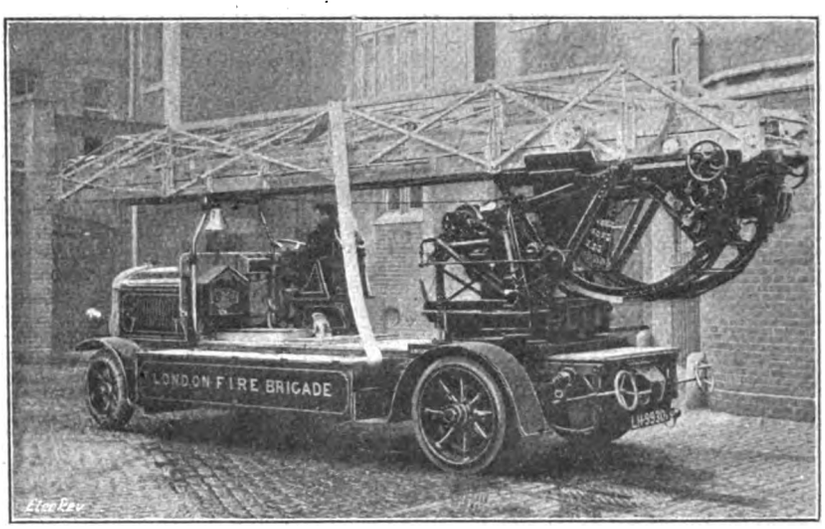
It may be of interest to record that the Tilling-Stevens petrol-electric vehicles have found extensive use with the naval and military services for running searchlight projectors, operating travelling workshops and for signalling purposes. They have also been employed privately for operating arc-welding plants, supplying temporary lighting and in connection with cinematograph apparatus. In view of the above list of uses, it is almost unnecessary to add that a self-contained travelling petrol-electric combination of the type mentioned is invaluable for many industrial applications, when its utility as a goods carrier and for haulage is also taken into account.

In conclusion, we may add that Messrs. Tilling-Stevens are also builders of an "all-electric" chassis, of the industrial type, suited for loads of 3 to 4 tons, and to run 30 or 40 miles on one charge, at a speed of 10 to 12 miles an hour.

Armstrong-Whitworth Road Train Fitted with Thomas Transmission.

It may be remembered that a few years ago a road train was designed by a French engineer, Colonel Renard, and a number of road trains were constructed in this country under his patents. A mechanical power shaft ran throughout the length of the Renard train, and provision had to be made for overcoming the unevenness of the drive, due to the varying angles at which the vehicles might be placed in relation to one another when moving on uneven surfaces, and turning corners. This necessitated the use of spring drives, universal joints, and numerous bearings, all of which made the system complicated, costly, inefficient and unreliable.

A few years ago a German firm, Messrs. W. A. Th. Müller, placed on the market a train which might be termed an "all electrical train." In the Müller train the leading vehicle carried a powerful internal combustion-engine and generator, from which current was transmitted to motors driving all the wheels of the train. Such a train, consisting of 11 vehicles in all, capable of carrying as much as 50 tons with axle weight not exceeding 5 tons, was shipped to Australia three years ago.



Petrol-Electric Fire Escape, showing Ladder Turntable.

The views we give relate to a train which is entirely the product of British brains and work. It was recently built by Messrs. Sir W. G. Armstrong, Whit-

Tilling-Stevens Petrol-Electric Fire Escape.

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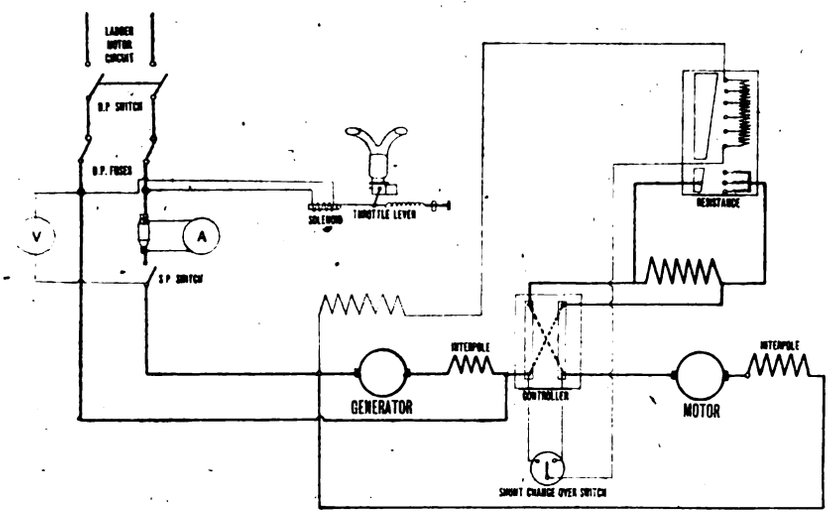
worth & Co., Ltd., who, to avoid the disadvantages of the "all mechanical" and "all electrical" systems adopted the with only a portion of the power for a relatively small portion of the whole running time, it is comparatively light and cheap.



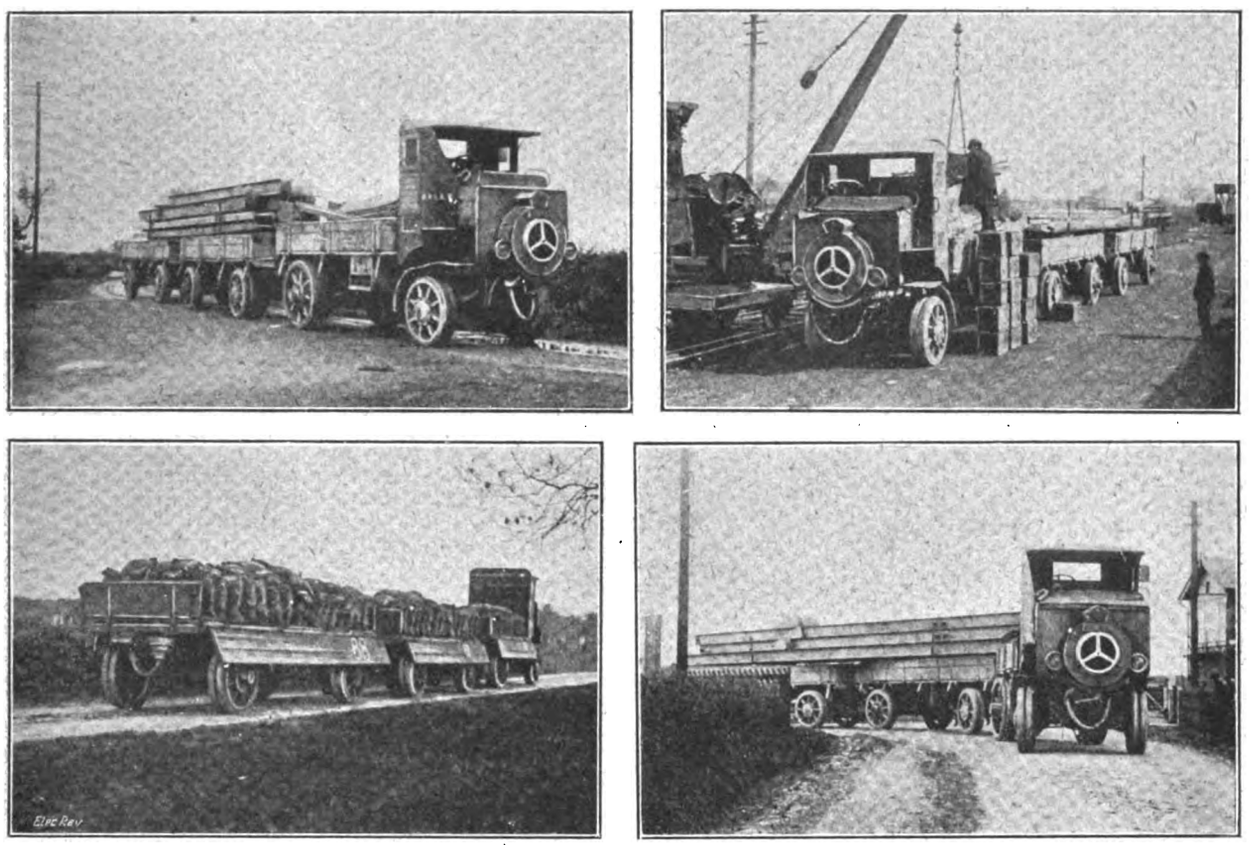
ELECTRICAL CONNECTIONS, TILLING-STEVENS FIRE ESCAPE.

We have before us particulars of a non-stop 210-mile test with a gross load of 30 tons, in which the train illustrated put up a record of 77-ton miles per gallon of petrol, and this in spite of wet roads and 10 hours' night travelling during the test.

The train is now carrying loads of 25 to 30 tons of the kind illustrated, the material carried being used in the construction of a large factory in the North.

It can be operated conveniently by two men, and in an emergency one man is sufficient. All the wheels are steered, and the facility with which the train can be backed out of awkward places or round corners is remarkable, the wheels following in the same track in either direction of travel.

All the wheels of the leading vehicle are braked by direct mechanical means in the ordinary way, whereas the brakes on the

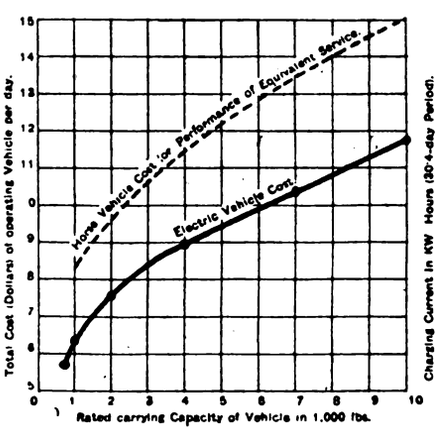


TYPICAL VIEWS OF A ROAD TRAIN FITTED WITH THOMAS ELECTRO-MECHANICAL TRANSMISSION.

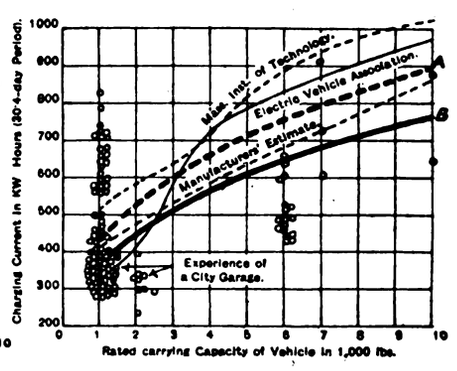
electro-mechanical system known as the "Thomas Transmission."

In previous issues of this paper we have from time to time referred to the Thomas system.; briefly it is a combination of an electrical with a mechanical system of transmission, whereby the power is transmitted partly electrically, but mainly mechanically. The portion of the power transmitted mechanically in the case of a road train is confined to the leading vehicle, while the electrical portion is easily transmitted to the trailers and controlled from the leading vehicle.

As in other applications of the Thomas system the electrical transmission is cut out on top drive; the electrical apparatus is used only when large tractive effort is required, *i.e.*, when starting from rest, when travelling on bad roads, and when climbing grades, and since it deals trailers are electrically operated by means of solenoids, the necessary exciting current being controlled by a switch


Total Cost (Dollars) of operating Vehicle per day.
Horse Vehicle Cost for Performance of Equivalent Service.
Electric Vehicle Cost.
Rated carrying Capacity of Vehicle in 1,000 lbs.

CURVE NO. 1.—OPERATING COST OF ELECTRICAL TRUCKS.


Charging Current in KW Hours (30-4-day Period).
Mass. Inst. of Technology.
Electric Vehicle Association.
Manufacturers' Estimate.
Experience of a City Garage.
Rated carrying Capacity of Vehicle in 1,000 lbs.

CURVE NO. 2.—CHARGING CURRENT FOR ELECTRIC TRUCKS.

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within reach of the driver. By means of an electric controller, 15 speeds in either direction are provided.

The train illustrated is equipped with an engine developing 75 H.P., at 1,000 R.P.M. It will run continuously at 12 M.P.H. on ordinary macadam roads, and if the surface be extra good, can be speeded up to 15 M.P.H.

On account of the large single-power unit, the efficient drive, and the relatively low tare weight, the fuel and other expenses of such a train will be very much less than that required by a number of single lorries to handle the same load.

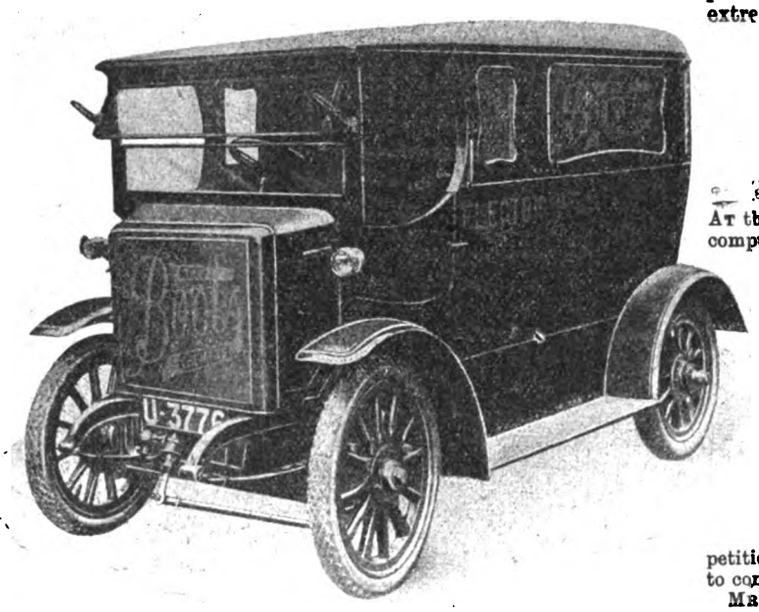
In conclusion, we are indebted to the Thomas Transmission, Ltd., for the foregoing particulars and views.

Electromobile Delivery Vans.

Messrs. Electromobile (Leeds), Ltd., have recently constructed two 15-cwt. delivery vans for Messrs. Boots, the well-known chemists, the general appearance of these vehicles being shown below. These are built with a similar chassis to that described in the Electrical Review of March 3rd, last; the battery is of the "Ironclad" type, consisting of 40 eleven-plate cells, allowing a travelling radius of 40 miles per charge.

Pedal resistance and drum control, operated by means of a lever underneath the steering wheel, are fitted.

The vehicles have a speed of 14 miles an hour, and in addition to their expeditious delivery work, provide an excellent advertisement for Messrs. Boots. We may add, as tending to show the simplicity of operation of such a



Electromobile Delivery Van.

vehicle, that the driver of one of them was able to commence his regular duties on the day after he ceased driving a horse-van.

A Battery-driven Recruiting Van.

Messrs. Drake & Gorham's Manchester branch, some time ago, supplied a standard Edison G.M. 2-ton electric vehicle to the Liverpool Corporation Electricity Department, and during the vigorous recruiting rallies in connection with the Derby scheme, Mr. Dickinson, the city electrical engineer, had a special recruiting body fitted, as shown in our view, the vehicle being in regular use for evening recruiting marches. The battery supplies a number of electric lamps fitted inside the body to illuminate the lettering, and the result was a very effective appeal.

The vehicle has now been in constant use on its ordinary duties for over a year, and has effected a very considerable economy in the cartage work of the department. It is employed largely in connection with mains extension work, and, in addition to the actual saving in the cost of carting (which, we understand, amounts on an average to between £7 and £8 per week), a further advantage is afforded by the reduction of time spent by gangs of men in reaching their work, as, apart from carrying the cable and other materials required, the car transports the mainsmen, labourers, and tools to the required locality with a minimum of delay.

Mr. Dickinson states that during the twelve months that the vehicle has been in use, it has covered 10,000 miles at

HIS MAJESTY THE KING
APPEALS FOR RECRUITS
FOR THE ARMY FOR THE PERIOD OF THE WAR
GOOD PAY AND CONDITIONS OF SERVICE
REMEMBER THE LUSITANIA AND NURSE CAVELL
GOD SAVE THE KING
RECRUITS ARE REQUESTED TO FALL IN AT REAR OF COLUMN
RECRUITS WANTED

Liverpool's Electrical Recruiting Van.

an average current consumption of 0·7 unit actual input to the battery. Repairs and replacements have been practically *nil*, so that the total operating costs have been extremely moderate.

LEGAL.

[illegible] Colston Electrical Works Co., Ltd.

At the Bristol County Court, his Honour Judge Stanger made a compulsory winding-up order in the case of this company.

Mr. Haslam, who appeared on behalf of the petitioning creditors, Messrs. Haslam & Stretton, of Cardiff, said the facts stated in the petition were not disputed, and he thought he was entitled to the winding-up order asked for. A short time ago the company approached the largest creditors, and asked them to agree to the petition being withdrawn, in order that the company might be wound up voluntarily. The company passed a resolution for voluntary winding up, and appointed Mr. A. Collins as liquidator on May 23rd. They stated that, provided that course was agreed to, outside people would provide a sum sufficient to pay 12s. 6d. in the £. His clients felt that if they got 12s. 6d. in the £ it would be as much as they expected. He did not withdraw his petition, though he thought the matter was one for the creditors to consider.

Mr. Weatherly, who appeared on behalf of the creditors, said that assuming that the meeting alluded to was regularly called, and assuming that 12s. 6d. in the £ was guaranteed, he would support the petition for compulsory winding up, on the simple ground that the assets would realise more than the liabilities.

Mr. Tayler, who represented the company, said the position of the company was this: The Simplex Conduit Co. claimed about £500. They issued process, got judgment, and put in an execution, which enabled them to reduce their claim to about £90. In view of what the Simplex Co. did, his clients sought the protection of the Court, and the Official Receiver was appointed liquidator to protect the assets. When the largest creditors were approached with a guarantee of 12s. 6d. in the £, on condition that the present petition was withdrawn, it was in the interest of the creditors that the application should not be proceeded with. If his Honour would not dismiss the petition, he suggested an adjournment, so that the matter could be further discussed. If the assets were worth more than 20s. in the £, the creditors would be paid in full. The company had got into its present position simply because it could not collect its debts.

Mr. Weatherly contended that it was just one of those cases which ought to be investigated by the Court. From the figures supplied to him by the Official Receiver, the assets, which had already realised £420, were likely to yield £960 to meet liabilities of £797.

His Honour made the order asked for.

Victoria Falls and Transvaal Power Co. v. Van Breda.

On April 10th, in the Transvaal Provincial Division of the Appeal Court, Mr. Justice Bristowe allowed the appeal of the company from a decision of the magistrate, who, while finding that there was serious and wilful misconduct on the part of the defendant,

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awarded £500 as compensation for his death. Van Breda was an electrician, admittedly experienced and competent, employed at Rosherville station, and he was killed on April 18th, 1915, by an electrical discharge at one of the transformers. Mr. Justice Bristowe, in reviewing the matter as considered by the magistrate, said that the magistrate was not entitled to infer, in face of evidence to the contrary, from the mere fact that a permit was signed, that the deceased in entering a live cubicle was acting with the knowledge and approval of Powell, the foreman electrician. Until the permit had been shown to the deceased and he had signed the declaration he could not know that the cubicle was dead. The fact that there were breaches of the regulations by other officials did not prevent the act of the deceased being so regarded. While one had the fullest sympathy with the defendant's wife and young child, one was not entitled to stretch the law in his favour. The appeal must be allowed, and the judgment altered to one of absolution from the instance, and the appellant would be entitled to costs in both Courts. The other judges concurred.

A Walford Bodie "Overdose."

A tailor's presser has been awarded £25 damages against "Doctor" Walford Bodie. Defendant was giving one of his entertainments at the Gaiety Theatre, Birmingham, and plaintiff took hold of the handles of the battery, under the defendant's assurance that he would come to no harm. He was thrown to the ground, and became unconscious for a few seconds, the audience laughing all the while. The County Court Judge said that plaintiff had suffered from an overdose of the current. A man who had a battery like that, and represented to the audience that it was safe, should exercise a high standard of care to keep the current under control, and see that no harmful results happened. He had not done that in this case. Stay of execution was granted.

THE EFFECT OF VACUUM FUSION UPON THE MAGNETIC PROPERTIES OF IRON.*

By TRYGVE D. YENSEN.

In a number of articles during the last two years the writer has described the remarkable magnetic properties obtained by melting electrolytically refined iron *in vacuo*. It has been shown that it is possible by this process to obtain magnetic permeabilities as high as 50,000, accompanied by hysteresis losses of ½ to ⅓ those of the best commercial transformer steels in use at the present time. The question has naturally arisen: What effect will the vacuum treatment have upon commercial grades of iron? In order to answer this question, one of the purest grades of commercial iron obtainable was selected for an investigation; this iron was made by the open-hearth process according to the most approved method.

Test pieces were prepared from the iron as it was received from the manufacturer, and others were prepared from the iron after its being re-melted *in vacuo*. These test pieces, before the final testing, were annealed at 1,100° C. *in vacuo*, and cooled at the rate of 30° C. per hour to room temperature.

The results obtained are given in the accompanying table and

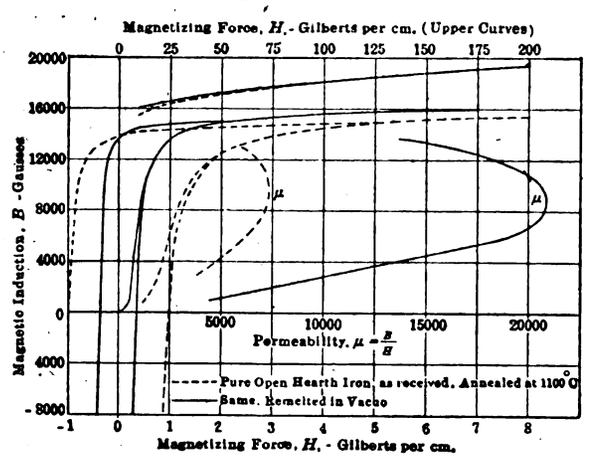

Fig. 1.—Magnetic Test Curves of Pure Open-Hearth Iron as Received and as Re-melted in Vacuo.

in fig. 1. It is seen that the vacuum treatment has increased the maximum permeability from two to three times, and decreased the hysteresis loss by a corresponding amount.† For the sake of comparison, there have been included in the table results previously obtained with electrolytic iron—with and without additions of silicon—melted *in vacuo*. This comparison shows plainly that nearly as good results are obtainable with pure open-hearth iron as a base as with the pure electrolytic iron.

* From *Metallurgical and Chemical Engineering*. Abstract.

† A similar improvement has been obtained with Swedish charcoal iron.

As far as the chemical analysis is concerned, it is difficult to point out any material difference between the open-hearth iron before and after the vacuum treatment. Only as far as the CO and CO_2 gases are concerned it may be stated that there has been a material reduction by the vacuum treatment. Density tests showed very slight differences between the treated and untreated iron, but the density of the vacuum-treated iron was in every case found to be higher, the average difference being about 0·1 per cent.

Photomicrographs show that in the untreated iron, while it is remarkably free from slag or other impurities such as are generally met with in commercial iron, there appear a large number of minute spots, evidently cavities caused by dispelled gases. The vacuum-treated iron is practically free from such cavities, and the crystals of the treated iron are much larger than those of the untreated iron.

The results seem to indicate that the purer the iron the larger are the crystals. Previous results also point towards a possible connection between high magnetic permeability and large crystals when comparing irons of the same general composition and having received the same mechanical and heat treatment. It may be a question, however, whether magnetic permeability has anything to do with the crystal size, as it may depend solely upon the purity of the iron. In favour of this contention may be cited the fact that when pure iron has been annealed at temperatures above 900° C., followed by slow cooling, the resulting crystals are much smaller than after annealing at or below 900°, and yet the magnetic permeability is generally increased by annealing at the higher temperatures.

From these facts and indications the only safe conclusion that may be drawn is that the open-hearth iron has been purified by the vacuum treatment to a degree not obtainable by any ordinary process of manufacture; and, furthermore, that this purification has resulted in marked improvements in the magnetic properties. Together with the results previously obtained with Swedish charcoal irons, these results show definitely that it is possible to obtain magnetic properties with commercial grades of iron by vacuum fusion that are comparable with those obtainable with electrolytic iron.

TABLE I.

Kind of specimen.	Maximum permeability.	Density for maximum permeability.	Permeability. B = 10,000	Permeability. B = 15,000	Hysteresis loss, ergs per cb. cm. per cycle. B = 10,000	Hysteresis loss, ergs per cb. cm. per cycle. B = 15,000	Retentivity in gausses. B = 10,000	Retentivity in gausses. B = 15,000	Coercive force in Gilberts per cm. B = 10,000	Coercive force in Gilberts per cm. B = 15,000	Spec. elec. resist., microhms.
Open-hearth iron, as purchased. Machined from ½-in. rod. Annealed at 1,100° C.											
Rod	7,250	10,000	7,250	2,710	—	5,550	9,000	13,000	·85	1·0	10·15
Open-hearth iron re-melted *in vacuo*, annealed at 1,100° C.											
Rod	14,180	8,500	13,200	5,350	1,080	2,190	8,700	12,300	·37	·40	10·05
Ring	17,000	9,000	16,700	8,250	852	1,755	8,400	12,600	·28	·33	—
Rod	20,900	9,000	20,200	7,500	865	1,760	9,300	13,600	·30	·34	10·20
Electrolytic iron melted *in vacuo*, annealed at 1,100° C.											
Rod	25,800	9,000	25,600	1,365	707	1,451	9,800	12,700	·23	·28	9·85
Electrolytic iron, with 0·15 per cent. Si melted *in vacuo*, annealed at 1,100° C.											
Rod	66,500	6,500	41,700	6,000	286	916	9,080	12,000	09	·165	11·80
Electrolytic iron, with 3·0 per cent. Si melted *in vacuo*, annealed at 1,100° C.											
Rod	72,600	9,000	69,500	2,500	254	926	9,400	13,700	·09	·16	44·75

Russian Electricity Tax.—A meeting of the Indirect Taxes and Monopolies Committee was held on May 13th, with A. I. Nikolaienka, Assistant Minister of Finance, in the chair. The tax on electrical energy was considered. According to the scheme of the Minister of Finance, it was proposed to put a tax on electricity used for lighting and for industrial purposes, the general tax for private lighting to be at the rate of 4 copecks (1d.) per KW.-hour, and that for street lighting 1 copeck (¼d.). Energy for industrial purposes is to pay 2 copecks (½d.), and for certain auxiliary industries ½ copeck (half-farthing). The representatives of industry said that to put a tax on electricity used for industrial purposes might very prejudicially affect the development of the country's productivity; but most of the Committee, including Profs. Bernadsky, Migulin and Tugan-Baranopsky, found such a tax to be quite admissible if moderately applied, the more so as such an indirect tax would be transferred by the producers to the consumers. Prof. Migulin raised the question of the monopolisation of the production of electrical energy. It was decided to submit this important question to a Special Financio-Economic Committee. The Committee approved the project of the new law.

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THE ELECTRIC LIGHTING OF SMALL TOWNS.

By H. N. MUNRO.

(*Abstract of paper read before the* Junior Institution of Engineers.)

The idea is prevalent in the lay mind that an electric undertaking will not pay unless developed on a large scale, and that to attempt to put down an electric generating station and provide electric light and power in a place of less than 10,000 inhabitants is to court disaster. This impression is entirely erroneous; villages with populations as low as 500 have found that it is a profitable venture to follow the times and use electricity in place of oil or gas. These concerns are not only self-supporting, but they manage to yield dividends of 2½ to 5 per cent., and sometimes more after a year or two of working, some of the more successful yielding 10 per cent. after a few years. It is, of course, essential that such concerns should be most economically run in order to keep expenses down and, at the same time, to maintain a reliable and efficient service.

It is well to bear in mind when contemplating the promotion of any such schemes that there will always be a certain amount of local opposition which must be overcome.

In opening up negotiations, the best plan is to interest and obtain the support of two or three prominent residents in the place, these preferably being tradesmen or members of the local governing body. The next thing to do is to call a meeting to which all interested are invited. Prior to this, a judicious distribution of literature stating the case for electricity will arouse interest sufficient to ensure a good representative attendance at the meeting, when the objects and scope of the undertaking can be clearly explained.

Assuming that the support of the inhabitants is assured, it will now be necessary to ascertain how far the local authorities and governing bodies may be expected to favour the scheme officially. This is most important. Assuming that consent is given by the governing bodies concerned, the formation of a company can be proceeded with immediately. There are many schemes of this nature working without any Provisional Order. The obtaining of a Provisional Order is a lengthy and often an expensive matter, and it places on the undertaker many responsibilities. The only substantial benefit to be got from it is permission to break up roads and streets for the purpose of laying cables, and also the securing of compulsory wayleaves; the breaking up of roads is unnecessary, as all mains are run overhead, and wayleaves are not very difficult to obtain when the support of the residents in the place is given to the undertaking. Furthermore, the Provisional Order does not convey a monopoly of electric supply to a company as is commonly thought, since the local authorities can give their consent to any other undertaker to provide an electric supply.

If at all possible, neighbouring villages should be induced to fall in with the proposals, and these should be grouped together, as this will be found to reduce costs per unit and management expenses, besides being conducive to more efficient service.

The company should be well supported locally if it is to be successful, and the majority of the shares should be held by the inhabitants of the locality. The articles of association should contain clauses relating to the selling of fixtures, wiring of premises, and extent of supply in order to give the company full scope for extension. The company should start with full capital and entirely free from all obligations and loans. If sufficient money cannot be obtained at the outset to purchase outright all plant, &c., arrangements can sometimes be made by which contractors will agree to accept shares in the company as part payment.

For a small town of, say, 5,000 inhabitants, a sum in the neighbourhood of £4,500 is necessary to provide plant and mains. A good average figure for load per 1,000 of population is about 12 kw., and the town under consideration will therefore require plant able to generate some 60 kw., which, at an average figure of £35 per kw., gives a sum of £2,100 for plant alone. A substantial brick and galvanised iron building may cost in the neighbourhood of £400, giving a total of £2,500 for plant and building.

In such a town as is here discussed, a mains length of four miles is a fair figure to take. This, carried on wood poles with bare copper conductors at 230 volts on the direct-current two-wire system, would cost approximately £400 per mile, making a total of £1,600 for mains. This would include services, protective apparatus, and house meters. A sum of £50 should be sufficient to cover legal expenses.

The odd amount of £350 should cover contingencies, thus bringing the capital, in round figures, to £4,500. Full powers should be obtained when the company is formed to increase the declared capital, if necessary, by a sum of, say, £1,500 to cover the cost of future extensions, &c.

An average number of 20-watt lamps per house or shop being assumed, the estimated possible load can be arrived at. For residential districts 60 per cent. of the estimated possible load may be taken as the maximum load on the feeders, and for shopping areas a percentage of 80. The next step is to divide the area into districts, each served by a feeder. The feeder termination point should be as near the power station as possible, but at the same time should be centrally situated in the district.

The distributors should be as few as possible, and each one should take in as many consumers as is practicable.

Each feeder, at its termination, should be adequately fused, as should each distributor leading from it. The fuses should be contained in cast-iron weatherproof boxes, and mounted high up on the pole.

Post Office telegraph or telephone lines must be protected from contact with the power lines by guard wires. At the station end of each feeder is a lightning arrester.

While most of the overhead work of this nature is carried out with wood poles, such as are used by the Post Office for telegraph lines, steel poles are occasionally used, presenting a better appearance. They are, however, about three to five times as costly as wood poles, are more difficult to erect, and cost more for maintenance than wood poles. Good wood poles well creosoted should last from 25 to 30 years, and under ordinary conditions require very little maintenance. Light poles used for carrying very small conductors along a straight route are from 22 to 30 ft. long, and about 6 in. diameter at top and 9 in. diameter at the bottom. For medium conductors poles are used about 25 to 35 ft. long, 8 in. at top, and about 10 in. at the butt. Stouter poles are used for heavy conductors and for corner or terminal positions where heavy strain is encountered.

For supporting the line, either wood or iron arms are used, or malleable cast-iron brackets. The insulators used are similar to those adopted by the Post Office on telegraph lines. Ironwork should be well galvanised, and all exposed screw portions should be coated with a tallow mixture. Poles and other woodwork should be well creosoted or impregnated with some preservative material, and poles or arms, when drilled or cut in any way after impregnation, should be treated with a coating of hot tar or other preservative solution at the parts affected.

The plant for a power supply in a large city has to be supremely efficient; cost is, to a certain extent, a secondary consideration. The small plants with which this paper is concerned are dependent, to a great extent, on low initial cost. Superlative efficiency is not required, but the plant must be reliable, strong, and simple to work, as skilled drivers and attendants are not readily obtainable in small places.

The type of plant largely depends on circumstances. If good coal is cheap, and plenty of water is obtainable, a self-contained steam plant is worthy of consideration. Some types of this plant are exceedingly efficient and possess a comparatively high overload capacity. With careful attention stand-by losses can be kept low. A suitable steam plant may be obtained for about £9 to £10 per B.H.P. The average space required for a small town station is about 7 or 8 sq. ft. of floor space per B.H.P. The fuel consumption of such engines ranges around 4 to 5½ lb. of coal per unit generated.

The gas engine and producer is a popular plant, and can be run very economically. Stand-by losses are not very great, cheap fuel can be utilised, and an abundant water supply is not necessary. It pays to use a fairly good anthracite coal in the form of peas. This ensures a clean gas being generated comparatively free from tar, and reduces cleaning costs.

An efficient horizontal gas plant consumes about 2 to 2½ lb. of anthracite per unit generated, and the cost, including producer plant, averages £8 to £9 per B.H.P.

Oil engines are an extremely satisfactory plant to deal with, provided they are well chosen and attended to carefully. The crude-oil engine is most frequently met with in small power stations for this work. This plant costs in the neighbourhood of £8 per B.H.P., and consumes about 1½ pints of crude oil or paraffin per unit generated. The space occupied is about the same as that of a steam plant of the same rating.

Shunt-wound generators are used, controlled by a shunt regulator, with properly designed steps. With low-speed engines a belt drive is usual, while direct coupling is resorted to in case of high-speed engines. A booster is used in stations where a battery is installed.

In such installations as are here considered the plant during the day has but little load to provide for. A reliable battery of adequate capacity should be installed. The maintenance of the battery is very important, and is usually undertaken by the suppliers under a maintenance contract.

A deciding factor in these schemes is the cost which must be borne by the householder in order to be able to use electricity. Unless it is absolutely certain that the arrangement is a sound one, free wiring should not be undertaken; it is better to have a small number of consumers entailing very little expense than a large number whose wiring has to be supplied at a heavy cost. A very satisfactory job can be carried out in wood casing at a cost of about 12s. per point. It is a very good plan for the company to have a separate department for the sale and hire of fittings. A meter rental of about 4s. to 5s. per annum is charged. A "penny-in-the-slot" meter is used in some places for the poorer class of consumer.

The disadvantage of the meter system is that a man must be employed to read the meters. The great advantage of the meter is that the station engineer can obtain valuable records which are indispensable to a progressive undertaking, and the consumer can see what units are actually supplied and charged for.

The method of charging by contract presents little or no

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difficulties in the way of operation. It requires no meter reader and no meter, and involves less clerical labour. It is open to the objection, however, that no records are available of each consumer's actual consumption. Of the two systems, the author favours the charging by meter. The lamps mostly used are 15, 20, and 25-watt, and an average of 12 lamps per building may be taken.

In a town of 5,000 inhabitants a reasonable installation to expect is in the neighbourhood of an equivalent of 1,000 lamps of 20 C.P. each for the first year's working. In a well-managed place this should easily be about doubled during the second year. In a great number of these small places gas or oil is the only illuminant, the gas being sometimes as high at 6s. or 7s. per 1,000 cu. ft. Electrical energy may be supplied up to 8d. per unit, 6d. being a good average to take, which compares favourably with gas at 3s. 6d. per 1,000 cu. ft. —a very low rate for a small town.

It is usually possible to enter into a contract with the local authorities for the electric lighting of the whole or part of the main streets; a reasonable price for this is about £3 per lamp per annum. While in many cases a dividend is yielded as the result of a first year's running, it would be unfair to base one's estimate of working on this year. In the second year the scheme has had a good chance to develop, and may be reasonably expected to be running normally.

The private lighting may be taken to comprise 1,800 20-watt lamps, the public lighting 100 3/40-watt lamps. The following figures are based on these assumptions:—

Expenditure.	£	s.	d.
68,040 units at 1d.	283	10	0
Management expenses	525	0	0
Total expenditure	£808	10	0

Revenue.	£	s.	d.
Private lighting—28,800 units at 6d. per unit	720	0	0
Street lighting—100 lamps at £3 each per annum	300	0	0
150 meter rents at 5s. each per annum ...	38	0	0
	£1,058	0	0

The profit is therefore £250. Of this amount £1,500 debenture or preference shares will absorb their dividend of 5 per cent., totalling £75. The balance of £175 remains to satisfy the ordinary shareholders and any reserve or other fund which is contemplated. A dividend of 5 per cent. can be paid on £3,000 ordinary shares, leaving the sum of £25 to be placed to reserve.

The foregoing figures are representative of what may be met with in actual practice. No notice has been taken in this paper of power loads or requirements or of any profit which may accrue from the sale of fittings, lamps, &c., which, after a few years' working, may amount to a substantial sum.

An average dividend of 5 per cent. has been figured from the statistics of ten companies, with populations varying from 2,500 to 10,500, which shows that such undertakings are paying concerns.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Metric System.

We have had long enough to wait for that very practical and economical reform—Daylight Saving—an idea originated by a Briton, but only adopted by Great Britain after almost every other European country. Shall we also be the last to benefit by that equally great, or greater, commercial reform, the substitution for our present weights and measures of the international metric system, the idea of which was also originated by a Briton?

For years the Decimal Association has urged the reform of our coinage and weights and measures to those on a decimal basis, and the prospects for the success of our work are now hopeful. I shall be pleased to send further particulars to anyone applying to me at Finsbury Court, Finsbury Pavement, London, E.C.

E. Merry, *Acting Secretary,*
The Decimal Association.

London, E.C., *June 3rd*, 1916.

Decimal Coinage.

"W.M.M.'s" reply is far from edifying in its criticism of my note. It is to such men as he that we owe our present backwardness in commerce and, to a certain extent, in science. These iconoclasts whose policy is to destroy where others construct belong to a class which, were it not so prevalent, one could well afford to ignore—always ready to magnify infinitesimal errors, while they themselves sit on the fence and watch others struggle. The slip of the pen which "W.M.M.'s" eagle eye spotted would have been obvious to any schoolboy, and allowed for as such.

"W.M.M." should remember that the system of which I wrote is, and has been, in practical use for nearly ten years all over the globe, and has "worked" with unfailing success during that period.

The imaginary coin, the speso, with its practical unit the spesmilo, 2s., has been scientifically designed in order to give the closest approximation possible to the standard coins of different countries.

By the way, has it occurred to "W.M.M." that *all* foreign coins are imaginary as far as *we* are concerned? A franc or mark is simply imagined by our contractors, and its relative value in English currency ascertained.

Unless "W.M.M." is mad (this is not an aspersion) he will not deny that the French decimal coinage system works O.K.; yet has he, or any other man, ever seen in modern French currency a centime piece, of which the French "penny" is a multiple or 10? The same remark applies to many other foreign "imaginary" units. What is needed is an international system to link them up, and the Esperanto spesmilo system supplies this need. Ours is about the only European country which has not made a move in the matter. Why, oh why, is England so inert?

Alfred Bridges.

London, W., *June 3rd*, 1916.

Economy in the Use of Coal.

The figures given by Mr. Horace Bowden in the letter which appeared in your issue of May 26th, advocating the universal substitution of electricity in place of gas for lighting and power purposes, are very misleading, owing partly to his somewhat over-estimating the efficiency of electric lamps and motors and under-estimating that of gas burners and engines, and partly to his leaving a very important factor out of consideration—that of residuals.

From every ton of coal carbonised in a gas works there is a residuum of 10 cwt. of coke for sale; so that, even if it takes two tons of coal to produce the same total candle-power by gas as one ton of coal will produce by electricity—and that is an outside estimate—the *net* consumption of solid fuel is the same in both cases. But then there must be taken into account the tar and ammoniacal liquor resulting from the distillation of the coal, residuals from which (1) our Navy and Army are deriving invaluable ingredients for the manufacture of high explosives, (2) a host of industries obtain chemicals that are vital to their existence, and (3) the farmers of this and allied countries derive one of the most important of all artificial fertilisers.

All these precious materials go up the chimney at an electric generating station, unless gas engines are used to drive the generators!

Mr. Bowden's figures regarding the relative usage of coal to produce H.P.-hrs. by the gas engine and the electric motor need material correction, as I have said; but even taken as they stand, and amended by the factor of residuals, they show an advantage as to fuel economy in favour of the gas engine. Corrected to a true comparison of efficiencies the balance in favour of the gas engine is very marked.

Mr. Bowden is seeking fuel economy in the wrong direction. It lies, rather, in putting coal through the retort as a prelude to obtaining from it the motive power for the generation of electric energy.

D. Milne Watson, *Managing Director,*
The Gas Light and Coke Co.

London, S.W., *June 3rd*, 1916.

The I.E.E. Rules.

These days of warfare may not be a suitable time for criticism of the new Wiring Rules issued by the Institution of Electrical Engineers. Electrical contractors have already noted difficulties and defects in the matter and arrangement of some of the rules. The revised rules must themselves be revised. So much is clear. The object of this letter is to recommend that the Wiring Committee begin preparations for a revisal as soon as the war work permits. I would suggest, also, that there should be added to the Committee the names of some wiring experts well known for their prolonged effort to raise the standard and the status of this branch of electrical work.

The majority of the Committee should be men whose work has been mainly wiring. Many engineers eminent in other branches undervalue the importance and complexity of wiring problems and practice.

Engineer.

June 3rd, 1916.

[Our correspondent appears to be deeply dissatisfied with the new Rules and refers to "difficulties and defects," but does not enter into particulars. It would be interesting and useful if he would specify the nature of his complaints in detail. We may remind him that the Wiring Rules Committee of the I.E.E. is a Standing Committee, and invites suggestions.—EDS. ELEC. REV.]

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WAR ITEMS.

After-the-War Trade.—In the House of Commons last week, Sir R. Cooper complained that the Board of Trade was too slow in tackling the question of trade after the war. It was unfortunate that there should be an impression in the country that many of the Committees which had been set up to deal with the matter were packed juries. Now was the time to get rid of the German octopus.—In reply, Mr. Pretyman said that the Board of Trade was alive to the situation which would arise in regard to labour when the war ended. He said, according to the *Morning Post* report, that the matter had been considered from the outbreak of the war, and he believed the arrangements which had been formulated would go a long way towards solving the problem when it arose. Before the war the tendency of trade was in the direction of international and cosmopolitan combinations. We looked upon this as a purely trade matter—we assumed political and trade honesty in the Germans. But there was behind this action on the part of the Germans a political object and, indeed, a dishonest trade object. One knew how agencies had been captured by Germans, and German goods gradually substituted for British. The Board of Trade had done a good deal to counter that. The Board of Trade were getting rid of, and closing down, the German element in British trade. One element which was most difficult to get rid of was when German agencies had practical control of the output of some product of pivotal character. It was necessary that this country should have the plant and material ready at the end of the war to combat this. The labour to make and erect such plant, far less to operate it, was difficult to procure. But the Board recognised that the country must be ready to be self-supporting at the end of the war, if we were not to lose our opportunity. If the gates had once again to be opened to an uncontrolled supply of vital products he could not see how they were to be closed again.

Exemption Applications.—At Batley, the managing director of a local firm of electrical engineers applied for exemption for himself as being in a certified occupation. He was regularly employed in the work of electrical fitting, and had suffered great depletion of staff. He had been an active member of the local Volunteer Corps from the beginning. Conditional exemption granted.

At Windsor, Mr. Fowler, electrician, who appeared in R.N.A.S. uniform, applied for exemption for his only adult employé. Mr. Fowler stated that he himself had joined, leaving the man appealed for in charge of the business. If this man left there would be no electrician in the town, and the business would close down. Three months' exemption allowed.

Windermere Tribunal, after considering appeals by Messrs. J. K. & Ernest C. Thornburrow, electrical engineers, granted the former six months' exemption and the latter one month.

Dover Tribunal has granted conditional exemption to G. Hopkins (32), coal and ashes trimmer at the Corporation electricity works, and six months to E. Smith, driver for a Corporation electric refuse vehicle.

Dartford Tribunal has refused exemption to a coal trimmer appealed for by Mr. Pember, electrical engineer to the U.D.C.

At Chatham, on May 30th, exemption was claimed by the Tramway Co. for 35 men, it being stated that if any more had to go things would become very serious. Before the war there were 234 men and 17 boys, but all the latter and 145 of the former had left, and the staff now consisted of 124 men, 28 boys, and 72 female conductors. The Tribunal gave conditional exemption to 22 motor-men, one engineer, and one repairer of electrical mains; three months to a clerk and a stoker; two months to a pavior and a night timekeeper; and one month each to a clerk, a night foreman, a chief motor inspector, and two truck-men. The other appeals failed.

Nuneaton Tribunal has granted exemption until August 1st to E. Burgoyne (29), the only man, out of seven, left with Mr. Harold Birch, electrical engineer.

At Torquay, conditional exemption has been granted to Mr. J. M. Keenan, deputy electrical engineer, and Mr. A. E. Williams, chief clerk at the electrical works.

At Macclesfield, a local firm sought exemption for their electrical engineer, and said that it was impossible to obtain a qualified man over military age. The company supplies a number of business concerns with current for manufacturing purposes, and it was stated that if the engineer went the supply might have to be curtailed, as the staff had now reached the absolute minimum. Three months' conditional exemption was allowed.

Tunbridge Wells Tribunal has granted three months' conditional exemption to Messrs. R. J. Spittles and R. F. Rack, electrical wiremen with Messrs. Strange & Sons.

The Chipping Norton Electric Supply Co., Ltd., appealed to the County Tribunal for Mr. G. G. Bates, shift engineer, claimed to be indispensable to the maintenance of the borough supply. The Local Tribunal considered that Mr. Bates was not wholly indispensable, and that he could be replaced by a man over military age. He had been "starred," but this was removed on May 11th. The Court declined to interfere with the Local Tribunal's decision, but gave the company a month in which to find a substitute.

At Bedford, Mr. R. W. L. Phillips applied for exemption certificates for 20 men at the borough electricity works. It was explained that although the men had been exempted they were being called up by the Recruiting Officer. The Tribunal decided to issue the certificates.

Before the West Kent Appeal Court, Messrs. T. White and Bushell, electrical engineers, of Chislehurst, appealed for Mr. H. S. White (28), as being indispensable to the business, but no exemption was allowed.

The Barnstaple Tribunal has granted conditional exemption to Mr. Frank Bickford, electrician, who had been passed for sedentary work only, and who supervises motors, &c., at local works.

At Canterbury, on May 29th, the city electrical engineer, Mr. C. A. Blascheck, appealed for three men engaged at the dust destructor, and said that there were now only six men instead of 12, and they could work with only one shift. Conditional exemption was allowed.

Chelmsford Tribunal has granted three months' exemption to F. J. East (40), who attends to the electric light installation at the residence of Mr. R. A. Ellis, J.P., of Stock.

Eastbourne Tribunal has given two months' exemption, with leave to appeal again, to an apprenticed electrician with a local firm, whose indentures have still two years to run, and who is the only one of the former staff of seven electricians left.—The proprietor of an electrical engineering business in the town has been exempted until the end of June.

At Hoddesdon (Herts), Messrs. Christie & Co., Ltd., appealed for Mr. W. R. Stone, electrician, responsible for supplying light for 100 men and the offices, and also to several houses in the town. He was exempted whilst he remains in his present position.

Woking Tribunal heard an appeal for five indispensable employés of the Accumulators, Ltd., of Maybury. S. F. Bates, foreman of the carpenters' shop and woodworking mill, was refused exemption, it being considered that he could be replaced; three months' each were allowed to E. H. Cooper, foreman of the assembling and formation department; A. A. Blatcher, foreman of the mixing and pasting department; R. H. Simpson, foreman electrical fitter; and P. D. Hollings, manager and analytical chemist. The same Tribunal has given three months to A. M. Dallen, chief clerk, and A. J. Jameson, meter tester, repairer, and reader, with the Woking Electric Supply Co., and one month to Mr. A. Gill, the company's accountant.

The Aylesbury Rural Tribunal has given three months' exemption to the electrician engaged at Hartwell House.

Oldham Tribunal has refused exemption to three married brothers, partners in the firm of Caton & Sons, electricians, ten of whose staff have enlisted. Three electrical fitters with Mr. J. Jackson, electrician, of Oldham, have been exempted until August 1st.

The military appealed against three months' exemption allowed to a charge-hand at the Rugby U.D.C. refuse destructor, who has been on the staff for ten years and is thoroughly conversant with the work. It was claimed by the surveyor that in the interests of health the work should be done efficiently. The exemption was allowed to stand, but it was intimated that it might not be renewed so easily.

The Peterborough Tribunal has granted six months' exemption to Mr. T. C. G. Clabburn, manager of the Peterborough Electric Traction Co.

At Rochdale, an electrical engineer, Mr. W. Pickard, aged 29, who was stated to be engaged in developing a patent, was granted temporary exemption till the end of August.

At Blackpool Tribunal, on June 1st, a local hydro company appealed for their engineer and electrician, aged 32. There were 1,100 lights in the hydro, the plant being under the control of this man. Conditional exemption granted.

Conditional exemption was granted by St. Annes Tribunal, on May 31st, to the chief electrician of the tramway company, and to two engine drivers at the electricity works.

The proprietors of the Royal Mills, Esher, applied to the Tribunal for their electrician to be exempted, he being the only one of the original staff left. Exemption granted until November 20th.

The Dartford Tribunal has granted exemption to Mr. S. W. Botterill, electrical engineer to Messrs. Swaislands, of Crayford.

At the Stockton-on-Tees Tribunal, on May 30th, an application was made for the exemption of Coun. H. C. Watson, manager of the electrical department of the firm of Messrs. T. B. Watson & Son, sanitary and electrical engineers; the department was turning out work for controlled firms, and so many men had joined the Colours that it would be impossible to carry on the business without Mr. Watson. Three months' exemption was granted, with leave to appeal again.

At Fleetwood, an electrical engineer who sought exemption for himself and for two of his employés, produced documents showing that he was fitting wireless to the mine sweepers, and regularly repaired electrical machinery on the boats. He was also engaged on electrical work for the Government and for firms outside the town who were on Government work. The applicant was granted conditional exemption. The other men were exempted till September 30th, and the employer was advised to get badges for them.

Ashby-de-la-Zouch Rural Tribunal has refused exemption to the man in charge of the electric light plant at Measham Hall, the seat of Sir W. Abney.

Before the West Kent Appeal Court, on Monday, Mr. H

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Williams, assistant manager of the Erith U.D.C. electricity works, appealed for Leonard Clarke (31), engineer-fitter's *mate*. Conditional exemption was allowed.

At Castleford, Mr. C. J. Cox, electrical engineer, appealed for his working manager, Mr. Ralph Sheard (28), and said that without him he would be unable to carry on the business. His other men were gone, and Mr. Sheard was the only man in the town who could do certain repairs at the works in the district. Exemption was allowed whilst he remains in his present occupation.

At Batley, the managing director of a local firm of electrical engineers, who said that, owing to the depletion of the staff he was regularly employed in the work of an electrical fitter, was granted conditional exemption.

The Aysgarth Tribunal has granted conditional exemption to an attested employé of the Askrigg Electric Light Co.

An attested farmer, butcher, and proprietor and manager of a "public electric light supply" at West Burton was granted conditional exemption.

The Economic Conference.—The Marquess of Crewe will attend the Paris Economic Conference in place of Mr. Runciman, President of the Board of Trade, who is suffering from a breakdown consequent upon the great strain of his manifold duties.

Breach of Lighting Order.—At Accrington, on June 1st, R. P. Gerland, electrician, was fined 7s. 6d. for a breach of the Lighting Order. Defendant had been carrying out electrical work in Whalley Road, and had omitted to switch off one of the lights when leaving.

Coal Trade Committee.—The President of the Board of Trade has appointed a Committee, consisting of the Rt. Hon. Lord Rhondda (chairman), Mr. A. E. Bowen, Mr. Newton Dunn, Mr. F. J. Jones, Mr. A. Nimmo, Mr. A. F. Pease, Sir Daniel M. Stevenson, Bart., and Mr. R. Wharham, to consider the position of the coal trade after the war, with especial reference to international competition, and to report what measures, if any, are necessary or desirable to safeguard that position. Mr. J. C. Smith, of the Board of Trade, will act as Secretary.

To be Wound-up.—The Board of Trade has ordered the following to be wound-up:—

Krupka & Jacoby, Ltd., 26-36, Chapter Street, Westminster, S.W. Importers of electric light fittings, &c. Controller: Thomas Wise, Bassishaw House, Basinghall Street, E.C.

Trading with the Enemy.—The "London Gazette" for June 2nd contains further lists of persons and bodies with whom trading is prohibited in Argentina, Bolivia, Chile, Norway, Peru, Spain, Sweden, Portugal, and other countries.

BUSINESS NOTES.

Catalogues and Lists.—British Thomson-Houston Co., Ltd., Rugby.—A very fully illustrated brochure of between 80 and 90 pages describing Curtis turbo-generators has been issued by the company. The descriptive matter is very detailed, and is accompanied by half-tone pictures of various parts of the plants and many views of complete sets, line diagrams and curves, and photographs of the works at Rugby. Altogether it is a very fine production and will be of service to power station engineers, consulting engineers, &c.

Messrs. T. W. Broadbent, Ltd., Victoria Electrical Works, East Parade, Huddersfield.—Leaflet No. 1 of a new catalogue which is being issued in sections. The "D" type generator for continuous current is described in this leaflet.

Messrs H. Tinsley & Co., Eldon Park Works, South Norwood, S.E.—Two pamphlets: No. 44 (12 pp.) contains a description with prices, &c., of the Drysdale-Tinsley non-inductive low resistance standards or "shunts"; No. 47 (12 pp.) deals with optical testing instruments, Dr. Drysdale's field glass and telescope testing apparatus, &c.

Messrs. Parmiter, Hope & Sugden, Ltd., Hulme Electrical Works, Manchester.—Advance copy of a new catalogue of 52 pages, in which fully illustrated and exhaustive information is given respecting the Fluvent fuse system, which is being largely used in the new munitions factories put up by the Government. "Fluvent" switch fuses, power centre boards, glands, &c.; "Ajax" ironclad switches and fuses, mining switches, fuse-holders, small power distribution boards, lighting fuseboards, and bi-metal fuse wire, are among the manufactures covered. A number of pages are occupied with shipping weights and dimensions. The firm have now an office in London (Queen Anne's Chambers), where samples of the Fluvent system can be seen.

To Develop Export Trade.—M. Crozier, the French commercial attaché in Belgium, Holland, Switzerland, and Scandinavia, advises certain modifications in present methods of securing trade in these countries. The union of producers is a leading point in his advice. Considering that the bigger firms stand in no need of his recommendations, he limits his remarks to the smaller firms engaged in turning out articles of restricted consumption, or "seasonal" articles, or to those afraid or hesitating to make a start in the export trade. To these he tenders the advice to combine or group their resources and efforts. It is, he says, a *modus operandi* found efficacious by our enemies. Such selling syndicates should combine from one to two dozen merchants or manufacturers of articles suitable for the same class of customers, but each firm different and non-competitive with other members of the same group or combine. The components of the group should be wisely studied; the number of its members happily limited, so as to help the work of agents and representatives, and assure a sufficient remuneration, so that none may think their interests sacrificed, such groups working in the foreign country chosen either by means of an agent sent direct and settled on the spot and holding local stocks, or by a resident representative of the country, recommended by, say, the French Foreign Trade Office. The choice of this agent or representative should be the subject of great care: he should be capable, intelligent, of credit in the country, and furnish every guarantee of integrity, serious business, mental acumen, and pro-French sympathy. On the other hand, it should be made possible to assure him a suitable position and a remunerative volume of business. At a pinch, resort might be had to commission firms, but these have the faults of occupying themselves with too great a variety of articles, buy from any French or foreign firms, and neglect the little known articles which it is the object of the group to export. Lastly, the attaché recommends the trial and employment of French women already trained in commerce, so as to leave the men free for industrial occupations.

U.S. Electrical Exports in February.—The U.S. electrical exports for the month of February established a new record. The previous record of last November was exceeded by nearly $168,000. An increase of over $1,259,000 occurred as compared with February, 1915. For the four electrical classes for which numbers of articles exported are given in the official reports, there were shipped in February the following:—Electric fans, 1,872; arc lamps, 112; carbon-filament lamps, 86,471; metal-filament lamps, 580,667.

	Feb., 1916.	Feb., 1915.
Batteries	$104,712	$109,214
Dynamos or generators	112,965	127,565
Fans	30,637	10,206
Insulated wire and cable	217,764	95,641
Interior wiring supplies, &c. (including fixtures)	133,500	67,648
Lamps—		
Arc	1,761	8,031
Carbon-filament	12,898	9,862
Metal-filament	107,715	51,373
Meters and other measuring instruments	59,170	22,807
Motors	439,769	326,224
Telegraph instruments (including wireless apparatus)	2,542	5,589
Telephones	105,176	101,957
Transformers	86,414	46,646
All other	1,527,588	700,804
Total	$2,942,611	$1,683,567

In February there were also shipped 19 electric locomotives valued at $134,405; these are not included in the above table.

For the eight months ended February 29th, 1916, the total value of electrical exports was $18,581,180; for the corresponding period ended February 28th, 1915, the total was $12,205,421; for the corresponding eight months of 1913-14, it was $17,725,804.—*Electrical Review and Western Electrician.*

Pay Wallets.—An ingenious pay wallet has been devised by Messrs. Martin Billing, Son & Co., of Livery Street, Birmingham. It consists of a sheet of stout paper, ruled for a statement of gross and net wages, and deductions for insurance, &c., so arranged that on folding it with Treasury notes and loose cash inside, and sealing two flaps, the coins can be inspected through perforations and the value of the notes ascertained, yet nothing can be withdrawn from the wallet without tearing it open. Thus there can be no dispute as to whether the wallet contained the correct sum when handed to the workman, as the latter can check the amount and return the wallet unopened if he is dissatisfied. The workman's name and number and the statement of wages can be read without opening the wallet. The device should prove very useful in safeguarding against loss by error or fraud, and preventing disputes.

Book Notices.—"The Year-Book of Wireless Telegraphy and Telephony for 1916." London: Wireless Press, Ltd. Price 3s. 6d. net.

"Science Abstracts." A and B. Vol. XIX. Part 5. May 25th, 1916. London: E. and F. N. Spon, Ltd. Price 1s. 6d. each section.

"The Economical Use of Coal." By John H. Anderson, Purfleet. From the Author: price 1s. post free.

The *Faraday House Journal* for the Summer Term contains a further list of students serving in the allied forces, biographical and obituary notices, and examination results for 1916, as well as the usual personal items, &c.

Bankruptcy Proceedings.—G. E. Bonner, electrical agent, Palmer's Green.—June 21st is the last day for receipt of proofs for dividend. Mr. E. W. J. Savill, trustee, 14, Bedford Row, W.C.

F. C. Poulton, consulting and inspecting engineer, Eccles.—June 21st is the last day for receipt of proofs for dividend. Mr. J. G. Gibson, trustee, Byrom Street, Manchester.

For Sale.—The County Borough of Barnsley has for disposal two 75-kw., high-speed, D.C., direct-coupled, generating-sets. See our advertisement pages to-day.

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Dissolutions and Liquidations.—LAKE & CURRIE, consulting engineers, Norfolk House, Laurence Pountney Hill, London, E.C.—Messrs. H. W. Lake and D. Currie have dissolved partnership.

EASTON LIFT CO., LTD.—This company is winding up voluntarily, with Mr. H. G. Holmes, 33, Paternoster Row, E.C., as liquidator. A meeting of creditors is called for June 15th, at Express Works, Southwark.

BRITISH AND COLONIAL LIGHTING CO, LTD.—A meeting is called for July 7th, to hear an account of the winding up from the liquidator, Mr. C. W. Rooke, 46, Queen Victoria Street, E.C.

AMERICAN ADDING MACHINE CO, LTD.—A meeting is called for July 7th, at 18, St. Swithin's Lane, E.C., to hear an account of the winding up from the liquidator, Mr. D. L. Honeyman.

WESTON ELECTRIC LAMP CO., 1 and 3, Sun Street, Finsbury, E.C., electric lamp factors and agents.—Messrs. C. S. Engzelius and J. S. Nunn have dissolved partnership. Mr. Engzelius attends to debts, and continues the business.

Trade Announcement.—MESSRS. BERRY, SKINNER AND CO. announce that in future the address of their head offices will be "The Switch House," 86, Newman Street, Oxford Street, W., where extensive premises have been acquired. Telegraphic address, "Ptolemaist Ox., London"; telephone Nos., "Museum 3310 and 3311."

Lamp Discounts.—MESSRS. SIEMENS BROS. DYNAMO WORKS, LTD., of Upper Thames Street, E.C., have issued a notice withdrawing the 7½ per cent. preferential discount on Wotan, half-watt, and tantalum drawn-wire lamps, as from June 1st, owing to the increased cost of raw material and labour, and the difficulties arising from the shortage of both.

LIGHTING AND POWER NOTES.

Aberdeen.—The total number of units generated during May at the Corporation electricity station amounted to 1,213,870, an increase of 285,360 units over the preceding month; an application has been received from a local shipbuilding firm for a power supply, and that the Electricity Committee has approved a recommendation that the firm be supplied with 400 H.P., on a three years' guarantee of energy consumption. A three-phase E.H.T. supply will be given to a sub-station in the yard.

Accrington.—The Tramways and Electricity Committee has decided that the whole of the fire insurance of its depôt shall be undertaken by the Corporation's own fire insurance fund.

The borough treasurer reports that of £26,250 borrowed under a sanction of June, 1900, for the electrical undertaking, provision for repayment had been made to the extent of £25,655 up to March, 1916, leaving a balance of £595.

The Electricity Committee has decided that the sum of £1,000 be repaid to rate funds during 1916-17, which will leave the balance owing at £3,558.

Barrow-in-Furness.—YEAR'S WORKING.—The report of Mr. Burnett, the borough electrical engineer, on the working of the Corporation electricity undertaking for the year ended March last, discloses an exceptionally prosperous state of affairs. Whereas in the previous year the units sold totalled 3,597,410, the total for 1915-16 reached 13,806,254 units, an increase of 10,208,844 units in the year. Of this total, over 12 million units represent power supply. The maximum load was 3,905 KW., and the load factor 40·36 per cent., these comparing with 2,285 KW. and 17·97 per cent. in 1914-15. Considerable increases were also shown in the lighting and tramway supply, but naturally public lighting units show a large reduction. The effect of this abnormal increase in power units, sold at an average price of ¾d. per unit, on the finances of the undertaking is of considerable interest. The revenue during the past three years was made up as follows:—

	1913-14.	1914-15.	1915-16.
Private lighting, &c. ...	£11,310	£13,286	£14 350
Power and heat	3,432	7,692	38,929
Public lighting	1,467	1,426	1,151
Traction	3,492	3,709	4,233
Meter rents, &c.	448	472	545
Total receipts	£20,149	£26,585	£59,208
Total costs	£11,460	£13,867	£34,809
% costs to receipts	56·87	52·16	58 79
Gross profits	£8,689	£12,718	£24,399
% gross profits to capital expenditure	6·68	8·55	14·80
Working costs per unit ...	1·32d.	·92d.	·605d.
Average price per unit ...	2·27d.	1·74d.	1·02d.
Net profit	£513	£3,163	£12,804

Some 382 motors of 2,760 H.P. are now connected to the mains, 94 being hired, and hired apparatus for heating and cooking has also attained respectable proportions. In regard to the domestic use of apparatus, Mr. Burnett mentions that the average consumption of a large number of domestic consumers in one district is now three times what it was four years ago.

During the year 723 new consumers were connected, and although many represent workmen's dwellings, the number of lamps added amounts to 63,067 30-watt lamps.

As regards working conditions, Mr. Burnett points out that increased price of coal represented no less than £6,000 or ·087d. per unit sold. Nearly 95 per cent. of the total output was generated by two turbo-alternators, which have run practically continuously, frequently overloaded, month after month, and demonstrated the reliability of this type of plant. The large increase in output was only rendered possible by the E.H.T. scheme carried out three years ago, when capital charges amounted to ·94d. per unit, as against ·20d. now.

In concluding, Mr. Burnett points out that capital repaid, revenue expenditure of a capital nature and renewals fund amount to 44 per cent. of the total capital expenditure; the whole of the balance of net profit, after meeting certain expenditure, has been placed to renewals.

The report is of great technical interest and is worth careful study.

Birmingham. — YEAR'S WORKING. — With further reference to the report of the Corporation electricity department for the year ended March 31st last, during the year the capital account was increased by £145,652. On buildings, including the ferro-concrete work and railway sidings at Nechells permanent station, and the cooling tower foundations at Summer Lane and small additions at sub-stations, £22,373 has been expended; the greater part of the £72,928 expended on machinery has been incurred at the Nechells temporary station, retention money on turbo-alternator and cooling towers at Summer Lane, and switchgear and converters at the Parker Street, Bordesley and Saltley sub-stations.

Mains and services cost £50,830. The total number of units sold, as compared with the previous year, was as follows:—

	Units sold.	
Low tension—	1916.	1915.
Lighting	9,064,172	8,726,306
Power	27,479,308	21,460,141
High tension	53,169,118	28,536,161
Tramway supply ...	27,303,723	24,186,574
Total	117,016,321	82,909,182

The output for lighting and power, exclusive of tramways, shows an unusual increase, the units sold being 52·8 per cent. higher than in the previous year. This is due to the large amount of power taken by manufacturers on Government work. The increase in the output for the tramway supply was 12·9 per cent. The balance of the revenue account, £191,283, represents the gross profits of the undertaking.—*Birmingham Daily Post.*

Blackpool.—YEAR'S WORKING.—According to figures presented to the Finance Committee, on June 1st, the electricity department made a profit last year of £2,478, and expects to make a profit this year of £2,000; and the tramways department made a profit of £16,275, and this year expects to make £10,000 profit.

The Electricity Committee has decided that no further applications for supply under the ratable value tariff be accepted during the war.

Bolton.—The Electricity Committee having received a letter from the B. of T. (railway department) calling attention to the question of possible economy in national resources that could be effected by a system of interconnection of electrical supply undertakings, the engineer has been requested to prepare a report on the matter.

Bradford.—PROPOSED PLANT EXTENSION.—The Electricity Committee has recommended the City Council, in view of the ever-growing demands upon the electricity department, to make application for sanction to borrow £100,000 for the purpose of extending the plant.

Canada.—An agreement has been entered into by the City of Edmonton, with the Alliance Trust Co., of Calgary, for a temporary supply of power until the new hydro-electric plant of the Edmonton Power Co. is ready for operation.—*Canadian Electrical News.*

Continental.—GERMANY.—The Daylight Saving scheme has brought some trouble in its train in Germany, for we learn that the leading electricity supply company in Berlin declines to recognise the new "summer time," and that it will not switch off the current furnished for hall and corridor illumination until 10 p.m., as hitherto, *i.e.*, what is now 11 p.m., and will charge accordingly. It justifies its action by the cost of re-adjusting its switching-off system, which would have to be re-altered in the autumn.

SPAIN.—Application has lately been made for a concession to establish a plant to utilise the water power of the river Toran, near Canejan (Province of Barcelona), in the generation of electrical energy for lighting and power purposes in the district.

Plans have been prepared for a new electricity generating station at Medina de Pomar (Province of Burgos). The water power of the river Nela will be utilised, an application having been made to the Spanish Government for the necessary concession.

A concession has lately been granted for the establishment of a plant to utilise the water power of the river Segas, near Tejos (Province of Santander), in the generation of electrical energy for lighting and power purposes in the district.

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FRANCE.—The present and future of the hydroelectric industry in the French Alpes region is set out in a recent issue of the *Revue Electrique*. The region embraces one-tenth of the total area of France, and includes the departments of Haute-Savoie, Savoie, Isère, Drome, Hautes Alpes, Basses Alpes, Vaucluse, Bouches du Rhone, Var, and the Alpes-Maritimes, and the basins of 37 rivers. The installed water-power in December, 1910, of this region amounted to 473,000 H.P., which had increased by December, 1915, to 738,000 H.P., or by 255,000 H.P. in the five years. The utilisation of this power in the latter year was industrially subdivided in H.P. as follows:—Power and light, 291,000; metallurgy, 255,000; electrochemistry, 147,000; traction, 10,000; saw-mills, paper-making, wood-working, 30,000; sundry (lime, cement, weaving, &c.), 8,000 H.P. The number of electric works in 1910 was 126, and in 1915, 205, or an increase of 79 in the five years. Their capacity varied as follows:—Up to 100 H.P., 9 in 1910 and 26 in 1915; 101 to 500 H.P., 43 and 70 respectively in the two periods; 501 to 1,000 H.P., 14 and 19; 1,001 to 5,000 H.P., 30 and 43; 5,000 to 10,000 H.P., 17 and 19; and 10,000 H.P. and upwards, 13 and 28 in the years 1910 and 1915 respectively. The electric plants of 500 H.P. and under mostly furnish light to small localities, whereas those above that figure are allied to large industries. The constant calls for energy, as well as the demand created by the increasing scarcity of imported coal, have created a situation such that the distribution companies constantly find themselves unable to meet demands. In consequence, many important undertakings for the utilisation of waterfalls are being taken in hand, and the next quinquenium's advance is likely to more than equal that of its predecessor.

ITALY.—A society has been formed at Turin with the title "Comitato Torinese per lo Sviluppo Hidroelettrico," which, as in the case of the Associazione Elettrotecnica Italiana, is intended to further the utilisation of Italy's water resources by hydro-electric plants. Influential personages and bodies in the Province of Piedmont have joined the board.

The Società Anonima Lugugnanese has been formed at Portobuffolé, with a capital of 35,000 lire, to supply electric current in an area which includes the town of Lugugnana. The Society proposes to purchase energy.—*Rivista Tecnica d'Elettricità.*

Exeter.—PRICE INCREASE.—The T.C. has decided to increase the charge for electricity for lighting from 4d. to 5d. per unit, as from July 1st next. It is estimated that the Daylight Savings Bill will reduce the income by £500, while restricted street lighting means a reduction of £1,250 for the year.

Finchley.—PRICE INCREASE.—The D.C. has decided to increase the price of current for private lighting by 20 per cent. in lieu of the increase of 10 per cent. previously decided upon. The increased price will apply after the June quarter. The price of current for power purposes will also be increased as from the above-mentioned date as follows:—(*a*) Consumers with a load factor of 33⅓rd per cent. or less, by 10 per cent.; (*b*) exceeding 33⅓rd per cent., the increase to be the percentage amount of the excess fuel cost over ·9d. per unit generated, with a limit of 10 per cent. It is also proposed to suspend, on and after August 1st next and during the period of the war, the clause of the general conditions of supply relating to free service connections.

Glasgow.—YEAR'S WORKING.—The electricity department has achieved a record output for the year ending May 31st, consequent largely upon the huge demands for power made by the different factories, shipyards and other establishments engaged on national work. The output for 1915-16 amounted to 130,000,000 units against 104,000,000 units in 1914-15, while the revenue was £500,000 against £400,000 respectively, an increase approximately of 30 per cent. So great was the demand that an overload was carried throughout practically the whole winter, a state of affairs which would have been obviated had the new works at Dalmarnock—a portion of which would have been in operation, but for shortage of labour and material—been ready.

Grimsby.—The Public Lighting Committee is recommending the T.C., in view of the fact that in the current year £966 has been taken from the reserve fund of the electricity undertaking to pay for extensions of mains and services, for which no loans are available, to transfer the whole of the balance of net revenue (£640) to the reserve fund.

Ilford.—REFUSE DESTRUCTOR REPORTS.—The question of utilising the steam from the destructor works has formed the subject of recent reports from the Council's officials. The surveyor estimates that some 75,000 lb. of steam per day should be available, and Mr. Shaw, the borough electrical engineer, describes three schemes by which this could be utilised in supplying electricity, giving respectively 551,000, 735,000, and 1,200,000 units delivered at the Ley Street works. For reasons given, either the first or second scheme is preferred, both involving the transfer of machinery from Ley Street to the destructor. Mr. Harvey, the tramway manager, says it is evident that neither of the first two schemes would alone provide the requisite energy for the tramways, and that the third scheme could not be carried out under present conditions.

Ilkeston.—SALE OF E.L. AND TRAMWAYS.—The Tramways and Electricity Committee has recommended the Corporation to accept the offer of the Notts. and Derbyshire Power Co. to take over the tramways and electricity undertakings on certain terms. The matter has been considered by the Council as a General Purposes Committee, and it was decided, by a large majority, to sell the undertakings, and the resolution to that effect will be submitted to the ordinary meeting of the Council for confirmation. The tramways have been in existence for 18 years.—*Sheffield Telegraph.*

India.—The Karachi Cantonment Committee has decided to light the streets by electricity.—*Indian Engineer.*

Keighley.—HOSPITAL LIGHTING.—The Keighley and Bingley Joint Hospital Board last week decided upon an installation of electric lighting in the permanent hospital buildings, at a cost of £216.

Lancaster.—YEAR'S WORKING.—The report of the Council's electricity department shows an income of £10,170, against £9,111 in 1914-15; the expenditure increased by £1,865, coal accounting for £1,119. While there was a decrease in lighting, there was an increase of 160,346 power units. For the first time since 1896, there was a deficit amounting to £393—less than anticipated, and met from the reserve fund, which now stands at £3,561.

Leek.—The U.D.C. has received the report of Dr. Watkinson, of Liverpool, on the breakdown at the electricity works, and it is being considered in conjunction with the report of the Council's own engineer.

Leyton.—STREET LIGHTING.—The Highways Committee of the D.C. has agreed to the electric lighting department's proposal to make a charge of £10 per lamp per annum for lighting arc lamps converted for incandescent lighting. The department is making no charge for carrying out the conversion, the cost of which is estimated at £100.

Liverpool.—The Corporation has been recommended by the Finance Committee not to approve the resolution of the Tramways and Electric Power and Lighting Committees to increase the pay of certain of their employés by ½d. per hour, but that a war bonus of 1s. 6d. per week should be given to all men in the Corporation employ on certain conditions.

Llanfyllin.—STREET LIGHTING.—The T.C. has decided to accept the offer of Mr. R. A. Jones to light the streets by electricity at £2 per lamp for 21 lamps, for a period of one year, subject to renewal; the town clerk is to prepare the agreement.

London.—HAMMERSMITH.—The L.C.C. has sanctioned the borrowing by the B.C. of £3,000 for electrical extensions, under the usual war conditions.

WESTMINSTER.—With reference to the amended terms for the supply of current to the City Council's buildings by the Charing Cross Co., the Council has been recommended to agree that the contract should be for one year ending June 24th, 1917, determinable at the end of that period, or on any quarter-day thereafter, by three months' notice.

Maidstone.—PRICE INCREASE.—The T.C. has adopted a new scale of charges for current, which are some 25 per cent. above the original prices.

Reigate.—The T.C. has decided to further overdraw the electric lighting capital account to the extent of £231, in order to enable certain work to be carried out for increasing the capacity of the two sub-stations. It was stated that the heating and power supply had increased 36·25 per cent. up to March last.

Rochdale.—PLANT EXTENSION.—Although the formal sanction of the L.G.B. has not yet been given to the expenditure of £10,157 on extensions at the electricity works, it is reported that an intimation has been received that the sanction will be given, and, acting on this, contracts for the work have been let.

Salford.—The Electricity Committee recommends the T.C. to agree to a reduction of 2½ per cent. in the normal contract charges for the supply of energy to the works of Messrs. R. Haworth & Co.

The Committee has decided to temporarily delete Clause 31 (relating to penalty for late completion of contracts) of the Model General Conditions of the I.E.E. from contracts entered into on such conditions.

South Africa.—The Cape Provincial Council has passed an ordinance whereby it will hereafter be lawful for any undertaker of a public electrical supply to supply electrical energy outside the area of a local authority, subject to the consent of the Administrator being obtained. The immediate object of the ordinance is to enable the Municipality of Oudtshoorn to supply electric lighting to the Divisional Council of the district, so that the Cango Caves may be illuminated.

Spenborough.—YEAR'S WORKING.—There is a loss of £152 on the Council's electricity undertaking for the past year, as compared with £600 for the previous year. This is considered satisfactory in view of the fact that there was an extra expense of £138 over which the Council had no control.

Sunderland.—YEAR'S WORKING.—The last year's working of the Corporation electricity department resulted in a revenue of £71,102, including £37,304 from power supply. After meeting working expenditure a balance remained of £30,636, and after providing for interest and sinking fund charges, the balance of £1,032, being net profit, was carried to renewals. The output sold amounted to 15,056,376 units, an increase of 3·84 per cent.; the load factor also improved from 26 to 31 per cent. The manager, Mr. Blackman, refers to narrow margin of plant capacity, and points out that the breakdown of a generator had led to estimated additions to working cost of £3,500.

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Wisbech.—Price Increase.—The T.C. has agreed to allow the Electricity Supply Co. to increase the price of energy for lighting to not more than 6½d. per unit, owing to the great increase in the cost of fuel.

TRAMWAY and RAILWAY NOTES.

Blackpool.—Electric Vehicle.—The Finance Committee has sanctioned the purchase by the Cleansing Committee of a second electric water-sprinkler, at a cost of about £1,000.

Bolton.—Electric Vehicle.—A deputation from the Electricity Committee having recommended the advantages of electrically-propelled vehicles, the Waterworks Committee has decided that it will consider the views put forward by the deputation when the question of motor transport is next before the Committee.

Female Labour.—The tramway manager reported a difficulty in obtaining suitable labour for car cleaning in the night time, and has been authorised to employ women for the work. It was reported that 154 employés of the department were serving with the Colours and 18 had still to go. Forty women conductors were now employed.

Glasgow.—Year's Working.—The official returns of the last year's working of the Corporation tramways show that the traffic receipts amounted to £1,149,264, an increase of £178,570 on the previous 12 months. The passengers numbered 362,371,464, an increase of 26,110,706, and the car-mileage was 24,963,309, an increase of 748,849. The receipts per car-mile were higher, although the receipts per passenger were slightly decreased. It is noteworthy that 232,871,360 passengers were carried at ½d. fares as against 93,768,671 at 1d. fares.

Lancaster.—Year's Working.—The borough accountant reports a traffic revenue of £5,696 on the Council's tramways, against £5,533 in the previous year, an increase of £163. The expenditure increased by £435, but £500 has been set aside for depreciation. After paying interest and redemption, the net deficit is £2,012.

Leeds.—Female Labour.—The tramway manager (Mr. J. B. Hamilton) has expressed his complete satisfaction with the women conductors, of whom he has now over 400. The employment of the women has released between 400 and 500 men for military service. The pay, with overtime, reaches 30s. a week.

Manchester.—Wages.—As from June 1st, a war bonus is to be paid to the paviors, &c., in the tramway department. The Tramway and Vehicle Workers' Union has applied on behalf of the traffic staff for an additional war bonus, and the Workers' Union has applied for an advance of wages for certain classes of workmen. Both applications have been refused.

North London Electrification.—On Saturday morning last, a successful trial run was carried out on the recently electrified line between Broad Street and Richmond.

Nottingham.—Year's Working.—The total receipts on the working of the Corporation tramway undertaking for the 12 months ended March 31st last amounted to £195,392, an increase of £16,077 compared with the previous year. Working expenses amounted to £121,266, an increase of £8,682, leaving a balance of £74,125, an increase of £7,394, carried to net revenue account. After providing for interest on loans, contribution to sinking fund, &c., the balance is to be divided, £20,350 going in aid of the rates, and £13,150 to reserve and renewals fund. During the 12 months the cars ran 3,885,322 miles, an increase of 95,465 miles over the previous year, and carried 45,741,208 passengers, an increase of 4,530,246. Since the commencement of the war 228 men have joined the Colours, and 62 left the service for munition work or other employment. There are upwards of 100 women conductors in the service, and the majority are carrying out their duties in a quite satisfactory manner. The difficulty of finding drivers has become serious, as men are leaving faster than they can be replaced. Further, the reserve of conductors suitable for training for drivers is exhausted, and very few applications for employment are being received.

Sunderland.—Year's Working.—The total receipts of the Corporation tramways for the last year amounted to £79,124; traffic expenses amounted to £20,915, and the balance carried to net revenue was £34,669. From this amount, interest and sinking fund charges were paid, £5,000 was placed to rate relief, £9,784 to renewals, and other expenditure was met. The passengers carried numbered 19,908,911 as against 18,619,364 in 1915.—*Northern Press Agency.*

Swansea.—Tramway Power-Plant Purchase.—At the last meeting of the B.C., it was reported in connection with the negotiations to take over the Tramway Co.'s power station, that the company had now acquired the freehold, which would be transferred to the Corporation instead of the leasehold interest. Under the agreement, the Corporation has undertaken to purchase the plant and machinery for £10,000, payment to be spread over 26 years at £400 per annum.

TELEGRAPH and TELEPHONE NOTES.

A Wireless Record.—It is reported that the American steamer *Ventura*, which has just arrived at Sydney from San Francisco, states that she picked up wireless messages from the station at Tuckerton, New Jersey, when she was 9,000 miles distant from that place. This is claimed to be a world's record.

Ashton-under-Lyne.—The substitution of junction for trunk circuits between Manchester and adjoining towns has been extended to Ashton-under-Lyne, with which are associated Mossley, Mottram, and Hyde.

Norway.—The Western Electric Co., Ltd., has received from the telegraph department a contract for nine automatic telephone exchanges for Christiania, having a total capacity of 30,000 lines and 35,000 subscribers' stations. The work will occupy a period of six years.

Russia.—Some time ago the Pan-Russian District Councils' League organised a telephone factory in Moscow on a small scale. As such apparatus, and most of the parts thereof, had previously been imported, the first efforts to make a complete telephone apparatus without importations met with serious mechanical difficulties. However, under pressure of the absolute necessity of having such apparatus, by the application of all available technical skill the difficulties were overcome, and solid progress has been made. The factory now employs over 200 hands, and the total production is over 50 apparatus per day.

Trans-Atlantic Telegraphy.—During the Irish rebellion many of the Atlantic cables landing on the West Coast of Ireland were for some days deprived of their land-line connections with the cables connecting Ireland with England, and were thrown idle, while the cables having direct submarine connection with England had to deal with an enormously increased traffic.—*T. and T. Age.*

The German Post Office has made arrangements to permit Swedish telegrams to be transmitted to the United States by German wireless telegraphy, subject to certain conditions.

United States.—The naval administration of the U.S. Government proposes to erect three large wireless stations, one at San Diego, California, one at Cavite in the Philippine Islands, and the third at Pearl Harbour, Hawaii. The last two will have a range of about 9,000 km., which is the distance from San Francisco to Paris. The contract has been placed with an American company. The new stations will enable the United States to communicate with Japan by wireless telegraphy.—*Journal Télégraphique.*

Wireless Telephony.—From May 6th to 8th wireless telephony was employed to transmit orders between the U.S.A. Government at Washington and the U.S. battleship *New Hampshire*, in Hampton Roads; the telephone was also used for communication with naval stations at New York, San Diego (Cal.), Pensacola (Fla.), and other places. During the test the *New Hampshire* was ordered to sea, and returned to her station, reporting by wireless telephone at every hour. The demonstration was successful in every respect.—*T. and T. Age.*

CONTRACTS OPEN and CLOSED.

OPEN.

Ashton-under-Lyne.—June 14th. Engine slack, for the Electricity Committee. Particulars from Borough Electrical Engineer, Wellington Road. Tenders to Mr. J. Neal, Borough Comptroller.

Australia.—Perth.—July 19th. P.M.G. Supply of insulators (Schedule 510). See "Official Notices" to-day.

August 16th. P.M.G. Distilling apparatus (Schedule 502), telegraph and measuring instruments (Schedule 498). See "Official Notices" to-day.

Melbourne.—July 26th. Victorian Railways Commissioners. 400 signal lighting transformers.

Sydney.—August 24th. P.M.G. Automatic switchboard and apparatus for North Sydney Exchange. Schedule No. 511.

Brisbane.—July 31st. P.M.G. Power board and accumulators. Schedule No. 381.

Halifax.—June 17th. Steelwork over the dam at the electricity works. Mr. James Lord, Borough Engineer, Town Hall, Halifax. Deposit £1 (returnable).

Keighley.—June 10th. Fitting up the Keighley and Bingley War Hospital, Morton Banks, with electricity. Messrs. Moore & Crabtree, Architects, Keighley.

London.—St. Pancras.—June 13th. B.C. Twelve months' supply of steam coal for the Electricity Department Borough Electrical Engineer.

L.C.C.—June 19th. Asylums and Mental Deficiency Committee. Electric lamps for three months. Mr. H. F. Keene, Clerk, 2, Savoy Hill, Victoria Embankment, W.C.

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New Zealand.—PAHIATUA.—July 10th. Borough Council. Overhead wires, poles, street lamps, gas engines, producers, dynamos, auxiliary apparatus and accumulators. Specifications from Borough Offices or Mr. E. J. Fenn, Consulting Engineer, Auckland.*

INVERCARGILL.—September 28th. Borough Council. Steam turbo-alternator, condensing plant and switchgear. Specifications from the Tramway Office.

Spain.—June 22nd. Municipal authorities of Sancti Spiritus (Province of Salamanca). Concession for the electric lighting of the town during an undetermined period.

June 28th. Municipal authorities of Infantes (Province of Ciudad Real). Concession for the electric lighting of the town during a period of five years.

The municipal authorities of Puebla del Maestra (Province of Badajoz) have lately invited tenders for the concession for the electric lighting of the town during a period of 10 years.

Stoke-on-Trent.—Coal and slack for the Corporation electricity works for a year. Chief Electrical Engineer, St. Peter's Chambers.

Torquay.—June 19th. Corporation. 5,500 tons of coal for use with mechanical stokers for the Electric Lighting Commitee. Mr. F. S. Hex, Town Clerk.

West Ham.—June 22nd. B. of G. Electrical fittings for three months. Mr. T. Smith, Union Offices, Union Road, Leytonstone, N.E.

Wolverhampton.—June 16th. Electricity Department. Coal and ash-handling plant. See "Official Notices" to-day.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Bury.—T.C. Washed slack, for the electricity works: Pemberton Colliery Co., Ltd.

Dewsbury.—Electricity and Tramways Committee. 2,000 tons of coal, for the electricity works: Crawshaw and Warburton, Ltd.

Installation Contracts.—The following contracts were placed with Messrs. H. J. Cash & Co., Ltd., during May:—

Admiralty.—Electric lighting installation, Chatham.
War Office.—Provision of L.T. cables and distributors, and electric light installation, Dover. Special fittings for operating theatres.
Post Office.—Electric power circuits and mains, telegraph factory, Birmingham.
L.C.C.—Electric light installation, Southampton Street School, Camberwell; ditto, Haverstock Hill School, London, N.W. (See list of tenders below.)

Keighley.—The Keighley and Bingley Joint Hospital Board. Accepted tender: Craven and District Private Telephone and Electric Co., at £216, for the electric lighting of the permanent hospital buildings and the sanatorium.

Leyton.—The District Council is entering into a year's contracts with the Electrical Apparatus Co., Ltd., the Reason Manufacturing Co., Ltd., and Messrs. Chamberlain & Hookham for ordinary electricity meters; also with the B.I. & Helsby Cables, Ltd., for slot meters. The British Thomson-Houston Co. wrote stating that under present conditions they were unable to enter into a contract, as their meter factory was otherwise engaged.

Llanfyllin.—T.C. Accepted tender for the lighting of the streets by electricity for one year, subject to renewal: Mr. R. A. Jones.

London.—London Education Committee. Tenders for installing electric light in the undermentioned schools:—

SOUTHAMPTON STREET, CAMBERWELL.

H. J. Cash & Co., Ltd. .. .. (accepted)	£446
Alpha Manufacturing Co.	491
Foote & Milne, Ltd.	504
Lund Bros. & Co.	506
Alex. Hawkins & Sons	526

HAVERSTOCK HILL, ST. PANCRAS.

H. J. Cash & Co., Ltd. .. .. (accepted)	£201
W. C. Tackley & Co., Ltd.	305
Tredegars, Ltd.	352
Foote & Milne, Ltd.	378
Pinching & Walton	410

The Committee will open and accept tenders received during the Whitsuntide recess for installing electric light in the County Secondary School, Forest Hill.

HAMMERSMITH.—Tenders received by the B.C. for panels required for new switchboards at Shepherd's Bush sub-station:—

Park Royal Eng. Co. (accepted)	£18	Ferranti, Ltd.	£29
Edison & Swan	19	Johnson & Phillips	30
Switchgear & Cowans	20	Electric Construction Co. ..	31
Reyrolle & Co, ...	21	Siemens Bros. & Co.	38
Bertram Thomas	25	General Electric Co.	41

Manchester.—Electricity Committee:—

L.P. pipework and valves.—Alton & Co., Ltd.
Switchgear.—B.T.H. Co., Ltd.
Two water-tube boilers, drain pipes.—Babcock & Wilcox, Ltd. (Sub-contractors: Economisers, E. Green & Sons, Ltd.; lagging, Newall's Insulation Co., Ltd.)
Cable.—Pirelli-General Cable Works, Ltd.
10,000-kw. turbo-generator, also switchgear.—B.W. Electric & Manufacturing Co., Ltd.
Two motors.—Phœnix Dynamo Mfg. Co., Ltd.

Tramways Committee. Accepted tender:—
Block tin.—Williams, Harvey & Co., Ltd.

Salford.—Electricity Committee. Accepted tenders for materials to March next:—

W. T. Glover & Co., Ltd.—Unarmoured cable, schedule of prices.
Key Engineering Co., Ltd.—Fibre pipes, approx. £100.
Doulton & Co.—Stoneware pipes, troughs, &c., £500.
Albion Clay Co.—Stoneware conduits, £200.

Also accepted:—

United Electric Car Co., Ltd.—Permanent-way wagon body, £159.
British Westinghouse Co., Ltd.—Auxiliary steam turbine, £740.
G. & J. Weir, Ltd.—Two roto-feed pumps, £560.

Tenders have also been accepted for the erection and equipment of a sub-station in Blackfriars Road as follows:—

Wm. Gornall.—Building, also machine foundations, £3,280.
British Westinghouse Co., Ltd.—Three-phase E.H.P. switchboard, £1,203.
Bertram Thomas.—Continuous-current switchboard, £2,215.

Materials required in connection with the Willans & Robinson 5,000-KW. turbo-alternator:—

Stewarts & Lloyds, Ltd.—Steel pipes and separator, £159.
Stanton Ironworks Co., Ltd.—Cast-iron pipes and valves, £772.

The Electricity Committee has approved the proposal of Messrs. J. Gerrard & Sons, Ltd., to sub-let the steelwork portion of the contract for the foundations for a turbo-generator to Messrs. Thomas Prickett & Sons.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Friday, June 9th. At 5.30 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Eyesight and the War," by Dr. E. Clarke, F.R.C.S.

Chief Technical Assistants' Association.—Saturday, June 10th. At 3 p.m. At the Tavistock Hotel, Covent Garden, W.C. Discussion on "The Advantages and Disadvantages of Various Types of Mechanical Stokers."

Institution of Electrical Engineers.—Thursday, June 15th. At 5.15 p.m. At the Institution Building, Victoria Embankment. Special meeting of Corporate Members to confirm the resolution to exclude alien enemies from membership.

Chemical Society.—Thursday, June 15th. At 8.30 p.m. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

Physical Society of London.—Friday, June 16th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Ordinary meeting.

NOTES.

Power and Heat for Chemical Plants.—In a letter addressed to *Met. and Chem. Engineering*, attention is drawn to the great economy that can be effected by using exhaust steam for heating purposes. The writer says:—

"If it be assumed that 25 per cent. of the heat units of the coal is required in the development of electric energy in an electro-chemical plant employing steam, *then that plant should be developed for utilising the remainder of the available heat units of the fuel* (chiefly in the form of the latent heat of the steam) in multiple-stage evaporating, &c. By so doing the electric energy required for the electrochemical work would be largely a by-product. There are many purely chemical operations where a large preponderance of heat over power is necessary.

"It is conceivable that great plants where heat (at low temperatures) is king, might well put in electric generators and thus obtain electric energy at very low cost. There are great industries in practically all manufacturing communities, where the two great forms of energy, heat and electricity, might mutually complement each other. As the situation now stands, we have great central lighting and power stations wasting 75 per cent. of the heat units of the coal in condensing the steam; and, on the other hand, we have vast sugar refineries and other industries whose chief need is steam-heat. From a heat standpoint they should operate in combination."

If this course were followed, not only could steam compete with water-power, but it might even be found to possess an advantage over the latter.

Clyde Valley Workers.—Mr. James Macdonald, Edinburgh, arbitrator under the Munitions of War Act, has rejected the claims of the labourers employed by the Clyde Valley Electrical Power Co. for increased wages, time-and-half overtime rates, and double pay for Sunday work.

Cobalt for Thermocouples.—In a paper read before the American Electrochemical Society, Prof. O. L. Kowalke advocated the use of cobalt in thermocouples, stating that it was strong and gave a high E.M.F., did not grow brittle like nickel, and could be obtained in a fairly pure state. The combination of cobalt and constantan gave a particularly satisfactory couple. Unfortunately, at present the metal is costly.

Safety Lamps.—The Home Secretary has approved the following safety lamps for coal mines:—

Best's "Excelsior" Lamp, No. 8.
Best's "Gauzeless" Lamps, No. 1 and No. 1A.
"Prestwich Patent Protector 08" Lamp.
Rothwell and Co.'s "A8," "B8," "C8," "D8," and "E8" Lamps.
Teale's Museeler or Thornburry No. 6 and No. 6A Lamps.
Teale's No. 1 Miners' Electric Safety Lamp.

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Foreign Trade.—The May Figures.—The following are the electrical and machinery figures given in the official returns for May :—

	Month of May.	Inc. or dec.	Inc. or dec. to date compared with 1915.
Imports.			
Electrical goods and apparatus, excluding machinery and uninsulated wire... ...	£186,489	+ £98 901	+ £294,569
Machinery	886,846	+ 84,957	+ 70,969
Exports.			
Electrical goods and apparatus, excluding machinery and uninsulated wire	381,161	+ 147,591	+ 367,977
Machinery	1,920,850	+ 90,550	− 310,417

Terrestrial Magnetism.—The report of the Astronomer Royal for the past year states that the magnetic declination is decreasing at the rate of nearly 10 minutes of arc per annum, the declination at Greenwich Observatory being now less than 15°. The magnetic dip, having passed through a minimum, is slowly increasing, and the horizontal force, after remaining at a maximum for some years, has been decreasing since 1912.

Danish Peat Fuel.—Electrical enterprise falls within the scope of the operations which the Danish Tekniske Forening have set themselves, and in 1903 that society instituted a prize of 1,000 kr. for a competitive essay for "the best means of utilising peat as a source of energy for electricity works," the object being to turn to advantage the extensive peat moors existing in Denmark. Various essays have since, at times, been submitted, showing the feasibility of utilising the gas extracted from peat for driving large electricity works. This year the society again invites essays on the best means of recovering and employing the gas for heating and driving purposes, as also the nitric acid and ammonia obtained for other uses.—*Dan Tekniske Forenings Tidsskrift.*

Patents, Designs, and Trade Marks.—The report of the Comptroller-General of Patents, Designs, and Trade Marks for 1915 states that during the year 154 applications for the avoidance or suspension of patent rights were made; licences were granted in 117 cases, 1 patent was suspended, 4 licences were avoided, 6 applications were refused, and 7 abandoned. The number of applications filed for patents was 18,191, compared with 24,820 in 1914 and 30,077 in 1913; the number of patents sealed was 11,457, compared with 15,036 and 16,599 in the two preceding years. The receipts from fees were £275,087, a decrease of £36,191, and the surplus of receipts over expenditure was £94,298, as compared with £128,062 in 1914. Renewal fees amounted to £183,929, a decrease of £1,145, and the sealing fees to £12,837, a decrease of £1,844. The number of applications for the restoration of lapsed patents was 26; 18 were granted, and others are pending. Only three patents are in force which have been prolonged beyond the normal period of 14 years.

Electric Smelting in Newfoundland.—The Hydro-Electric Smelting Co., Ltd., has recently installed an electric copper smelter at St. Johns, Newfoundland. Tests have been made on ore from the Little Bay copper mines, with satisfactory results.

Volunteer Notes.—1st London Engineer Volunteers.—Orders for the week by Lieut.-Col. C. B. Clay, V.D., Commanding.

Monday, June 12th.—Technical for Platoon No. 9, 46 Regency Street, S.W.; Squad and Platoon Drill, Platoon No. 10; Signalling Class and Recruits.

Tuesday, June 13th.—School of Arms, 6 to 7; Recruits, 7.15 to 8.15.

Wednesday, June 14th.—Platoon Drill, No. 2 Platoon.

Thursday, June 15th.—Platoon Drill, No. 6 Platoon; Shooting for No. 9 Platoon; Miniature Range; Recruits, 5.45 to 7.45; Instructional Class, 5.45.

Friday, June 16th.—Technical for No. 10 Platoon, 46, Regency Street, S.W.; Squad and Platoon Drill, No. 9 Platoon.

Saturday, June 17th.—Probable date of Inspection by Lord French. Special orders will be issued.

Sunday, June 18th.—Entrenching duties: Parade, Victoria Station (S.E. & C. Railway Booking Office), 8.35 a.m.

Macleod Yeabsley, *Adjutant.*

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, June 8th, 1916 :—

Week-End Parades.—Saturday.—The Battalion will Parade outside Baker Street Station at 2.30 p.m., and proceed by train to Wembley Park for Drill under the Commandant.

Sunday.—The Battalion will Parade at Liverpool Street Station (Low-Level entrance, G.E.R.), at 9.30 a.m., and proceed by train for Entrenching duties.

G. H. F. Duncan, *Acting Adjutant*, O.B.C., *Platoon Commander.*

Technical College for Middlesbrough.—The *Times* states that Mr. Joseph Constantine, a Middlesbrough shipowner, has given £40,000 towards a scheme for the establishment of a technical college in the town, and other local firms have promised £15,000.

Institution Notes.—National Electric Light Association, U.S.A.—At the end of last month the annual convention of the "N.E.L.A." was held at Chicago. The Association was formed in 1885, and now has a membership of over 14,700, representing, according to the *Electrical World*, nine-tenths of the electricity supply industry of the United States, which possesses an aggregate capitalisation of 600 millions sterling and an annual revenue of 90 millions.

Institution of Electrical Engineers.—On Thursday next, June 15th, at 5.15 p.m., a special meeting of Corporate Members will be held to confirm the resolution which was passed on May 25th to exclude alien enemies from membership. It is to be hoped that members will not regard this as a mere formality, and fail to attend in sufficient numbers to ratify the resolution; it is important that they should not now slacken their efforts, but be present in force to complete the work to which they have set their hands.

Inquiries.—Makers of electrical condensers of large capacity, and machinery for manufacturing small pocket batteries for flash-lights, are asked for.

Appointment Vacant.—Engineer for telephone system in India. See our advertising pages to-day.

The Organisation of British Engineering Industry.—The following resolutions were unanimously carried at a general meeting of the Council for the Organisation of British Engineering Industry (Manufacturing Engineering Concerns Section), held in Manchester on Tuesday last :—

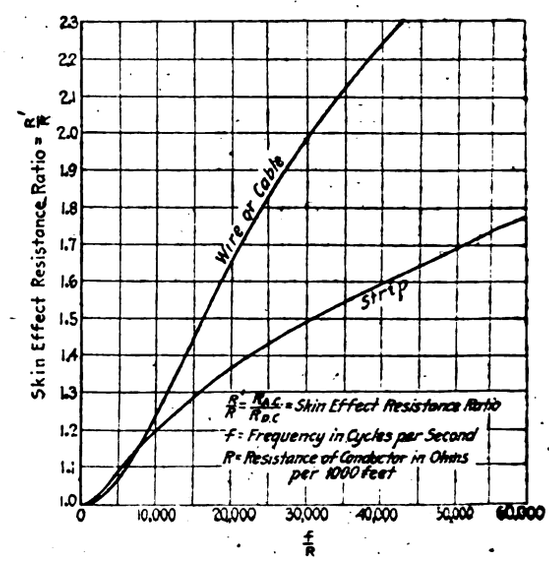
"1. That this meeting approves the steps taken to organise British Engineering Industry by the Council appointed on December 6th, 1915.

"2. That this meeting approves the formation of an Association on the lines advocated in the memorandum circulated, with power to negotiate, and if advisable to amalgamate or combine with existing or projected Associations; and this meeting pledges itself to support such an Organisation.

"3. That those firms who by signing the card have promised their adhesion and support to the Organisation be asked to subscribe to the funds of the new Association, and to make forthwith a minimum payment of £5 on account of their first year's subscription towards preliminary expenses.

"4. That the existing Committee be empowered to give effect to the resolutions passed at this meeting."

Skin Effect in Strip Conductors.—In the *Electrical World*, Mr. H. B. Dwight has given a practical way to calculate the skin effect in strip conductors—that is, the ratio of the alternating-current resistance to the direct-current resistance.



Skin Effect in Cable and Strip Conductors.

The curve shown in the figure, which is self-explanatory, applies to strip of copper, aluminium or other non-magnetic conductor. The strip should not be close to the return conductor; that is, there should be an air space between the strip and the return conductor somewhat greater than the width of the strip. The thickness of the strip should not be more than about one-tenth the width, otherwise the value of skin effect will lie intermediate between the curves for strip and wire. The curve applies to a single strip, and not to the case where two or more strips are close together and connected in parallel, as in ventilated bus-bars. The curve is applicable for any temperature, since the value of the resistance R is to be taken for the temperature required.

Resistance Alloys.—Messrs. F. M. Sebast and G. L. Gray read a paper at a recent meeting of the American Electrochemical Society on alloys of nickel and chromium with copper and manganese. They stated that an alloy of 15 Cu, 85 Ni, 30 Cr, had a very high resistivity (112 microhms per cm.^{3}), and a negligible temperature coefficient (0·000078). An alloy containing approximately 55 Cu, 45 Ni, 15 Mn had a resistivity of 70 microhms per cm.^{3}, and a zero temperature coefficient at 20° C. This they considered a better resistance alloy than any at present used for precision apparatus.

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Russian Copper Production in 1915.—According to a statement issued by the Military Industrial Committee, the total production of copper in Russia in the year 1915 amounted to 1,587,155 poods, against 1,949,721 poods in 1914 and 2,095,289 poods in 1913. The production per district in the last three years was as follows, in poods:—

	1913.	1914.	1915.
Urals	1,055,122	1,025,057	1,043,892
Caucasus	610,661	495,387	233,559
Siberia	345,273	342,881	259,423
Chemical and refining works	84,233	86,396	50,281
	2,095,289	1,949,721	1,587,155

Embargo on the "E.T.Z."—It is reported in *l'Industrie Electrique*, on the authority of the Swiss *Elektroindustrie*, that the German Government has forbidden the transmission abroad of the *Elektrotechnische Zeitschrift*, the official organ of the German Elektrotechnischer Verein and the Verband Deutscher Elektrotechniker. The *E.T.Z.* has never busied itself with war affairs, but our contemporary suggests that the interdict is due to the desire of the Government to conceal from foreign eyes the scarcity of certain materials such as copper and aluminium, which is revealed by the publication of official regulations for the use of zinc and iron as electrical conductors. If so, it comes too late.

The Metric System.—On April 1st, 1916, the old systems of weights and measures in use in Denmark were abolished and the metric system came into force.

Germans and Austrians Suing in the Courts.—In the City of London Court, on June 6th, A. T. Speedometer, Ltd., assignee of George Zimmermann, of London, E.C., sued Stanley & Co., of Southend, for £10 for goods supplied. Defendants objected to pay because plaintiffs were Germans. Mr. H. Snowman, plaintiffs' solicitor, said that Zimmermann was a German, and he was interned. While he was an alien enemy he did not come within the scope of the Defence of the Realm Act. A man named Max Niechy, who said he was an Austrian who was exempt from internment (although he was not naturalised), having lived in England for 10 years, was called to prove the assignment. The plaintiff company, he said, was now in liquidation, and was under the control of the Board of Trade. The majority of the shareholders were Austrians and Germans. Some of them were in England and some in Germany. Judge Atherley-Jones, K.C., said he must find for the plaintiffs with some reluctance, having regard to the last decision of the Court of Appeal, as that was the law until the House of Lords gave its long-deferred judgment. In his humble view, the opinion of the Court of Appeal enabling such companies to sue was not the law of the country. Therefore, as the company was registered in England, it was entitled to recover, notwithstanding the fact that the beneficiaries were alien enemy shareholders resident, or carrying on business, in enemy territory. But the money would be kept in Court until after the war was over. That was a security against the money leaving the country.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—Mr. P. Priestley, the engineer and manager of the Mexborough and Swinton Tramways Co., who is about to leave to take up the management of the Oldham Corporation tramways department, was the recipient of a presentation and good wishes at the Tramways Institute, Rawmarsh. The presentation took the form of a silver tea service.

Mr. G. H. Browne, A.M.I.E.E., acting engineer and manager of the Borough of Ilkeston tramways and electricity department, has been appointed manager and engineer of the Mexborough and Swinton Tramways Co., at £400 per year, succeeding Mr. P. Priestley.

Mr. W. G. Stock has been appointed chief engineer at the Hindhead (Surrey) electricity works.

On May 4th one of the employés at the Fulham electricity works (J. Fish) was struck by the crane on the Quay Wall at the Townmead Wharf, and knocked insensible into the river at high tide. Shift engineer T. H. Welch promptly jumped in and saved him. The Electricity Committee has very fittingly passed a resolution congratulating Mr. Welch upon his courage and skill, and recommending him for the Royal Humane Society's Medal or Certificate.

The original list of 42 candidates for the position of tramways manager at Belfast has been reduced to six. The question of the appointment has been referred to a sub-committee of the Tramways and Electricity Committee for consideration and report.

General.—Mr. J. Arthur Sykes, M.I.E.E., assistant to general manager of Messrs. Wm. Beardmore & Co., Ltd., Glasgow, has resigned this appointment in order to take up that of works manager to the Yorkshire Copper Works, Ltd., Leeds.

In the list of aliens to whom certificates of naturalisation were granted during May, the following entries appear:—

J. Prosper Dethier (known as John Prosper), Belgium, electrician, residing at Palmers Green, Middlesex.

F. C. C. Nielsen, Denmark, retired manager of a telegraph company, residing at Westminster.

Coun. James Heald, head of the firm of Messrs. Calvert and Heald, electrical engineers, Lancaster, and chairman of the Lancaster Electricity Committee, has been elected Alderman of the Borough, of which he was Mayor in 1904-5.

Prof. Dobson, general manager of the Johannesburg municipal gas, electric, and tramway departments, has been appointed Major in command of two Pioneer Corps for service in East Africa. Each Corps is to consist of 120 men, and is intended to be formed of men skilled in the use of explosives.

Mr. J. M. Gray, assistant engineer and electrician at the Maypole Margarine Works, Southall, has retired after 22 years' service. He was presented with a gold watch by the directors, a canteen of plate by the heads of departments, and a marble clock by the engineering staff. The Maypole Co. produces its own power, the average output being over 1,500,000 units per annum, the installation comprising over 100 motors.

Mr. G. S. Herschell and Mr. T. Birkett, who have both been 42 years in the service, has been appointed to succeed Messrs. H. M. Knight and T. Warden (retired), as superintendents in the telegraph department of the Edinburgh Post Office.

London Gazette notice:—Territorial Force, Royal Engineers. *Tyne Electrical Engineers*: Staff-Sergeant Addison Stanley Burdis to be Second-Lieutenant (on probation).

Mr. C. le Maistre, secretary of the International Electrotechnical Commission, arrived in New York on May 12th on a mission to the electrical engineering societies of the United States and Canada with regard to the adoption of international standards for electrical machinery, &c.

Birthday Honours.—In the list of King's Birthday Honours are the following, to whom we tender our congratulations:—

Knighthoods are conferred upon: George T. Beilby, Esq., F.R.S., the well-known chemist; E. C. Geddes, Esq., Deputy-Director-General of Munitions, and formerly of the North-Eastern Railway.

Appointed C.B.'s:—Capt. M. H. P. Riall Sankey, late R.E.; the Hon. Arthur Stanley, M.V.O., M.P.; George E. Pemberton Murray, Esq., Secretary to the Post Office; W. H. Beveridge, Esq., Assistant Secretary, Board of Trade; U. F. Wintour, Esq., C.M.G., Director of Contracts, War Office.

Roll of Honour.—In the first list of losses of officers in the great battle of the North Sea, May 31st, we find the names of the following:—

Warrant Electrician Lawrence Gatt, *H.M.S. Queen Mary*.

Warrant Telegraphist Ernest Kemp and Warrant Electrician Arthur C. Worthington, *H.M.S. Invincible*.

Warrant Electrician Arthur Beales, *H.M.S. Indefatigable*.

Warrant Telegraphist Henry Arberry, *H.M.S. Defence*.

Acting Warrant Telegraphist Harry Burnell and Warrant Electrician E. G. Goad, other ships.

Mr. John Reginald Hatch, an electrician on the *Queen Mary*, which was lost in the big sea fight last week, was employed at the Southport electricity works prior to his enlistment in the naval service, being apprenticed to Mr. A. Black, the borough electrican engineer.

Private A. McCulloch, of the Loyal North Lancashire Regiment, formerly employed at the Peel-Conner Telephone Works, Salford, has died from wounds received in action.

The death in action of Private Chas. Holdway, Loyal North Lancashires, who, prior to the war, was engaged at the works of Messrs. Dick, Kerr & Co., Ltd., Preston, is reported.

Mr. C. R. Steele, of the Somerset Light Infantry, who has fallen in action in France, was, until the war broke out, engaged at Siemens Bros. Dynamo Works, at Stafford.

Mr. Harwood Maulkinson, of the Royal Naval Reserve, formerly an electrician at Fleetwood, has lost his life through the mining of a trawler in the Mediterranean whilst on patrol work.

The Distinguished Service Cross has been awarded to the following officer in recognition of his services whilst employed on transport duties at the Dardanelles:—

Harold G. E. Wightman, Officer Commanding cable ship *Levant*, who rendered good services in connection with the laying of the cable from Imbros to Suvla on the night of the Suvla landing, and in laying and repairing cables off the peninsula frequently under heavy fire.

The following officers are mentioned for good services whilst employed on transport duties at the Dardanelles:—

Alan Henry Black, Chief Officer, cable ship *Levant*.

Alfred L. Spalding, Chief Electrician, cable ship *Levant*.

Thomas C. Birbeck, Assistant-Electrician, cable ship *Levant*.

Alexander S. Henderson, Chief Engineer, cable ship *Levant*.

Arthur Hill, Cable Jointer, cable ship *Levant*.

The Distinguished Service Medal is to be awarded to Wireless Telegraph Operator (First Class) A. Andrews, R.N.R., O.N. 13 W.T.S.

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Obituary.—Mr. Leslie S. Robertson.—Amongst the staff of Lord Kitchener on board *H.M.S. Hampshire* was Mr. L. S. Robertson, whose death will be lamented by the engineering world, and is to ourselves a personal loss. Mr. Robertson was best known as the Secretary of the Engineering Standards Committee, a position which he filled with the greatest ability from the formation of the Committee in 1901 to the time of his death; in July, 1915, he received an appointment at the Ministry of Munitions as Assistant to the Director of Production, in which capacity he was accompanying Lord Kitchener to Russia. He was the youngest son of Sir W. R. Robinson, sometime Governor of the Presidency of Madras (the family name "Robertson," its original form, having been resumed in 1898), and entered engineering life at the works of Messrs. Denny Bros., Dumbarton; he afterwards joined Messrs. John I. Thornycroft & Co., of Chiswick. He was the author of a standard work on steam boilers, and a member of the firm of Robertson & Outram, consulting engineers; he also took an active part in the management of engineering concerns, being a director of a large number of companies, and chairman of two of them. His loss will be long and widely felt, not only in the engineering world, but also in social circles, for he was a most genial and warm-hearted companion, and of a kindly disposition.

Mr. D. T. Miles.—The death occurred on Monday of Mr. D. T. Miles, mains engineer, Bath Corporation electricity works. He was taken unwell with tonsilitis on Saturday morning. He had for 15 years held the position of mains engineer at Bath, and had been solely responsible to Mr. Francis Teague, the electrical engineer, for the whole of the outside work. He assisted to lay the original cables in Bath in 1889, when he was a foreman for Callender's Company, the contractors. Mr. Miles's death is deeply regretted, for he was one of the best known men in Bath. He leaves a widow and four children.

NEW COMPANIES REGISTERED.

Mander & Co., Ltd. (143,989).—This company was registered on May 31st, with a capital of £2,000 in £1 shares, to take over, as from April 1st, 1916, the business of electrical and mechanical engineers now carried on at 125, Hockley Hill, Birmingham, and to adopt an agreement with A. F. Mander. The subscribers (with one share each) are: A. F. Mander, 38, Davy Road, Handsworth, electrical engineer; J. E. Bendall, 20, Greenhill Road, Moseley, baker and confectioner. Private company. The first directors are A. F. Mander and J. E. Bendall (both permanent). Solicitor: E. H. Clutterbuck, Minories Chambers, Birmingham. Registered office: 125, Hockley Hill, Birmingham.

Galloway Engineering Co., Ltd. (9,604).—This company was registered, in Edinburgh, on May 26th, with a capital of £40,000 in £1 shares, to carry on the business of engineers, electricians, chemists, &c. The subscribers (with one share each) are: D. L. Forrest, 116, Hope Street, Glasgow; C. Finlayson, 160, West George Street, Glasgow. Private company. The number of directors is not to be less than two or more than seven; the first are Major H. R. Alexander and R. H. Ballantine. Qualification, £100. Registered office: Shakespeare Street, Dumfries.

Telephone Motor Works, Ltd. (143,934).—This company was registered on May 25th, with a capital of £1,000 in £1 shares, to take over the business of motor engineers, makers and repairers, &c., carried on as the Telephone Motor Works at 15b, Allsop Place, Baker Street, W., and elsewhere. The subscribers are: A. J. Watt, 15b, Allsop Place, Baker Street, W., engineer, 200 shares; C. W. G. Green, 28, Rectory Road, Stoke Newington, N., law clerk, 350 shares. Private company. The number of directors is not to be less than two or more than five; the first are A. J. Watt (managing director), and C. W. G. Green. Solicitor: A. Sargeant, 207, Union Court, Old Broad Street, E.C. Registered office: 15b, Allsop Place, Baker Street, W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

C. A. Vandervell & Co., Ltd.—Particulars of £100,000 debentures, created by resolutions of March 24th and May 18th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital and freehold and leasehold properties. No trustees.

Baxendale Bros., Ltd.—Particulars of £2,000 debentures, created May 11th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Pritchett & Gold and Electrical Power Storage Co., Ltd.—Deposit on May 12th, 1916, of deeds of a mortgage on land and buildings at Highfield, Feltham, Mdx., to secure all moneys due or to become due from company to Barclay & Co., Ltd., 95, Victoria Street, S.W., stamped to cover £3,000 registered. A memorandum of satisfaction in full on May 11th, 1916, of charge dated July 29th, 1915, securing all moneys due or to become due from company to Barclay & Co., Ltd., has also been notified.

Berkeley & Young, Ltd. (formerly Bergtheil & Young, Ltd.) (95,405).—Return dated September 21st, 1915 (filed April 20th, 1916). Capital, £12,000, in £1 shares. 10,010 shares taken up. £7 paid. £10,003 considered as paid. Mortgages and charges: Nil.

British L. M. Ericsson Manufacturing Co., Ltd. (79,061).—Capital, £200,000, in £1 shares (99,990 preference and 100,010 ordinary). Return dated March 29th, 1916. All shares taken up. £1 per share called up on 50,010 ordinary, 8s. per share on 50,000 ordinary, and £1 per share on 99,990 preference. £170,000 paid. £30,000 (12s. per share) considered as paid on 50,000 ordinary. Mortgages and charges: £50,000.

Electro Galvanizers, Ltd.—Particulars of £4,000 debentures, created May 9th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

CITY NOTES.

Lancashire Dynamo and Motor Co., Ltd.

After providing for debenture and bank interest, and charging extra depreciation on machinery and plant on account of war wastage, the profit for the year ended December 31st, 1915, was £31,534, plus £1,118 brought forward. The dividend on the preference shares, 5½ per cent., is paid, and interim and final dividends and bonus on the ordinary shares total 12½ per cent. for the year, free of tax, as against 8 per cent., free of tax, for the previous year. Directors' fees require £1,400, £14,992 is put to reserve (making it £42,000), and £1,450 is to be carried forward. The profit as shown for the past year is considerably greater than the pre-war average years (1912 and 1913), but this is almost entirely caused by additional output, partly at Trafford Park works, but mainly at a specially equipped new works for war service. The total number of persons employed in 1915 was double the average of the two pre-war standard years. The current year's orders on hand are very large, and might be still further increased if they could be executed, but the shortage of men continues. Women in considerable numbers have been engaged and successfully trained for working the smaller machines installed in the new works. The annual meeting was held on Monday last.

German Electrical Companies.

The Hoch Frequenz Maschinen A.G., of Berlin (Goldschmidt machines for wireless telegraphy) has been absolved from submitting accounts for the past year.

The Kabelwerk Duisburg, of Duisburg, recommends the payment of a dividend of 18 per cent. for 1915, as in the previous year, together with a bonus of 12 per cent.

The accounts of the *Kabelwerk Wilhelminenhof, of Berlin,* which belongs to the Carlswerk group, show net profits amounting to £12,200 for 1915, as compared with £10,500 in the previous year on an ordinary share capital of £50,000.

The Ver. Isolatoren Werke, of Berlin-Pankow, report that the company's activity in peace manufactures (insulators, &c.) further diminished in 1915, although extensions of buildings and machinery were necessary for the execution of Army orders. No dividend was paid for the previous year, and the net profits of £600 earned in 1915 also do not permit of any distribution on the ordinary capital of £50,000.

The accounts of *Felten & Guilleaume, Carlswerk, of Cologne-Mulheim,* for 1915 indicate net profits, after appropriating £149,000 for depreciation, as against £111,000 in 1914, amounting to £353,000, as compared with £300,000 in the previous year. A dividend of 11 per cent. is in contemplation, as compared with 8 per cent. in 1914. It is proposed to increase the share capital to £3,000,000 by the issue of new shares for £250,000.

The report of the *C. Lorenz A.G. (Telephone and Telegraph Works), of Berlin-Schoneberg,* states that the turnover in 1915 experienced a considerable increase, and most of the business was for war contracts. The orders referred almost exclusively to articles of bulk production, and special plant had to be obtained for their manufacture. Including the balance from 1914, the accounts show net profits amounting to £83,000, as compared with £50,000 in the preceding year, and a dividend of 34 per cent. is proposed, as against 32½ per cent. in 1914. It is now intended to increase the share capital to £225,000 by the issue of new shares for £75,000, at the price of 175 per cent.

The Deutsch-Ueberseeische Elektrizitats Gesellschaft, of Berlin, which owns large supply works at Buenos Aires and other towns in South America, reports gross receipts amounting to £1,520,000 for 1915, against £1,495,000 in the previous year. After defraying general expenses, interest charges, &c., there remain gross profits of £1,118,000, as against £1,105,000, of which depreciation and reserve funds have absorbed £371,000 and £353,000 in the two years respectively. The directors recommend the payment of 6 per cent. on the preference capital, as compared with 5 per cent. in 1914, and 10 per cent. on the ordinary shares, as in the preceding year.

The report of *Hartmann & Braun A.G., of Frankfort-on-Main,* states that the production of munitions, which began at the end of 1914, was brought into full operation in 1915, and new electrical measuring instruments were also required for the defence of the country. Thanks to the large stocks of measuring apparatus, the company was able to supply customers in neutral countries in so far as legal regulations do not impose an embargo. After allocating £26,000 to depreciation, as compared with £12,000 in 1914, the accounts exhibit net profits of £38,000, as against £15,000, and the dividend proposed is at the rate of 12 per cent., this contrasting with 8 per cent. for 1914.

The directors of the *Akkumulatoren Fabrik A.G., of Berlin-Hagen,* report that the works were well employed in 1915, and the turnover of the German and Austrian works rose from £1,011,000 in 1914 to £1,229,000 last year. Increases in sale prices were made to equalise the dearness of raw materials and higher wages, so as to earn the profits used in peace times. It was impossible to give any information regarding the company's foreign undertakings, as communications, even with neutral countries, were difficult. The net profits for 1915 £138,000, as compared with £148,000, but as no special war provident grant is provided for, as against £26,000 set aside

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for this purpose in 1914, the dividend is at the rate of 20 per cent., as compared with 18 per cent. in the preceding year.

The report of the *Deutsch Sudamerikanische Telegraphen Gesellschaft, of Cologne*, states that the cable between Monrovia and Pernambuco was still in operation during the first eight months of 1915. On September 13th, however, the cable was severed, and since that date the company's network has been at a standstill. The Compania Telegrafico-Telefonica del Plata, of Buenos Aires, in which the company is interested to the extent of £106,000, again concluded its year's working with a slight loss, and the Cologne company consequently transferred £15,000 from the disposition fund, so as to provide a reserve for this investment. The net profits are returned at £41,000, as compared with £59,000 in 1914, and a dividend of 6 per cent. is proposed, being the same rate as in the previous year.

The report of the *Deutsch-Atlantische Telegraphen Ges., of Cologne*, states that it could not be foreseen when the repair of the company's interrupted cables and the resumption of working could take place. The news from the Vigo station was good, and the information from Horta to the end of March, 1916, was also favourable. The gross profits declined by £62,000 in 1915, as compared with the previous year. After meeting general expenses, the accounts indicate a loss of £43,000, which is reduced to £26,000 through the balance brought forward from 1914. By the appropriation of £100,000 from the special reserve fund, it is possible to extinguish the deficit and pay a dividend of 6 per cent. on the ordinary share capital of £1,200,000, as compared with 6½ per cent. in 1914, and 7½ per cent. in each of the four preceding years.

The report of the *Bergmann Elektrizitats Werke* for 1915 states that while the departments reserved for peace manufactures had to work at a restricted output owing to the State seizure of various raw materials, those devoted to the production of war materials had to work with continuous day and night shifts. A considerable increase in the turnover took place as compared with the preceding year, and the sale prices were adjusted to the dearer raw materials and higher wages. The greater total profits were not only due to the execution of war contracts, but also to the sale at good prices of stocks which were previously entered at a low valuation. In order to render the undertaking independent as far as possible in the provision of raw materials, the company had embarked upon the working up of metals in substitution for those which were requisitioned by the Government. The dividend, as previously reported, is at the rate of 10 per cent., as against 5 per cent.

Indo-European Telegraph Co., Ltd.

The adjourned general meeting was held on May 30th, Mr. J. H. Tritton presiding. The position of the company, he said, had remained unchanged during the year. Their communications through Germany had remained severed. The South Russian and Persian lines had done good service, the staff everywhere having remained at their posts. The Odessa-Constantinople cable, in which they had a joint interest, had been closed down since Turkey entered the war. There was no prospect of resumption of the company's main route, and it was the wish of the British Government and the cable companies with whom they had working arrangements that they should await the termination of hostilities before committing themselves to any definite decision for the re-establishment of the through service to India *via* Russia, so that the most suitable route should be determined upon. Last year they received an assurance from the British Government that facilities would be given to the company for the re-establishment of the Indo route. The Imperial Russian Government had also promised facilities to the same end, together with an extension of the existing concession. Such extension should render possible the very considerable expenditure on capital account which would be involved in the re-establishment of their route. The revenue for the year showed an important increase, and the expenses a decrease—a satisfactory and unlooked-for state of affairs, which was entirely due to a prolongation of the working arrangements with the other telegraph administrations, except for which a large decrease of receipts would have been recorded. They could not hope for a continuance of such more or less artificial prosperity, and under new arrangements with their friends they considered they were assured of sufficient receipts to provide a dividend of 7 per cent. upon the capital of the company after payment of all expenses, an arrangement which would continue until one year after the war. The company had been very liberally treated by the Indo-European Telegraph Department of the Indian Government and the Eastern and associated companies. It would remain with the directors to augment the dividend thus provided by withdrawal from the fund established for the equalisation of dividends. They might well congratulate themselves that the reserve funds of the company stood as they did. Their endeavours to assist the Government of the country had ranged from the manufacture of gauges of microscopic accuracy, which had more than once received high commendation, to subscriptions to war loans aggregating upwards of £150,000. The levy of the tax-gatherer in respect of excess profits necessitated the putting aside out of surplus £15,000 for last year's excess. In regard to the constantly recurring items of depreciation of investments, the £25,000 set aside in 1914, which some thought excessive, had not proved sufficient, and they had now set aside £35,000 for the same purpose. It was proposed to appropriate £10,000 towards wireless development and research, although last year's vote had not been quite exhausted. They would not be able to do this out of income for 1916. They would eventually have no cause to regret the money expended in this direction. The Indo Co. had a predominant interest in the Galletti Co. For more than eighteen months it had been nothing but a source of expenditure to them, and this in spite of negotiations which at one time appeared likely to offer a solution of what was practically, owing to the war, a deadlock, but which came to nothing. The directors had determined to bring to an end this state of affairs; indeed, they had no option but to do so in view of the material diminution of the earning power of the Indo Co. They proposed, therefore, in the interest of all concerned, and particularly of the Galletti shareholders, before whom there was no other alternative than liquidation, to enter into a new combination of interests with Creed Bille & Co., Ltd., manufacturers of telegraph apparatus of every sort, whose business was in a highly prosperous position. This company would be enlarged by the issue of additional capital, of which the Indo Co. would take up to £30,000 for the development of the wireless side of the business. The patents owned by the Indo Co. and those owned by the Galletti Co. would be transferred to the Creed Bille Co., on whose board the Indo Co. would be represented. The value at which these patents were taken was fixed at £105,000, of which the greater part was applicable to the Galletti Co., to be paid in cash by an annual percentage of the divisible profits of the combined undertakings. Facilities were also given for an option to take up 20,000 £1 shares at par, should the issue be advisable, thus enabling Mr. Galletti or others interested to participate in the future development of their patents. The directors felt that the prospects of the radio-telegraphic and telephonic patents would be enhanced by this arrangement. They hoped that in the interest of the War Office and the Admiralty no difficulty might be found when they made the necessary application to the Treasury Committee for new issues to sanction the scheme. They would regret that anything should retard a step which they considered afforded good prospects of ultimate success and provided an immediately dividend-paying investment.

Anglo-Argentine Tramways Co., Ltd.

Mr. J. B. Concanon presided at the annual meeting on May 25th. He said that there was a net decrease in receipts of £141,380, and a saving in expenses of £94,256. The amount carried to net revenue account was £47,123 less than last year. In view of the outlook for the current year they could not recommend an ordinary dividend. Although the financial position in Argentina was sound, enterprise in Buenos Aires had been almost at a standstill, particularly in the building trade, capitalists and financiers being reluctant to embark in new operations. Confidence seemed to be slowly gaining ground, but he feared that no marked improvement could be looked for during the continuance of the war. The very high cost of freight and limited tonnage hampered both exports and imports, and would have a very detrimental effect on expenditure on cost of energy. Up to April 30th, though the receipts were down by only £32 compared with the corresponding period of 1915, the expenditure was £33,495 more, entirely due to dearer energy, and they would have to face a greater ratio of increase for the remainder of the year. The supply company from whom they got their current assured them that they had already secured sufficient fuel to carry on until the end of the year. Great credit was due to the general manager, Mr. Pedriali, for the substantial economies he had effected, but there was a limit beyond which he could not go, having regard to the efficient working of the system. The sinking fund for the redemption of the 5 per cent. debentures came into operation this year, and would entail a charge on revenue of £8,000. The chairman said he thought it well that he should correct a misapprehension which had got about to the effect that the company was "controlled by Germans." There was no foundation for that rumour. The ordinary shares were all held by the Compagnie Générale de Tramways de Buenos Aires, of Brussels, and the shares of the Brussels Co. were owned by Belgian, French, and Swiss subjects, none being held by Germans.—Mr. G. A. Touche, M.P., who seconded the adoption of the report, said that the position was that the gross takings had gone back to a little below the level of 1912, notwithstanding the opening of the subway. Shipping difficulties would stand in the way for some time to come. While the present condition of things obtained it would be idle to pretend that the outlook for such an enterprise as theirs, depending upon the supply of fuel, was promising. He feared that the position was likely to get worse rather than better.

Great Northern Telegraph Co., Ltd., of Denmark.

At the meeting held at Copenhagen, on May 6th, Consul-General W. Weimann said that the company had experienced the same difficulties as had hampered all international intercourse since the beginning of the war, but the strict neutrality observed by the company and the correctness of its service were being rewarded by the continued confidence of its concessionary Governments. Apart from the cables between Denmark and Russia, which, on account of the war, they had been unable to repair since they became interrupted in November, 1914, seven of the company's cables in Europe had suffered 11 interruptions, whilst in the Far East 19 breaks had occurred in nine cables. Considering the dangers to navigation in

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the European seas spanned by their cables, it was fortunate that the interruptions during 1915 had been less numerous than in the last few years. In Europe the cable steamer *H. C. Orsted* had been on active service for 140 days, of which 32 were for the account of others, whilst in the Far East the cable steamers *Store Nordiske* and *Pacific* had been occupied for 171 days, for 103 of which they were engaged for account of other parties. The Wladiwostock and Kiachta routes had been in satisfactory working order, but unfortunately the decrease in the traffic transmitted by these lines between Europe and the Far East since the beginning of the war had continued, and had been even more perceptible towards the end of the year. In these circumstances, they had provisionally returned to the Imperial Russian Telegraphs the wire between Petrograd and Irkutsk, which some years ago was placed at the disposal of the company's offices at the two places above-mentioned and was reserved for the transmission of the Far Eastern traffic. The wire was now fully used for the huge internal correspondence of Russia. The automatic instruments lately introduced at their principal offices in Europe had demonstrated their great value during the war; but for these instruments the work would have proved overwhelming for the staff. They had recently commenced to introduce similar instruments in the Far East, where the working conditions differed in several respects from those existing in Europe, and as soon as circumstances permitted these instruments would be employed more generally in the Far East also. They naturally continued to watch the development of wireless telegraphy, but hitherto had had no occasion for occupying themselves actively therewith, apart from the installations on board the cable steamers during later years. A change in this passive attitude might, however, be brought about in the near future, as they were negotiating an arrangement with the Danish Government, by which the company was to undertake the establishment of wireless communication within the Faroe Islands and the working of the stations on behalf of the Government. Circumstances permitting, two stations were to be erected in the course of the current year, one at Thorshavn (Stroemoe) and the other at Tveraa (Suderoe); the former would be open also for communication with ships at sea. The scope of the scheme was purely local, and, as the traffic to be transmitted was insignificant, they did not expect to derive pecuniary benefit from the arrangement. Their main purpose in proposing to saddle themselves with this wireless service was to facilitate the fulfilment of a most natural wish of the Danish Government, viz., to give to the inhabitants of Suderoe the benefit of telegraphic communication with the rest of the world. The International Telegraph Conference which was planned to take place in Paris last year—the 50th since the foundation of the Telegraph Union—had been deferred *sine die*. During the year, and particularly during the first six months, the telegraphic traffic over the company's European cables had been extraordinarily heavy, and, as a consequence, the working zeal of the staff at the majority of the European stations had been tested most severely. The employés had, however, everywhere performed the very strenuous task imposed upon them with goodwill and with unflagging ardour; but now that certain classes of traffic were decreasing owing to circumstances in connection with the war, they might hope to obtain a well-earned respite shortly. The outcome of the present situation was still so obscure that every reason existed for repeating the view emphasised at the last general meeting, viz.: "That this appalling war which has hitherto brought prosperity to the company, may at any moment affect its interests adversely." The speaker proceeded to refer to the accounts, and to say that the board felt that the same dividend and bonus as last year (22 per cent.) might safely be paid.

Eastern Telegraph Co., Ltd.

Sir J. Wolfe Barry, presiding on May 24th at the annual meeting, said that the result of the year's operations was remarkable. The gross revenue was in excess of any hitherto attained by the company, and amounted in round figures to £2,104,000, an increase of £458,691. The total expenses were about £72,000 more than last year. Included was an amount of £36,642 for special payments to the staff and other expenses in connection with the war. The large sum of £307,037 appeared in expenses for income-tax payable in England and excess profits duty. Notwithstanding these heavy additional taxes and the increased expenses, the final amount available for distribution was £113,895 in excess of 1914. Under these circumstances, they were fully justified in recommending a final dividend of 2½ per cent., making 6 per cent. for the year, as against 5 per cent. which had been paid for many years past, while maintaining the usual bonus of 2 per cent., making a total distribution of 8 per cent. for the year, free of income-tax. The stockholders were asked to approve the proposal that the directors' fees should be paid free of income-tax, as was the case in respect of the stockholders' dividends and bonuses, and was also the case with respect to all salaries of the staff at home and abroad. He had referred at recent meetings to the renewal of some of the older section of cable in the Red Sea, and to new cables which had been laid between Gibraltar and Alexandria and from Aden to Colombo. These operations had entailed a very large expenditure, aggregating nearly £1,400,000, and this sum had been charged against the general reserve fund during a period covering the last five years, the final instalment of £200,000 being included in the present accounts. Although it was difficult under the existing circumstances to obtain a reliable valuation of the reserve fund investments, it had been decided, as a result of the approximate valuation made, to increase the provision for investment fluctuations, and a further sum of £125,000 had been taken from the general reserve fund for that purpose, making a total provision to date of £450,000. This fund had been well maintained, and the balance remaining was £1,805,945, or rather more than it was before the heavy withdrawals on account of the new cables, &c. He believed that at no period in its history had this company stood so well in the eyes of the Government and of the public as to-day. The foresight exercised in laying additional cables to provide in advance a margin of carrying capacity beyond immediate requirements had stood them in good stead. It had enabled them to maintain an efficient system for the Government, and, subject to the conditions which had necessarily been imposed upon commercial correspondence, a continuous and trustworthy service had also been available, notwithstanding the unprecedented volume of traffic. The principal factors which had caused the increase in the number of words carried during the year were the interruption of the Indo-European Telegraph Co.'s line to India, and also that the carrying capacity for commercial work of the Great Northern Telegraph Co.'s route to China and Japan had been greatly reduced on account of Governmental requirements. Although the Government had permitted the use of nine codes, which had to a considerable extent restricted the use of plain-language telegrams, still the amount of work transmitted over the cables had shown a large increase, so that when any of the main cables had become interrupted from one or other of the natural causes, some delay to commercial traffic must necessarily result. So far, however, they had been able to maintain a constant service throughout their system. The chairman proceeded to refer in some detail to the manner in which the company had assisted Government departments, the Colonial, and other Forces by facilitating communication by telegraph in every possible way.

New General Traction Co., Ltd.

The revenue received and accrued during the year ended March, 1916, amounted to £20,289. The profit was £11,300, plus £7,081 brought forward, making £18,381. A dividend of 4 per cent. is recommended, less income-tax, leaving £7,901 to be carried forward. The traffic receipts of the Norwich Electric Tramways Co., Ltd., were fully maintained, and a 3 per cent. dividend was paid for the year ended June, 1915, the same as for 1914. The necessary work of relaying and renewing portions of the track has been continued throughout the year. The Douglas Southern Electric Tramways system has been closed down on account of the war; all expenses have been reduced to the minimum necessary for the safeguarding and upkeep of the undertaking. The income received from the Philadelphia undertaking was £14,238. The balance of the proceeds of the sale of the Coventry undertaking to the municipality has now been distributed, and the company's interest in that concern is, therefore, finally liquidated. Annual meeting: June 14th.

Marconi International Marine Communication Co., Ltd.

The business continued to show substantial expansion during 1915. The net profit amounted to £63,630, after deducting £29,281 for depreciation and debenture interest, compared with a net profit of £55,668 for 1914. Notwithstanding the considerable decrease in passenger traffic, and the necessary restrictions in respect of private messages at sea, the revenue from ships' telegrams, subsidies, &c., amounted to £208,899, a substantial increase over 1914, when it was £175,021. This increase is mainly due to the greater number of ships installed with wireless apparatus. The number of telegraph stations owned and worked by the company as public telegraph stations on the high seas increased from 875 in 1914 to 1,008 in 1915. The organisation of this company, together with that of its associated companies, with a total of some 2,300 mercantile vessels fitted with Marconi telegraph stations, has continued to render inestimable service. The amount of the profit and loss account now stands at £75,062, including £11,971 carried forward. The directors recommend a final dividend of 7½ per cent., which, with the interim dividend, makes 12½ per cent. for the year. The losses sustained in consequence of attacks upon the mercantile fleet during the latter part of 1914 and those incurred during 1915 have now been debited to profit and loss account. Therefore the £10,000 which was placed last year to the credit of a special reserve account to meet any losses arising from this cause remains intact, and it is now proposed to transfer this sum, together with the share premium account, to a general reserve account, which will then stand at £27,639. The continuous growth of the company's business and the large number of additional telegraph stations on board ships, which are being installed year by year without the issue of additional capital, render it prudent to carry forward the substantial balance of £33,841, after providing the sum of £3,500 for the redemption of debentures. During the year under review there has been a net increase of 133 stations, representing a substantial capital outlay for which it would have been impossible to provide without raising additional capital had it not been for the policy of prudently husbanding the cash resources of the company. The balance carried forward will also serve to meet the excess profits duty, which must exceed £8,095, the amount payable under this head for 1914. The

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Amalgamated Wireless (Australasia), Ltd., in which this company is interested, has paid a dividend of 6 per cent. for the year ended June, 1915. Annual meeting: June 14th.

United Electric Tramways of Monte Video, Ltd.

During the year ended October 31st, 1915, the gross receipts of the tramway system were $1,553,824, a decrease of $154,061, and the operating expenses were $988,791, a decrease of $45,151. The net receipts were $565,033, a decrease of $99,910, which at exchange of $4.7 to the £ is £21,257. The passengers carried were 40,337,643, a decrease of 3,525,206, and the car miles decreased by 44,070. The percentage of operating expenses to gross receipts increased by 2.78 to 63.64. The further decline in tariffs which was anticipated is attributable mainly to the war. The summer weather conditions were also unfavourable, but conditions in general showed some tendency towards recovery at the close of the year. Further economies in working have produced the substantial decrease in operating expenses. Certain services which had been reduced on the outbreak of war owing to the uncertainty of obtaining coal supplies, have been resumed by municipal regulation, although in some instances they are unremunerative. The charges for freight and insurance have shown an alarming percentage of increase. Owing to the scarcity of shipping, high rates for freight still exist, and the cost of coal delivered in the power-house in Monte Video is now between 150 and 200 per cent. above the pre-war cost. Capital expenditure was £30,482, mainly for paving and rolling stock, the latter ordered before the war. Only 10 cars and 15 trailers had been ordered and supplied. Further expenditure on rolling stock, &c., had been postponed where possible until after the war. The amount receivable from La Sociedad Comercial de Montevideo in respect of revenue was £111,414. The profit and loss account for the year, after providing for administration expenses and charging £48,937 for debenture interest, showed a credit balance of £51,693, plus £12,973 brought forward. There has been put to redemption of debenture stock £3,562, to redemption of preference and ordinary capital £2,500, to renewals and contingencies £20,000. The dividend of 6 per cent. on the preference shares, less income-tax at 3s. in the £, for the year ended March, 1916, required £25,500, leaving to be carried forward £13,103. Owing to the war no dividend on the ordinary shares is recommended. Annual meeting: June 15th.

Reduction of Capital.—*Browett, Lindley & Co., Ltd.*—Mr. Justice Sargant, in the Chancery Division on Tuesday, June 6th, confirmed the reduction of the capital of Browett, Lindley & Co., Ltd., electrical engineers, by a sum of £12,500, being capital lost or unrepresented by available assets. Mr. H. E. Wright, for the company, said the company was incorporated in July, 1899, with a capital of £120,000, divided into 60,000 preference and 60,000 ordinary shares of £1 each. They issued 50,000 preference and 50,000 ordinary shares, all fully paid. The Articles of Association gave the preference shareholders priority as to their cumulative dividend and capital, and to nothing more, and the ordinary shareholders got the rest of the assets in the event of a winding-up. The resolution for reduction threw all the loss on the ordinary shareholders, but a scheme had been arranged, which did not require the sanction of the Court, by which the holders of both preference and ordinary shares would be satisfied. It had been approved by both classes of shareholders. As to the cause of the loss, the company had been compelled to take over investments in satisfaction of bad debts, and these were never worth the nominal value at which they were put into the balance sheet. His lordship remarked that the scheme was of the nature of a bargain.

Ferranti, Ltd.—At an extraordinary general meeting, called for June 16th, a resolution will be submitted extending the borrowing powers, which already stand at £200,000, to £200,000 exclusive of amounts owing or secured to the Government.

Worcester Electric Traction Co., Ltd.—Including £293 brought forward, the accounts for 1915 show:—Available, £4,042; dividend 3 per cent., transfer £1,000 to reserve, carry forward £180.—*Financial Times.*

Marshall, Sons & Co., Ltd.—A financial daily states that the dividend for the year is 7½ per cent., with £10,000 carried to reserve, and £19,633 forward.

STOCKS AND SHARES.

TUESDAY EVENING.

The first effect of the news of Lord Kitchener's tragic death was to bring business in the Stock Exchange to a standstill. Nobody could believe it possible; and for half-an-hour business was suspended. Then markets quietly returned into something approaching their usual condition. A slight fall in Consols was the only noticeable change. There was no rush to sell; the investor and the community at large take their loss with courage and calmness—eloquent testimony to the confidence with which Lord Kitchener has inspired the nation as to the eventual conclusion of the struggle, come what may in the meantime.

Therefore prices remain firm and steady. The readiness of the investor to buy securities is so great as to give rise to some surprise in the City that the Government do not issue a popular long-dated loan. The public are content to buy Home Railway debenture stocks up to a price that reduces the yield to 4¼ per cent. on the money; and even at this level there is not enough stock to go round.

Industrial markets continue to hold the field for activity and public interest. And the reason for this is simple. Investors find that they have such difficulty in getting even good second-grade stocks that they turn perforce to the ordinary shares, and to such preferences and debentures as are available, particularly those of the best sort, amongst manufacturing concerns.

There is a strong disposition, moreover, to endeavour to discount what is going to happen after the war is over; and money is being directed to any direction which is likely to experience a rebound of prosperity in those days. Interesting problems crop up here-anent; and we have been asked, quite seriously, what price Armstrongs shares will command when peace is signed.

In the industrial markets are to be found wider ranges of selection than other departments afford. The man who holds War Loan says he would not sell it, even apart from patriotic reasons, simply because he does not know in what other stock of similar class he can employ his money to equal advantage. The holder of Colonials re-echoes this sentiment. Meanwhile, money is being piled up in the provinces. A great part of the present national spending consists of transferring bank balances from one set of pockets into another set; and the restrictions laid upon new issues, together with those which militate against realisations by capitalists outside Great Britain, are all points in favour of existing securities here.

Nevertheless, the electric lighting market is dull, and the only two movements on the week are in the downward direction. St. James' fell ⅛, Brompton ordinary ¼. The latter stand at 6½, and are worth considering by the investor, because the company was one of those which did not reduce its dividend for 1915, and at the present price the return on the money comes to £7 13s. 10d. per cent. No doubt the various calls to economy, daylight saving, linking up, reduction in lighting, and so on, have the effect of keeping money away from this department. But its turn will come some day, of course; and then it will be just as difficult to buy shares as now it is hard to realise them at reasonable figures.

Home Railway stocks were buoyant until Sir Edward Grey's cold douche to the peace expectations led to modification of the buying orders which had been steadily streaming in. North-Easterns keep good, in consequence of the anticipations in connection with the electrification. The Underground list is steady, with recovery in the price of Underground Electric income bonds. It is worth noticing that the return at the present time is 6¼ per cent., which, allowing for income-tax at 5s. in the £, works out to the equivalent of 9½ per cent., less tax, on the money. No changes worth mentioning have occurred in Districts or Metropolitans.

Telegraphs are good all round. Advances have occurred in the American and the Eastern groups. Great Northerns are up 10s. Westerns gained ½. Globe shares of both kinds participated in the improvements, which, of course, come on the top of gains recently established. A feature is the strength of Marconis, which are 7/32 higher at 2 7/16, on the expectation of a favourable report. The Marconi Marine Co. has done very well, and the dividend is raised from 10 per cent. to 12½ per cent. The company carries forward the substantial balance of £34,000. It is stated in the report that the Amalgamated Wireless (Australasia), Ltd., paid a dividend of 6 per cent. in respect of the year ended June 30th last. The price of Marconi Marines is better at 29s. Oriental Telephone ordinary shares are ⅛ up, and the strength of the market is carried on into the industrial list.

Telegraph Constructions are 30s. higher. There are rises of 15s. in India-Rubber shares, of 10s. in Callenders and in Henleys. Another noticeable spurt in this department is one of 3s. 6d. secured by British Aluminium ordinary, the shares standing now at 27s. 6d., against 20s. a few weeks ago. British Westinghouse preference improved to 2¼. The electrical manufacturing shares, however, have moved in the other direction. Electric Constructions fell 1s. 6d., Edison and Swan fully-paid 2s. 6d. Engineering, iron and steel descriptions are mostly good, and further rises are recorded in some of the chemical shares. Castner-Kellners are 3 7/16 ex the interim dividend of 1s. 9d.

Brazil Tractions are fluctuating sharply. The price rose to 64½, fell 2 points, and recovered to 64, at which it shows a rise of 1¾ on the week. The buying is attributed to New York. Mexicans are not so good, the news from the country being still vague and unsatisfactory. Nothing fresh has occurred in the British Columbia list. The heaviness of the Anglo-Argentine Tramway group is giving way to a better feeling, but there is no quotable change in price.

The rubber share market keeps firm, upon a recovery in the price of the raw material. Business continues quiet, as compared with what it was six weeks ago. A good deal of money is being put into the shares; and any material

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advance in the price of rubber would probably find a scarcity of shares if demand became pressing.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price June 6, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6¼	— ¼	£7 18 10
Charing Cross Ordinary	5	5	8⅝	— ¼	7 2 10
do. do. do. 4½ Pref.	4½	4½	8½	—	6 18 6
Chelsea	5	4	8½	—	6 8 1
City of London	9	8	12	—	6 13 4
do. do. 6 per cent. Pref.	6	6	10½	—	5 14 3
County of London	7	7	10½	—	6 13 7
do. 6 per cent. Pref.	6	6	1[illegible]	—	5 15 8
Kensington Ordinary	9	7	5	—	7 0 0
London Electric	4	3	1[illegible]	—	7 11 0
do. do. 6 per cent. Pref.	6	6	4½	—	7 1 2
Metropolitan	8½	8	2[illegible]	—	6 6 4
do. 4½ per cent. Pref.	4½	4½	3	—	7 10 0
St. James' and Pall Mall	10	8	5⅞	— ⅛	6 16 4
South London	5	5	2[illegible]	—	8 18 10
South Metropolitan Pref.	7	7	1[illegible]	—	6 14 0
Westminster Ordinary	9	7	5[illegible]	—	6 4 5
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	102½	+ ½	5 17 0
do. Def.	30/-	33/6	29[illegible]	+ [illegible]	7 10 9
Chile Telephone	8	8	6[illegible]	—	6 5 6
Cuba Sub. Ord.	5	5	7½	—	6 18 4
Eastern Extension	7	8	14[illegible] xd	+ [illegible]	*5 18 4
Eastern Tel. Ord.	7	8	142 xd	—	*5 12 8
Globe Tel. and T. Ord.	6	7	12[illegible]	+ ½	*5 12 0
do. Pref.	6	6	10[illegible]	+ [illegible]	5 15 8
Great Northern Tel.	22	22	37	+ [illegible]	5 19 0
Indo-European	13	13	49	—	6 12 8
Marconi	10	—	2[illegible]	+ [illegible]	4 2 0
New York Tel. 4½	4½	4½	100[illegible]	—	4 9 4
Oriental Telephone Ord.	10	10	1[illegible]	+ [illegible]	5 8 1
United R. Plate Tel.	8	8	6[illegible] xd	+ [illegible]	*6 6 9
West India and Pan.	1	Nil	19/-	—	9 6 1
Western Telegraph	7	8	14[illegible]	+ [illegible]	*5 9 4
Home Rails.					
Central London, Ord. Assented	4	4	70	—	5 14 4
Metropolitan	1½	1	25½	—	8 19 0
do. District	Nil	Nil	19½	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	1[illegible]	+ [illegible]	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	6	6	97½	+ ½	*6 17 6
Foreign Trams, &c.					
delaide Sup. 6 per cent. Pref.	6	6	4[illegible]	—	6 6 4
Anglo-Arg. Trams, First Pref.	5½	5½	8[illegible]	—	7 17 2
do. 2nd Pref.	5½	5½	8[illegible]	—	8 9 2
do. 5 Deb.	5	5	77[illegible] xd	—	6 8 7
Brazil Tractions	4	4	64	+1½	6 5 0
Bombay Electric Pref.	6	6	10[illegible]	—	5 15 8
British Columbia Elec. Rly. Pfce.	5	5	59	—	9 9 8
do. do. Preferred	—	Nil	40	—	Nil
do. do. Deferred	—	Nil	26	—	Nil
do. do. Deb.	4½	4½	62	—	6 17 1
Mexico Trams 5 per cent. Bonds	—	Nil	42	—1	Nil
do. 6 per cent. Bonds	—	Nil	35	—	Nil
exican Light Common	Nil	Nil	20	—	Nil
do. Pref.	Nil	Nil	32	—	Nil
do. 1st Bonds	Nil	Nil	42	- 1	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	2[illegible]	—	5 9 1
British Aluminium Ord.	5	7	27,6 xd	+8/6	5 1 10
British Insulated Ord.	15	17½	10[illegible]	—	7 2 10
British Westinghouse Pref.	7½	7½	45/-	+1/-	6 13 4
Callenders	15	20	12 xd	+ [illegible]	8 6 8
do. 5 Pref.	5	5	4½	—	5 17 8
Castner-Kellner	20	—	8[illegible] xd	+1/-	5 15 3
Edison & Swan, £8 paid	Nil	—	10/-	—	Nil
do. do. fully paid	Nil	—	1[illegible]	— [illegible]	Nil
do. do. 5 per cent. Deb.	5	5	57	—	8 15 8
Electric Construction	6	7½	15/6	—1/6	10 6 10
Gen. Elec. Pref.	6	6	9[illegible]	—	6 4 8
Henley	20	25	1[illegible]	+ [illegible]	*8 6 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11½	+ ½	*8 17 10
Telegraph Con.	20	20	38[illegible]	+1[illegible]	*6 4 7

* Dividends paid free of income-tax.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month. £		No. of weeks.	Total to date. £		Route miles open.	Inc.
Blackpool-Fleetw'd	May 27	2,041	— 62	21	8,769	— 7	8	..
Bristol (Trams)	„ 26	19,481	—2,027	21	96,714	+ 1,560	30·5	..
Cork	„ 25	2,019	— 178	21	9,663	— 190	54·25	..
*Dublin	„ 26	16,800	—3,029	80	112,360	— 9,845	9·89	..
Hastings	„ 26	3,914	— 69	21	17,278	+ 178	19·8	..
Lancashire United	„ 31	7,115	— 495	22	36,805	+ 1,400	42	..
Llandudno-Col. Bay	„ 26	1,166	— 628	25½	5,757	— 460	6·5	..
Anglo-Argentine	April 22	204,146	-9,685	17	813,468	— 2,988	..	..
Auckland	May 5	21,202	+ 755	44½	231,906	+ 4,808	25·42	1·66
Calcutta	„ 27	17,555	+ 850	21	..	+ 5,572	..	..
Kalgoorlie, W.A.	Feb.	2,248	..	..	4,484	..	..	..
Madras	May 31	3,956	+ 72	21	20,721	+ 1,688	..	..
Montevideo	May	28,849	+ 578	80	215,768	+13,842	..	..
Dublin-Lucan Rly.	May 26	476	— 204	21	2,506	— 358	7	..

* Three weeks.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, June 7th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/8	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	„	£54	..
a Bisulphide of Carbon	„	£28	..
a Borax	„	£20	..
a Copper Sulphate	„	£53	..
a Potash, Chlorate	per lb.	2/6	..
a „ Perchlorate	„	2/-	..
a Shellac	per cwt.	95/-	..
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	„	£14	..
a „ Lump	„	£10	..
a Soda, Chlorate	per lb.	1/4½	..
a „ Crystals	per ton	120/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2' to 12' basis)	per lb.	1/5 to 1/5½	¼d.—⅜d. dec.
c „ Tubes (solid drawn)	„	1/5½ to 1/6	1d. dec.
c „ Wire, basis	„	1/5½ to 1/6½	¼d.—1½d. dec.
c Copper Tubes (solid drawn)	„	1/7½ to 1/8½	1½d. dec.
g „ Bars (best selected)	per ton	£164	£10 dec.
g „ Sheet	„	£164	£10 dec.
g „ Rod	„	£161	£10 dec.
d „ (Electrolytic) Bars	„	£140	£20 dec.
d „ „ Sheets	„	£158	£20 dec.
d „ „ Rods	„	£147	£20 dec.
d „ „ H.C. Wire	per lb.	1/6½	2½d. dec.
f Ebonite Rod	„	2/-	..
f „ Sheet	„	2/6	..
n German Silver Wire	„	2/3	..
h Gutta-percha, fine	„	6/10	..
h India-rubber, Para fine	„	2/7	1½d. dec.
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
l „ Wire, galv. No. 8, P.O. qual.	„	£36	..
g Lead, English Pig	„	£38 5	5s. inc.
g Mercury	per bot.	£16 12 6 to £16 15	..
e Mica (in original cases) small	per lb.	6d. to 2/-	..
e „ „ „ medium	„	2/6 to 6/-	..
e „ „ „ large	„	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/8½	..
r Steel, Magnet, in bars	per ton	£35	..
g Tin, Block (English)	„	£189 to £190	£8—£10 dec.
n „ Wire, Nos. 1 to 16	per lb.	3/-	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Rangoon Electric Tramway & Supply Co., Ltd.—The cars carried 10,815,613 passengers, a decrease of 323,335, during the year, the total receipts being Rs8,60,664, a decrease of Rs32,252, or 3.61 per cent. In the private lighting and power department the gross receipts for current amounted to Rs7,32,172, an increase of 13.77 per cent. The gross profits for the year were £63,347. Out of this there is allowed for depreciation on sundry assets in Rangoon £1,847, transferred to reserve for renewals account £12,500, to special reserve for cables, &c., £2,500. A dividend on the ordinary shares of 3 per cent. for the year, tax free, is to be paid, leaving £2,783 to be carried forward.

Russia.—At the annual meeting of the Volta Co., where 13,078 shares were represented, of which the chairman, A. L. Nobel, and the Discount & Loan Bank, controlled 3,000, the accounts presented showed a profit of 394,811 roubles for 1915, or 20 per cent. more than in 1914. The increase was due to better prices and a larger business.

Richardsons, Westgarth & Co., Ltd.—Profit for 1915, £76,241. After paying debenture stock interest, providing for depreciation, writing off capital expenditure, &c., there is a credit balance of £17,511. Special contracts received early in 1915 were not sufficient to compensate for the large amount of mercantile work hung up.

Calcutta Electric Supply Corporation, Ltd.—The number of units sold to consumers during the four weeks ended April 28th, 1916, amounted to 1,917,213, compared with 1,804,722 units in the corresponding four weeks of 1915.

Canadian General Electric Co., Ltd.—Dividend on the common stock for quarter ended June, 1¾ per cent. (7 per cent. per annum).

Mackay Companies.—Quarterly dividend, 1¼ per cent. on the common stock.

Brazilian Traction, Light & Power Co., Ltd.—Quarterly dividend of 1½ per cent. on the cumulative preference shares.

Western Telegraph Co., Ltd.—Third quarterly dividend, 3s. per share (6 per cent. per annum), free of tax.

Commercial Cable Co.—Quarterly dividend, 1¼ per cent.

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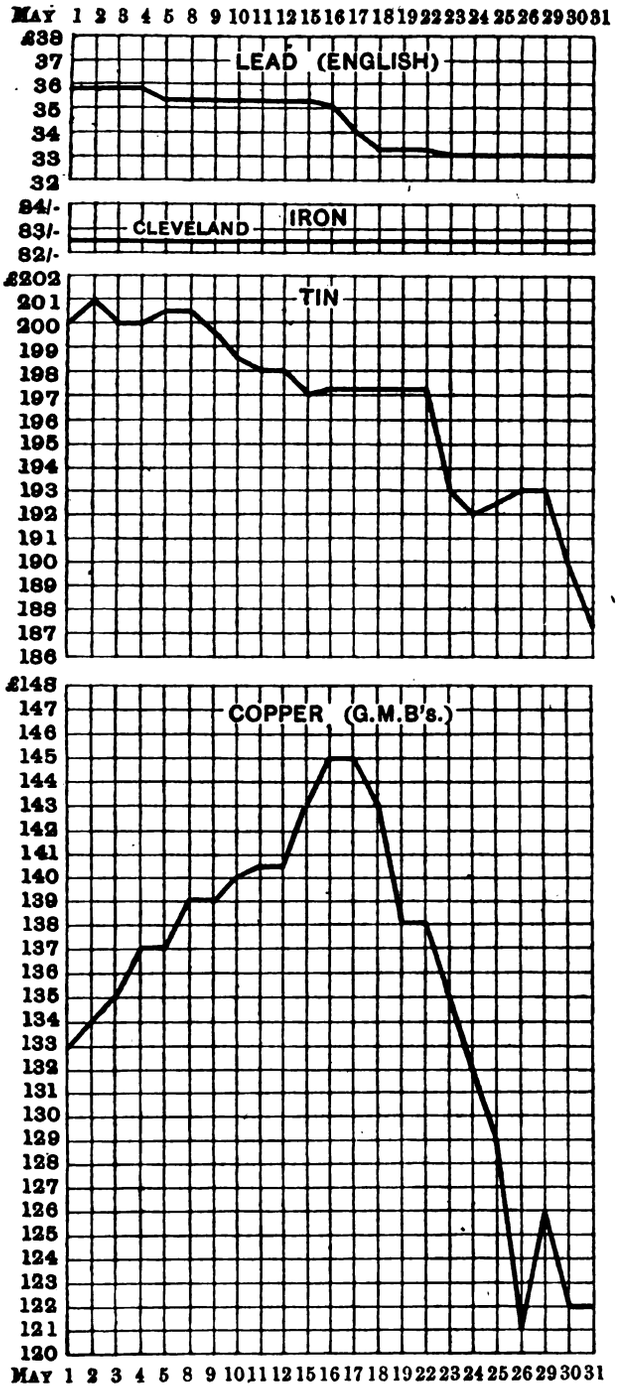
METAL MARKET.

Fluctuations in May.



Electricity Works and "Excess Profits."—The *Financial Times*, writing editorially on the problems of the Excess Profits Duty, refers to the case of electric supply companies, which are in a peculiar position in regard to the Act, as follows:—"Mr. H. B. Renwick, who is closely associated with the working of such undertakings, and who is an authority on electrical finance, reminds us that these concerns work under such special restrictions, that it would be most inequitable for the present statutory percentage standard to be taken to apply to such undertakings without increasing it by at least 4 per cent. The electric supply companies are under statutory obligations to provide machinery, to lay mains, and to give supply wherever required under their orders, thus necessitating a continuous expenditure of capital in advance of profitable demands, with the result that ordinary shareholders have to go without dividends for many years in the earlier stages. Further, the companies have a very limited tenure, mostly from 33 to 42 years, during which to earn a return on their capital, and at the end are subject to purchase under conditions which are particularly onerous. They have, therefore, necessarily to look to the latter years of their tenure to compensate for the unproductive early years, and to make provision for loss of capital. Certainly these factors should be taken into consideration, and there seems good ground for a modification of the rate by the Board of Referees."

LABOUR AND INDUSTRY.

(*Continued from page* 612.)

At one critical stage of the war, when the need for expediting the raising of the new armies and the production of munitions was very real, there was such a strong feeling exhibiting itself in some Labour conferences that it seemed possible that it might be necessary for the Labour representatives to leave the Coalition Government. It is a matter for gratification that that was not the upshot; and while it cannot be said that the Labour representatives in the Government have the unanimous backing of the workers' organisations, the presence of Mr. A. Henderson and his colleagues has been responsible for the smoother running of the industrial wheels. We believe that it will be in that direction, rather than by any direct initiative exercised in the office over which he more particularly presides, that the President of the Board of Education will be found to have served the nation by his counsels in the Cabinet. But though Labour in some of its parts would have liked to hold aloof from the Coalition, we find it, in others, expressing a strong dissatisfaction with the constitution of some of the Committees that have been set up by the President of the Board of Trade to study after-the-war trade problems. It will make its voice heard when we come to the question of adopting new national policies; and it does not see why, in forming Committees which are to make suggestions for the future safety and development of industries which involve the security and prosperity of the workers, it should be ignored. There may be, and probably is, some justification for that attitude, but so much must depend upon what these Committees are expected to do. If their sole thought is to be devoted to suggesting, as the result of their specialised industrial and trade experience, effective ways in which we may ensure ample prosperity of their own class of industries—that is, increased turnover and a satisfactory rate of profit, also the safety of "key" industries—they will almost certainly be all the time studying means which shall safeguard employment for the worker. To secure or increase the volume of industry will be to provide for work and wages in those trades; but we do not see the absolute necessity of Labour men sitting on Committees where for the most part the problems arising will be quite foreign to what they are in the habit of considering. Educationally, no doubt, it would be for their good and for the good of Labour that they should learn at close quarters what have been, and will be, the acute problems of the industrial employer, but—we hope that we can say it without being misunderstood—they could hardly expect to bring to a gathering of employers a counsel of ripe experience in actual trade and industry which could assist such Committees to arrive at better conclusions than they could reach alone. Briefly, it is a case where the employer, in thinking out what is best for the national industries, and, therefore, what is best for himself and his colleagues as units in those industries, is studying the interests of Labour. Perhaps Labour will be able to suitably represent its cause in the form of evidence before the Committee. When recommendations are made, and the Government of the day evolves a policy based thereon, Labour will be well able to protect itself if it finds itself in disagreement with the proposed policy, or policies. At the present juncture, Labour politicians would be better able to serve the ultimate best interests of the nation by stimulating a healthy Labour attitude in the different industrial centres of the country, than by aspiring to scatter themselves over a number of Parliamentary Trade Committees. Labour needs strong and timely leadership to prevent an irreconcilable spirit from becoming dangerous in the critical days that must almost inevitably follow the war, and if it can be led along the lines adopted by Mr. Hodge, M.P., and his colleagues in the League referred to last week, well and good; if the workers can be induced to listen, there are many useful and educative truths that may be spread broadcast, and with urgency and emphasis. For example, if one thing is more certain than another, it is that, considering the demands of the Colonies and of the Allies, who will reduce their trade connections with the Central Empires if it be made possible for them to do so, we shall have to be equipped in every

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way with modern and efficient management, with scientific insight and oversight, with increased manufacturing capacity, and with increased efficiency of Labour, and more of it. It will be of little avail for Labour, as representing the workers, to cry out against future trade with Germany, if by its policies, and by reluctance to comply with the necessities of the new situation, it is going to clog the wheels of our industries. There never was a time when harmony and co-operation between Capital and Labour were so urgent a matter as they will be when the economic position assumes its next phase—as the Government ceases to be the employer of millions, when the high wages of a national emergency cannot be paid out of trade as they are now being paid out of national capital, and when the excess profits drawn from war business give way to the much smaller ordinary profits of every-day trade.

There is one aspect of the work of these After-the-War Trade Committees which, to our mind, bids fair to affect Labour very materially—we refer to its suggestions for increasing our share of trade with colonial and foreign markets. By adequate regard being paid to our national representation throughout the world, we could do vastly better than we have done in the past. We have for years witnessed the efforts of the Teuton to wrench from the British grasp by dint of Governmental and financial force, and to filch, by characteristic underhand methods, our trade connections, not entirely for the purposes of legitimate business, but for other ends which are now revealed in the clear light of day. Our national weaknesses in such matters have been fully availed of by the enemy, and we have largely to thank ourselves that we have afforded him the opportunity to work his dark designs and strengthen his movement towards Commercial Domination. Too many people seem to overlook the fact that one aggressive, enterprising representative abroad may, by the timely and appropriate exercise of business ability and adequate knowledge, secure for British factories work which may employ thousands of British workers for a year. This is so elementary a thing that we dare hardly utter it again here; it is, of course, mainly a matter calling for initiative on the part of manufacturers and financiers, commercial men, and, at times, concession-hunters, either individually or collectively; but the worker needs to recognise these common trade truths so that he may see how important it is that in such representation we should have support of the utmost efficiency in the form of Governmental assistance. We refer to such matters as Consular activities, trained and accredited Commercial attachés, and Trade Commissioners. Labour will not be slow to see that the expenditure in such ways of hundreds of thousands of pounds annually may be a profitable national investment in the interests of the worker. It needs to have a vision of the developing world which none can give it in more appropriate manner than some of its own Leaders, who, as they tell us, have seen the Union Jack flying from the lonely shack in Canada, West Australia, and so on, and have observed the spirit of Home and Empire so warmly displayed. Surely, if the workers can be brought to see something of the immensity of the demands of the thousands of millions of population in other lands for manufactures which they cannot yet produce for themselves, if they will ever be able to do so, they will see that there ought to be "work for all," and no complaining in our streets, if only we avail ourselves in an awakened manner of the world's opportunities as they will present themselves when the nations gradually feel their way back to normal life again. We repeat that this is a question for Labour quite as much as for Capital, and we consider that Labour should, and probably will, as it comes to a better understanding of the difficulties of British industry in the past, see that the demand for a more extensive and more efficient organisation of Governmental fostering of trade by official overwatching in all parts of the Globe, is not a selfish cry from a few manufacturers, as the representatives of capitalists, as has sometimes been suggested, but is a reasonable demand made in the interests of national industry, which, if satisfied, should go far to provide that "work for all" *who desire it*, which employers are anxious to be able to give.

In some trades, and more particularly those connected with engineering and electrical pursuits, there is considered to be a large reservoir of orders accumulating which will await execution after munitions are done with, and the increased works and plant capacity, when adapted, will certainly require all that business to keep it occupied. No doubt for some years to come also there will be very large requirements from countries where the destructive effects of war have been so great; but a revision of our Consular and trade representation system and service should not be delayed because of the arrears of orders and the work of rehabilitation that await us. In this matter it is in the interests of industry, and therefore of Labour, that we act in time, for the problem of finding ample work for all will be more acute after a year or two than it may be at once. The difficulties of readjustment consequent upon the transfer of labour from different places and from different industries may be enormous, but the need for increased volume of some classes of trade will probably make itself keenly felt a little later. Organised Labour, therefore, needs, in whatever policy it adopts, to be very long-sighted; some of these matters which appear at first sight to be questions for the master, are far from remote in the interest that they possess for the worker. Indeed, here again we need to make it known that the interests of employer and employé are, in the main, alike; they only differ in degree.

(*To be continued.*)

ELECTRICAL PRECIPITATION OF SMOKE AND DUST.*

By HALBERT P. HILL.

Electrical precipitation has proved an effective method for obviating smoke and dust and for the recovery of solids suspended in gases.

The writer has conducted a number of experiments under many varying conditions on various materials to determine the most practical ways of making electrical precipitation effective. The first apparatus used consisted of a 7·5-kw. motor-generator set operated from 220-volt direct current, generating alternating current at 154 volts, 60 cycles, single-phase. This unit was connected to a transformer with primaries arranged with six taps so that secondary voltages of 40,000, 50,000, 60,000, 70,000, 80,000 and 100,000 were available. In order to get a finer adjustment a variable resistance was connected between the tape, so that it was

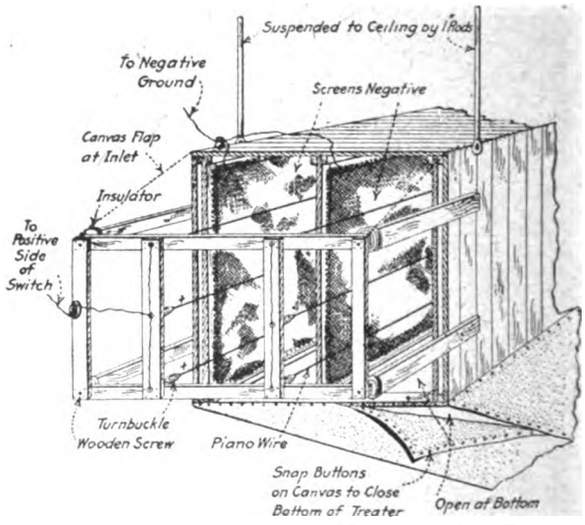

Fig. 1.—Construction of Home-Made Dry Gas Treater.

possible to secure voltages in 1,000-volt steps from 40,000 volts to 100,000 volts, and ratings from 2·5 kw. to 7·5 kw. The secondary of this transformer was connected to a rotary rectifying switch which rectified the current into a pulsating unidirectional current. From the switch the high-tension wires were carried to the treater. Since the experiments were being conducted on relatively cold gases, at a temperature seldom exceeding 200° F., a wood box 8 ft. long, 6 ft. wide and 4 ft. deep was used, in which wooden frames covered with copper screens of No. 100 mesh were mounted. There were six screens, and all were connected to the ground. An insulated frame was provided at each end, and between each screen three piano wires were so spaced that they were 10 in. from

* From the *Electrical World*.

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each screen and 10 in. apart. All these wires were connected together and formed the positive pole (fig. 1).

This treater was used in conjunction with an atomising house, where fluids containing solids, such as milk, salt solution, and various chemicals were atomised. By applying heat and spraying the solution in the room, a large percentage of the solids would fall to the floor as a powder, but from 15 to 20 per cent. was carried off in the exit gases. Various mechanical means for the recovery of the solids carried away in suspension were tried, but the electric treater was found the most effective and dependable. Serious difficulties were encountered at first with the treater, as long sprays of the product would build up and cause the treater to arc. Mechanical means for shaking the screens were provided which proved quite effective. Another difficulty was encountered in building a transformer that was dependable for the service, as the end coils would gradually disintegrate owing to corona. It was only after numerous experiments that it was possible to correct this difficulty. The first experiment was conducted with a disk switch having four contacts 90° apart, with one strap connecting

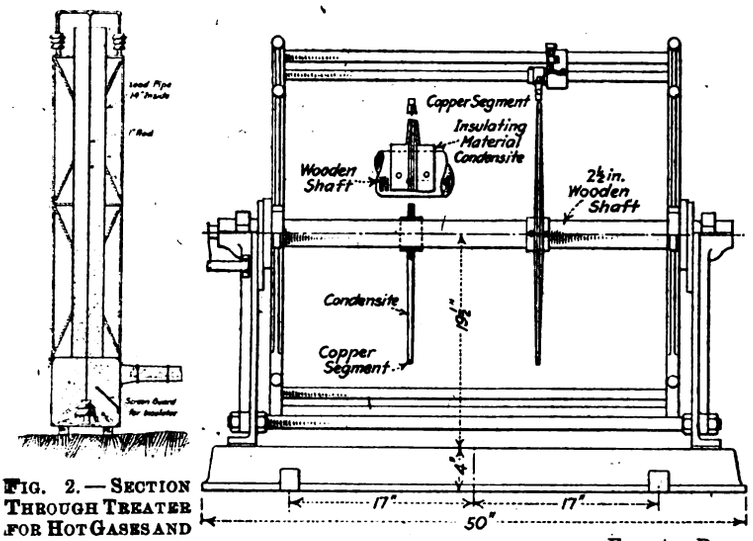

FIG. 2.—SECTION THROUGH TREATER FOR HOT GASES AND SMOKE.

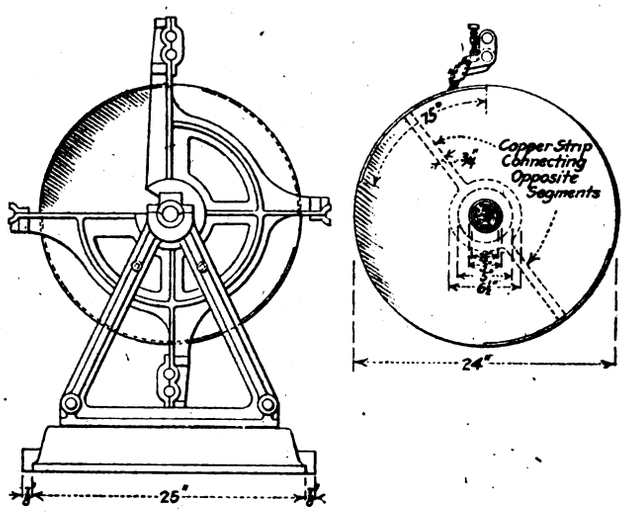

FIG. 4.—POSITIVE-CONTACT SWITCH.

the top and right-hand stud, and a second strap connecting the bottom and left-hand stud (fig. 3). In front of these two studs a second disk was mounted with four contact shoes each about 10° long, and to the top and bottom studs were connected the high-tension secondaries from the transformer. The right-hand and left-hand studs were connected to the treater. The right-hand stud, being positive, was connected to the positive wires, with the negative left-hand stud connected to the screen or ground.

With switches of this character, as well as two-arm and four-arm rectifier switches, in the beginning only 10 per cent. of the wave was rectified. Finally the shoes were increased until 70 per cent. of the wave was rectified. Trouble still developed in the transformers, however, caused by the fact that the treaters had high condenser capacity, and the current commutated arced from the rotor arm to the shoe, so that a high frequency was set up. The experiments seemed to show that the longer the arc or the greater the portion of the wave that was commutated the less current it was necessary to

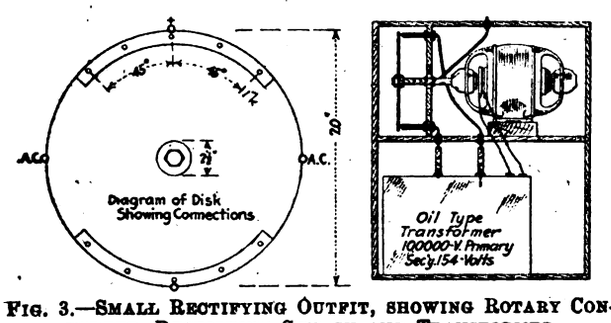

FIG. 3.—SMALL RECTIFYING OUTFIT, SHOWING ROTARY CONVERTER, RECTIFYING SWITCH AND TRANSFORMER.

use to get good results on the treater. As an illustration, when handling 80,000 cb. ft. of vapour containing about 15 per cent. of milk powders and solutions, 50 milliamperes at 70,000 volts was used with a switch having shoes commutating 10 per cent. of the arc. When these shoes were increased to 60° it was possible to operate with 50 000 volts and about 35 milliamperes. Afterwards a switch was substituted consisting of two disks with two copper selectors bolted to the sides, the selectors being 80° each, and four brushes made of hack-saw blades resting on glass plates. The plates were 22 in. in diameter, and ¼ in. thick, and were mounted on aluminium quills. These were slid over a wooden shaft; the whole was mounted in a cast-iron frame, and the brushes were supported on condensite tubes. This made a positive contact-switch commutating 80° of the wave. There was very little sparking, as the break occurred 5° in advance of the zero line, and the voltage was quite low at this point. It was found that more of the product could be handled by the treater with 27 milliamp. and 40,000 volts and this type of switch than with a make-and-break switch using practically twice the electrical energy. Using this type of switch corona on the transformer was practically eliminated.

Tests were conducted to determine the actual advantages of using a positive contact switch. It was found that the frequency was over 350,000 oscillations when using the make-and-break switch commutating 10° of the arc, and when using the positive contact switch commutating 80° of the arc, the frequency dropped to about 40,000 oscillations. The results of the experiments seemed to prove that the ideal method would be to employ static machines. They, of course, could only be used in very small plants owing to their limited capacity and the uncertainty of operation in damp weather. The next approach to static machines is the positive-contact switch and a 40-cycle to 60-cycle source of supply. The writer believes it a mistake to commutate only the apex of the wave, and also a mistake to use too low a frequency. Assume that a given weigh of materials passing through a treater at a given velocity it attracted by a certain force and a certain number of times per second, always bearing the fact in mind that when the contact at the switch is broken the treater charges and discharges and the velocity of the materials must necessarily be retarded a certain percentage because of the discharge of the treater. Therefore, with the positive-contact switch, the materials passing through the treater take on a charge, or each particle stores up a certain kinetic energy which will carry it a fixed distance, so that the nearer a true direct current or a uniform positive charge can be applied to the substance in suspension the greater attraction will be imparted to each particle and a more perfect precipitation secured.

A number of experiments have also been conducted on tube-type treaters, laying them flat and passing the gases through them at a fixed velocity; standing them on end and admitting gases through the bottom; and standing them on end and admitting gases at the top (fig. 2). The best results were obtained when the gases were admitted at the top, as the weight of the material as well as the momentum imparted by the velocity tended to deposit it in the bottom of the chamber or the treater. Experiments were conducted operating the apparatus at various frequencies from 25 cycles to 100 cycles, and while at the higher frequency better results were obtained, for commercial efficiency 40 to 60 cycles was deemed best, as this allowed a speed of 1,200 R.P.M. at 40 cycles for the switch and 1,800 at 60 cycles. The size of the transformers and the cost of the apparatus were in favour of the 60-cycle equipment.

The size of the treater and the proportioning of the positive and negative elements are important considerations. Owing to the extremely large condenser effect of the treaters, great care should be exercised in the designing of a transformer to operate in connection with them. The windings should be protected with mica insulation, and as each end of the transformer is alternately grounded at every alternation, extreme care should be taken in insulating the coils from the core. The best design of transformer seems to be a square magnetic circuit with a primary wound in the bottom and a secondary in the top. The secondary should be divided into at least four coils, and should be spaced at least 6 in. apart and well insulated with oil. All the transformers used by the writer were put up in steel cases, with the terminals 17 in. apart. The 5-KW. and 7·5-KW. sizes were designed for continuous operation at 40° F. rise in temperature. Owing to the length of the magnetic core and spacing of the coils to get proper insulation, there is considerable leakage in these transformers, which, however, is not an objectionable feature, as there are frequent short-circuits in the treaters, and this leakage is an advantage during periods of short-circuit.

A peculiar condition that the writer has never satisfactorily accounted for is that the insulation on the alternator seems to break down, particularly on the collector rings, and for no apparent reason. After operating a rectifier with a positive-contact switch, this trouble seems to have been eliminated.

The field for electrical precipitation is very large. The apparatus can be successfully used for abating smoke nuisance, provides an ideal means of removing the soot, clinker and ash in blast-furnace

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gas which is so objectionable when used with gas engines, and may be used in cement mills and in conjunction with smelters.

In the *Electrical World* of May 13th, Mr. E. R. Walcott described an electrostatic voltmeter reading up to 75,000 volts for use in connection with the precipitation of smoke and fumes. It is constructed on the principle of the Kelvin guard-ring electrometer, comparing the electrostatic attraction due to the pressure with the gravitation of a small weight under zero conditions. The instrument is said to be accurate to one part in 1,000.

THE DUBLIN TRAMWAYS AND THE IRISH REBELLION.

We are indebted to Mr. Marshall Harriss, general manager of the Dublin United Tramways Co. (1896), Ltd., for the following interesting particulars and views of the stirring events which took place recently in the Irish Capital.

We feel sure that our readers will join with us in congratulating

DUBLIN TRAMWAY STANDARD, SHOWING SHELL HOLE.

the company and its officials on having escaped what might have involved much more serious loss.

At the commencement of the trouble on Easter Monday, at 12.30 p.m., immediately after the Sinn Feiners occupied the principal public buildings, the Tramway Co. commenced to withdraw its cars from the city, and at 2.30 p.m. most of them were safely in the different depôts.

In Sackville Street, however, one of the Howth cars was stopped, and the motorman and conductor covered with revolvers and ordered to leave. An attempt was made to upset this car by hand, to form a barricade for Earl Street, but failed, and subsequently a charge of dynamite was exploded underneath it, but did little or no harm. Eventually this car was burnt, due to the adjoining house having caught fire and fallen upon it. Another car was caught on the South Quays, and was also burnt in the same way, and minor damage was done to four or five of the cars by rifle fire. The trolley-wires suffered most severely, several miles being brought down all over the city by rifle fire. Several tramway standards were also damaged by shell fire, and one of the views shows a standard at the corner of O'Connell Bridge and North Quays through which a shell passed. Subsequently this pole, and others which were damaged, were filled up with concrete, reinforced with steel rods, on site.

The day after the outbreak the Sinn Feiners surrounded the power station, and eventually entered and ordered the men out. The rebels carried revolvers, and some of them a revolver in one hand and dagger in the other. They gave the engineer on watch an hour to clear out, under penalty of death, and ordered the whole system to be shut down. This was exactly what it had been decided to do by the officials of the company. However, the Sinn Feiners were apparently satisfied that their wishes were carried out, as they did not return, and the staff remained in occupation of the station in its shut-down state throughout the whole of the disturbance, notwithstanding the heavy rifle-fire in the district, which was one of the worst situated, and was the last to capitulate. No attempt was made to do any damage to the power station, nor, indeed, was any direct attempt made to damage the cars except from the Sinn Feiners' military point of view.

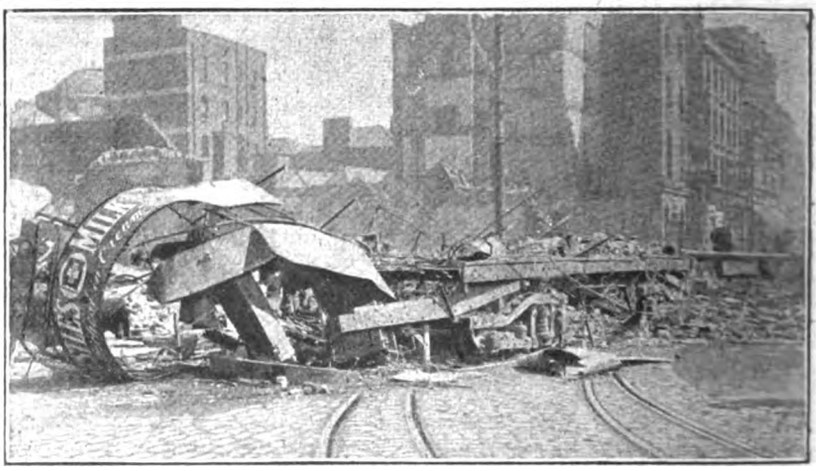
One of the motormen, in getting his car away from the danger zone, was shot and seriously wounded, and another, coming from a city depôt, was shot dead by rifle-fire from the General Post Office; several other tramway employés were also shot by stray bullets in the vicinity of their own homes. The loss included the two cars referred to and the damage to the overhead system, but the loss of traffic was the most serious matter that the Tramway Co. has experienced.

On May 2nd, immediately after the burning of the General Post Office, the fires in the power station were restarted, and on May 3rd most of the system was in working order.

Sniping was very prevalent throughout the whole of the system, which made it very uncomfortable for the men repairing the overhead wires; but by May 5th practically every feeder was temporarily repaired and the service restored as far as allowed by the military authorities, who had drawn a cordon around the whole city, and would not allow the cars to pass more than two bridges—one on the south side and one on the north side.

The total damage to the rolling stock, including the two cars destroyed and injuries to six other cars—mainly breakage of glass by rifle-fire—did not much exceed £1,500; the total damage to the overhead system amounted to about £500. Considering, however, the amount of property the company had throughout the city—the various depôts and large number of cars—the company may be congratulated on their good fortune. The system was at a standstill from 12 30 p.m. on Easter Monday, April 24th, until May 3rd.

One of the views shows the Howth car referred to, which was burnt; this car, as well as a smaller one destroyed on the South Quays, was eventually towed home on its own wheels. The field coils of the motors were destroyed, but the armatures are apparently not very much the worse. Notwithstanding that the metal melted from all the bearings, the trucks are not beyond repair. No damage appears to have been caused to the truck as the result of the attempt to blow the car up.



DUBLIN CAR DESTROYED DURING THE IRISH REBELLION.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

New Shop-window Reflector.

It is gradually becoming recognised that a shop window may be even more effective as an advertisement by artificial light than by daylight, owing to the precision and flexibility with which the illumination can be arranged.

Considering the variety of conditions which have to be dealt with, the demand for an unusually efficient mode of shop-window illumination might seem beyond the range of practical engineering. But a method has been devised for illuminating the typical deep shop-window in such a way that every article placed in it, in any position, is lit to the best advantage. The means by which this result is obtained will be clearly understood from the accompanying diagram—fig. 1.

The diagram shows how these limitations are avoided in a new system of reflectors that has just been brought out by the GENERAL ELECTRIC CO, LTD., of London. By arranging plain mirror reflectors of certain dimensions and of certain angles, in a conchoidal curve, with lamps about 18 in. apart at the focus of the curve, a complex system of direct and reflected light is obtained. The multiplication of reflectors at different angles prevents the streaki-

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ness which is usually the result of using plain mirrors; and the general effect is that articles set in any position within the window are bathed in light from every side. At the same time, no light, either direct or reflected from the mirrors, falls in front of the window line; nor are the lamps visible to the public. The stage effect so much sought after is thus retained, with a complete

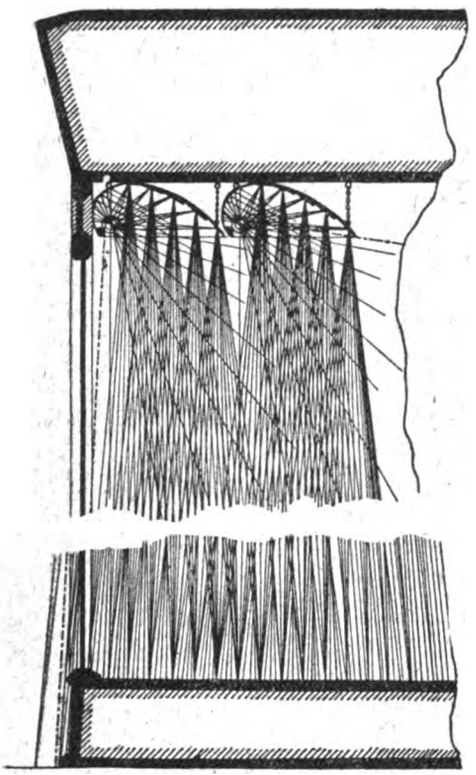

Fig. 1.—Diagram Showing Reflected Light Rays in the G.E.C. New Reflectors for Shop-window Lighting.

absence of glare or harsh shadows. It will be seen from the diagram that, from the point of view of effective illumination, it is a matter of indifference how the articles in the window are arranged.

This method of lighting has already been put to the practical test in the window-lighting of large drapery establishments, and has proved completely successful. It provides, in the simplest possible manner, an ideal mode of illumination, and, moreover, it is adapted to the present lighting regulations, which prohibit the overflow of light on to the pavement.

Numerous other applications of this ingenious system of reflectors might be suggested. Stage-lighting is one of the most obvious; and in happier times than the present it will find its use for poster and sign illumination.

"Zedlite" Electric Candles.

The "Z" Electric Lamp Manufacturing Co., Ltd., of Southfields, S.W., have issued a leaflet dealing with their electric candles.

The "Zedlite" candle, fig. 2, is claimed to resemble closely its waxen predecessor; it consists of only two parts, the lamp and the opal tube to slide over the latter, which can be removed for cleaning without disturbing the lamp.

The makers claim that it is the only electric candle that remains upright, being unaffected by vibration. It has been extensively used in the Piccadilly Hotel and many large houses. It is sold for

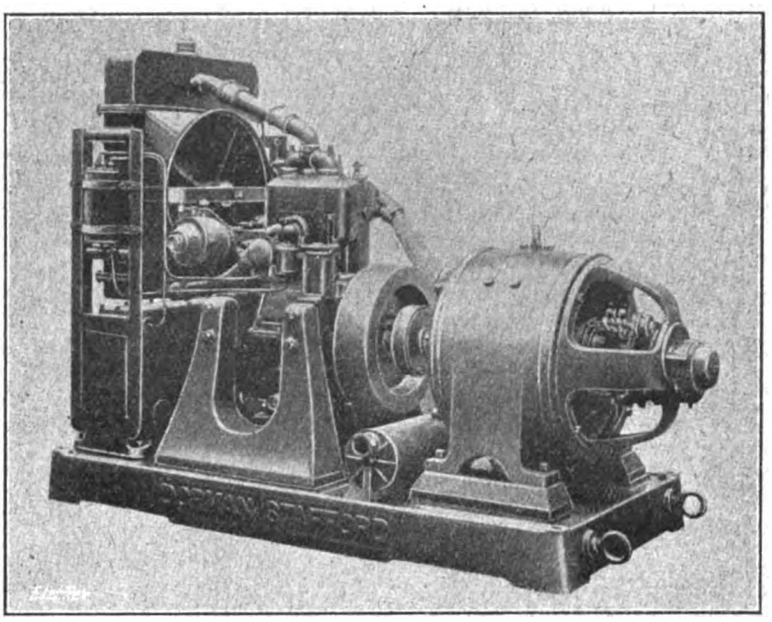

Fig. 4.—Dorman 8-10 kw. Petrol-Electric Set (see p. 664).

circuits of 20 to 260 volts pressure, and in candle-powers from 8 to 16.

Lee Electric Water-Heater.

The Lee Electric Radiator Co., of Chicago, has placed on the market the electric water-heater shown in fig. 3. The most popular sizes in use are the single-heat elements of 500 and 750 watts, although the line is completed with 1,500 and 2,000-watt sizes with three-heat control.

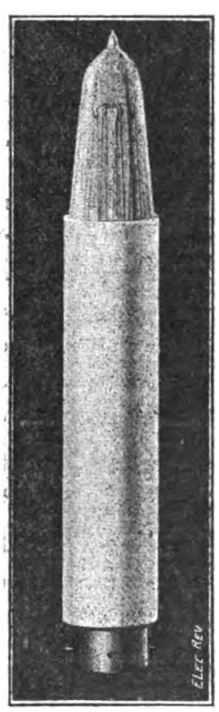

Fig. 2.—"Zedlite" Electric Candle.

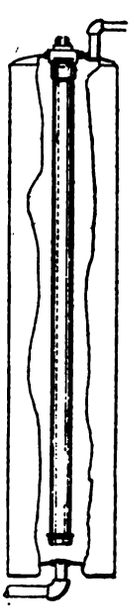

Fig. 3.—Electric Water-Heater.

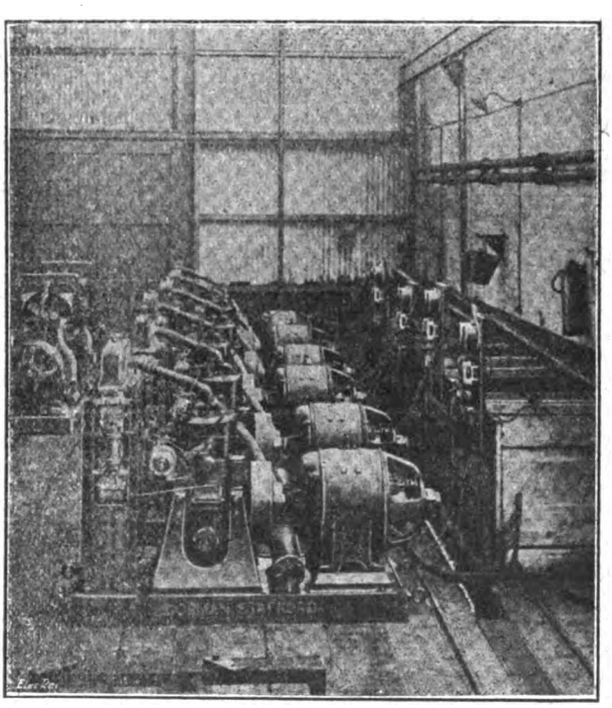

Fig. 5.—Dorman Petrol-Electric Sets under Test (see p. 664).

In construction the water-heater is like a pipe or rod 1·25 in. in dia., 56·5 in. long, and threaded for one inch at the top, so that it is only necessary to insert this unit through the standard opening in the top of any ordinary range tank. The pipe is filled with an insulating, non-oxidising fluid, in which is submerged an open resistance-coil or heating element.

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Dorman Petrol-Electric Sets.

MESSRS. W. H. DORMAN & CO., LTD., of Stafford, have been supplying for Government lighting and power uses a number of their standard 8-10 KW. self-contained petrol-electric sets, which we illustrate in figs. 4 and 5 (p. 663). Engine, generator, fan-cooled radiator, fuel tank and silencer are all mounted on one bedplate.

The engine is the firm's standard two-cylinder vertical water-cooled monobloc type 120 mm. bore × 140 mm. stroke, capable of developing 18 B.H.P. at 1,000 R.P.M. on petrol; it can also be adapted to run on paraffin, in which case petrol is used for starting.

A special type of centrifugal governor is provided which controls the voltage within 5 per cent. between full load and no load. The lubrication is automatic, the oil being forced to all the bearings under pressure through a drilled crankshaft from an oil pump in the base chamber; oil level and circulation indicators are provided. The engine is coupled to the dynamo through a flexible coupling.

The fuel tank is mounted above the base plate, the starting handle of the engine being carried in bearings integral with this tank. The fuel is lifted from the tank to the carburettor or vaporiser on the engine by means of the "Auto-Vac" patent feed system.

The radiator is mounted above the fuel tank, the circulation being by thermo-siphon; the radiator is cooled by a large diameter fan driven by a Whittle belt from the engine shaft.

The silencer is carried on the bedplate.

The total net weight of the set as shown in the views is approximately 35 cwt.

These sets have proved exceedingly convenient for both permanent and emergency purposes; the petrol consumption is approximately 1·6 pints per KW.-hour, and the plant will run continuously with the minimum of attention.

Such plants are built in sizes ranging from 4 KW. up to 30 KW.

Full particulars of the engines are contained in the firm's sectional catalogue No. 20.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

TRANSIT OF GOODS THROUGH FRANCE.—An official statement has been published in the *Board of Trade Journal* of May 11th, giving full particulars of the arrangements for transit through France of goods sent from the United Kingdom to Switzerland, Italy, and Spain *via* France. Goods sent by parcel post to Spain may pass in transit through France without special formality. In the case of Switzerland and Italy, however, a special label indicating that exportation has been licensed must be affixed to the parcel. Special facilities exist for the transmission to the Société Suisse de Surveillance Economique of parcels by post weighing less than 11 lb. gross, and containing certain specified goods. Full information is available at the Commercial Intelligence Branch of the Board of Trade.

BRITISH DOMINIONS, COLONIES, &c.—The Board of Trade have received information that Consular Certificates of Origin are not now required for goods shipped from Italy to British oversea ports.

UNITED KINGDOM AND CERTAIN FOREIGN COUNTRIES.—A Supplement to the *Board of Trade Journal* of May 18th contains complete lists of articles which are prohibited to be exported from the United Kingdom, and certain foreign countries, viz.: Denmark, France, Greece, Italy, Japan, Netherlands, Norway, Portugal, Roumania, Russia, Spain, Sweden, and Switzerland. The list of articles prohibited to be exported from Sweden is based upon information received at the Board of Trade up to May 15th, and should be of considerable interest to British exporters to Russia in view of the application of the Swedish prohibitions to goods passing in transit through Sweden to Russia. The present Supplement supersedes that issued on February 17th last. Copies may be obtained, price 3d. (3½d. post free), from the usual sale agents for Government publications.

CAMEROONS.—The former German Customs Tariff remains in operation. According to the Comptroller of Customs, Nigeria, goods for the Cameroons may be entered at Victoria, where a Custom House has been opened, but goods for Rio del Rey are required to be entered at Calabar. The specified schedule of import duties includes "articles of iron of all kinds," which pay an *ad valorem* rate of 20 per cent. All goods not mentioned in the schedule and not exempted from import duty pay 10 per cent. *ad valorem*. Among the articles on the free list are appliances for wireless and cable telegraph stations; machines and implements of all kinds.

An export duty of 40 pfennige per kilog. net (about 2d. per lb.) is payable on rubber, except plantation rubber.

ST. VINCENT.—By an Order-in-Council, dated March 17th, previous Orders issued in March, 1915 (under which an additional duty of 20 per cent. was levied, with certain exceptions, on dutiable articles imported into the Colony) are rescinded, and new additional duties are imposed in lieu thereof, including an increased duty of 10 per cent. on all articles other than tobacco, wines, and spirits.

NORWAY.—The exportation of worked, unworked, and scrap platinum has been prohibited.

FRANCE.—The Bill proposing to authorise the Government, while hostilities continue, to prohibit by Decree the importation of foreign goods, or to increase the import duties thereon—*vide* the REVIEW of May 12th—has now become law

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & CO., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

7,244. "Electrodes of electric melting and heating furnaces." S. DAVENPORT & V. STOBIE. May 22nd.

7,252. "Electric devices for automatically turning lights on and off." E. STEIGER. May 22nd.

7,255. "Loading coils." BRITISH INSULATED & HELSBY CABLES, LTD., AND H. H. HARRISON. May 22nd.

7,258. "Call-distributing telephone systems." WESTERN ELECTRIC CO. May 22nd. (U.S.A., May 22nd, 1915.)

7,275. "Electric heating apparatus." E. ERICHSEN. May 22nd.

7,288. "Miners', &c., electric lamps." F. J. TURQUAND. May 22nd.

7,291. "Refillable fuse plugs." J. G. CLEMENS. May 22nd. (U.S.A., May 25th, 1915.)

7,303. "Shadeholders for artificial lights." A. HAGUE. May 23rd.

7,305. "Stands or pedestals for electric lamps." W. J. FURSE & CO AND W. F. FURSE. May 23rd.

7,314. "Adapter for electric signalling lamps." R. A. WICKENS. May 23rd.

7,328. "Multicore electric cables." CALLENDER'S CABLE & CONSTRUCTION CO. AND J. O. CALLENDER. May 23rd.

7,334. "Telegraph key." F. PALMER. May 23rd. (New Zealand, May 29th, 1915.)

7,335. "Telephony." L. C. BYGRAVE & RELAY AUTOMATIC TELEPHONE CO. May 23rd.

7,336. "Thermo-electric switches." RELAY AUTOMATIC TELEPHONE CO AND G. K. ROBERTSON. May 23rd.

7,347. "Means for earthing electric conductor conduits." L. R. LACY AND G. RUSHTON. May 23rd.

7,380. "Electric lamps." J. MERSING. May 24th.

7,392. "Electric ignition or sparking arrangements." W. A. BRISTOW, H. W. F. IRELAND AND SIEMENS BROS. & CO. May 24th.

7,456. "Electro-chemical microphones for wireless telephony and telegraphy, &c." S. FORD & A. F. SYKES. May 25th.

7,471. "Electrical lock and commutator for railway signal levers." W. D. PARR. May 25th.

7,497. "Hygienic appliance for telephones." E. LEMAITRE. May 26th.

7,517. "Sparking plugs." A. E. LAMKIN. May 26th.

7,518. "Electric ship propulsion systems." R. V. MORSE. May 26th.

7,535. "Spark plugs." A. C. FERRIER. May 27th.

7,540. "Transmitting gear of ships' telegraphic, &c., apparatus." G. W. HASTINGS & A. ROBINSON & CO. May 27th.

7,543. "Morse signalling for aircraft." C. M. BOSTOCK & R. N. COLE. May 27th.

7,567. "Separators for secondary batteries." W. J. MELLERSH-JACKSON (India-Rubber Co.). May 27th.

PUBLISHED SPECIFICATIONS.

1914.

17,872. CONSTRUCTION OF HIGH-FREQUENCY ALTERNATORS. Soc. Marius Latour et Cie. July 28th. (November 22nd, 1912. Divided application on 26,934/13. November 22nd.)

1915.

2,404. ELECTRO-MAGNETIC DRIVING MECHANISM. T. Rushton & Coventry Electric Clock Co. February 15th. (August 13th, 1915.)

3,760. INCANDESCENT ELECTRIC LAMPS. A. A. Canton. March 9th.

6,296. ARC LAMPS ADAPTED TO BE USED ALSO FOR THE PRODUCTION OF ELECTRIC OSCILLATIONS FOR WIRELESS TELEGRAPHY, WIRELESS TELEPHONY, AND FOR OTHER PURPOSES. L. Mauclaire & A. Bréon. April 27th.

6,647. SOUND DIRECTING APPLIANCES FOR USE WITH TELEPHONES AND MICROPHONES. E. M. C. Tigerstedt. May 4th. (May 20th, 1914).

6,674. SYSTEMS FOR THE PROTECTION OF ELECTRIC CABLES IN THE EVENT OF EXTERNAL DAMAGE. C. J. Beaver & E. A. Claremont. May 4th.

6,818. AUTOMATIC SWITCHES OF ELECTRIC TRAIN LIGHTING SYSTEMS. W. King. May 6th.

6,930. ELECTRIC MEASURING INSTRUMENTS. A. Philip & L. J. Steele. May 8th.

6,980. JOINT FOR AN ELECTRIC CABLE. A. E. Tanner & E. A. Claremont. May 10th.

7,025. ELECTRIC TIME ALARM AND CALL SIGNALS. F. L. Cantrall. May 10th.

7,177. SWITCHING-OVER SYSTEMS FOR ELECTRICAL LIGHTING INSTALLATIONS FOR RAILWAY TRAINS AND THE LIKE. H. Grob. May 12th.

7,308. ELECTRIC SWITCHES. G. Webb. May 15th.

7,324. SHIPS' STOREHOLD AND ANALOGOUS TELEGRAPHIC APPARATUS. W. Chadburn & Chadburn's (Ship) Telegraph Co. May 15th.

7,366. ELECTRICAL TRANSMISSION FOR AUTOMOBILE VEHICLES. Daimler Co., F. W. Lanchester & J. L. Milligan. May 17th.

7,367. WIRELESS SIGNALLING SYSTEMS. British Thomson-Houston Co. (General Electric Co., U.S.A.). May 17th.

10,762. DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. & A. A. Pollock. July 24th.

11,627. FLUID-PRESSURE STARTING AND STOPPING DEVICES FOR ELECTRIC MOTORS OPERATING PUMPS. Westinghouse Brake Co. August 11th. (December 24th, 1914.)

13,207. ALLOYS. British Thomson-Houston Co. (General Electric Co., U.S.A.). September 15th.

17,535. TIME-LAG ELECTRIC SWITCHES. Allmanna Svenska Elektriska Aktiebolaget. December 15th. (January 9th, 1915.)

17,876. KEYBOARD-CONTROLLING DEVICES, PARTICULARLY APPLICABLE TO TELEPHONE SYSTEMS. Western Electric Co. (Western Electric Co., U.S.A.). December 22nd.

1916.

339. RADIOTELEGRAPHY APPARATUS. W. J. Mellersh-Jackson (A. Arbot). January 7th, 1916. Patent No. 100,384.

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THE PROGRESS OF ELECTRICITY SUPPLY.

THE movement towards the adoption of rational methods in the generation and distribution of electricity in this country, to which an added impulse has been given by the Board of Trade circular, is gaining impetus, and, we hope, will soon be in full swing. Our "Lighting and Power Notes" to-day contain references to the steps taken in Lancashire, where a scheme is being prepared for linking-up, and in London, where the municipal authorities have held a conference and passed a resolution in favour of the proposal. Much has already been accomplished in the Metropolitan area, but much remains to be done, and it is to be hoped that the difficulties interposed by the Treasury earlier in the war, as in the case of the Hammersmith-Battersea-Fulham scheme, will be removed by co-operation, if not linking-up, between the Government Departments concerned. It is, no doubt, inevitable that the requirements of the different Government Departments should sometimes clash, as in this instance, as well as that of the Ministry of Munitions and the Board of Trade on the fuel-saving question, but there should be no difficulty in arriving at a solution of the trouble, and facilitating progress in the interests of the nation.

Our present aim is to support the arguments of Mr. E. T. Williams and Mr. J. A. Robertson—and, of course, their distinguished leader on this path, Dr. Ferranti—by drawing attention to some noteworthy examples of the beneficial effects of concentration of management, enlargement of area, and development of the power load. For the most striking of these we have to go to the United States. The undertaking which supplies electrical energy to the City of Chicago is the largest in the world; some up-to-date particulars will be found in our "Notes" columns to-day, from which it will be seen that the annual output by now exceeds the almost incredible amount of 1,200,000,000 units, and the annual revenue is over four million pounds sterling! Why have we no such immense concern to our credit? Simply because, for well-known reasons, the business of electricity supply in this country has been split up into innumerable independent fragments, of which but a very few have been able to attain dimensions of real importance. It cannot be suggested that the social and industrial conditions which obtain in this country do not permit of similar developments—in the areas round several of our great cities there are populations, industries, and railways quite comparable with those of Chicago; the fundamental obstacle to progress is the small scale upon which our electricity supply undertakings have been conceived and developed. Granted that more than half of the Chicago output is supplied for traction—the remainder is still gigantic, nearly four times as great as the output of any of our municipal undertakings for *all* purposes; and have we not railways that can and should be electrically operated? Thanks to the conduct of supply on an enormous scale, the largest and most up-to-date machinery can be employed—a turbo-alternator of no less than 60,000 KW. is on order in the United States—and the capital and running costs can thus be reduced to values which 10 years ago would have been derided as unattainable. The use of electricity for all purposes results in an excellent load factor, and the concentration of management enables the concern to command the services of the most able men available.

In our "Lighting and Power Notes" to-day we give the results of the past year's working of the Manchester Corporation Electricity Department, the largest municipal undertaking in this country. It will be seen that with one-sixth of the capital expenditure of the Chicago undertaking,

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its sales of energy amount to over 140 million units—less than one-eighth of the Chicago sales—and the average income per unit is 0·06d. higher. The results are undoubtedly admirable, and reflect the greatest credit upon the city and its engineering staff. But why should not the Manchester undertaking rival, and outrival, that of Chicago in magnitude and output? Since 1904 the former has increased five-fold—the latter seventeen-fold.

The possibilities of the industry are perhaps still more strikingly shown by the case of Barrow-in-Furness, of which some particulars were given in our last issue. Nothing could more admirably demonstrate the importance and the profitable nature of the power load. Due allowance must, of course, be made for the state of war and its effect upon the rate of growth of the demand; but this has the advantage that instead of comparing the results obtained at an interval of five or 10 years, we can compare the records of two successive years, and note the remarkable contrast which they afford. Thus, in the year 1914-15, the total receipts were £26,585; last year they were £59,208. The total costs during these periods were respectively £13,867 and £34,809, the gross profits being, therefore, almost doubled; but the net profits increased from £3,163 to £12,804, more than fourfold. Also the total costs per unit decreased from 0·925d. to 0·605d., and the average price obtained from 1·742d. to 1·020d. What was the cause of this phenomenal advance?

No change was made in the tariff; the cost of coal, wages, and materials was considerably increased. The improvement was solely due to the increase in output from 3,597,410 to 13,806,254 units, in almost the same ratio as the net profit, and the load factor has improved from 17·97 to 40·36 per cent. The bulk of the increase, amounting to over 10 million units, is attributed by Mr. H. R. Burnett, the borough electrical engineer, to the power and heating load, and almost the whole of the increased revenue is derived from the same source, the receipts under this heading rising from £7,692 to £38,929. These results speak for themselves; but we may emphasise the moral: it is not with the lighting load, but with the power and "other uses" load that the future of the supply industry is bound up—in other words, *with the cheap units*.

To supply at low prices, it is necessary to secure a high load factor, a good diversity factor, and a large output, whilst keeping down capital outlay and running costs; all these objects are best attained by extending the area of operations and increasing the magnitude of the undertaking.

The Position of Rubber.

There has been so far no improvement in sentiment in the market for crude rubber, and prices have fluctuated considerably with an erratic tendency in values, which is not surprising, for the outlook has been in no small degree obscured by political apprehensions and the trend of the war news. Prices dropped at one period to about 2s. 6d. per lb. for best plantation rubber on the spot, the lowest figure recorded since October last year, and showing a set-back of 1s. 8d. per lb. from the extreme highest seen this year. The market last week showed at one period quite a good rally, but fresh weakness ensued owing to the fitful character of the demand. At the current relatively low prices holders occasionally displayed more resistance, but in the absence of any sustained demand from users, who seem very reticent about providing for their future needs, and so long as the authorities refrain from granting licences more freely for export to neutrals, it is probable that things will remain unsettled. There is, moreover, a considerable tonnage of the product left unsold on this side, which naturally tends to discourage the nursing of speculative holdings, these being apparently of respectable dimensions. Yet there has been some reduction in the home stocks in the course of the past month, as shown by the usual statistics. The deliveries for May, indeed, made a good showing, amounting to 6,206 tons for London and Liverpool combined, against receipts of 5,834 tons. The stocks have thus fallen to 9,031 tons, this comparing with 8,763 tons last year, and 5,778 tons two years ago. Of these stocks, only about 1,200 tons represent wild rubber, the bulk being plantation descriptions. There is an increasing inclination on the part of big consumers on either side of the Atlantic to await developments in the general political situation before increasing commitments for forward deliveries, although prices have now again reached a level at which the merits of the commodity should be more closely considered. Pending a lead in that direction, however, buyers are cautious. Indications as to the progress of the world's consumption are anything but clear, while there is just a possibility of American requirements falling off temporarily. It is, moreover, difficult to form any idea regarding the extent of invisible supplies, while not a few people suggest that consumers are as a rule fairly well provided. At the same time, the outlook in shipping is not so tight as it was a few months ago, so that regular supplies should be pretty well assured. The total shipped last month from the Federated Malay States to all ports was about the same as for the previous month at a little below 4,000 tons, making an aggregate of nearly 22,000 tons for the five months against 15,787 tons in 1915, and 11,544 tons in 1914. Our imports from Brazil are now comparatively small, and there is, for the time being, not much interest centered on fine Para, the outlet for which is undoubtedly interfered with by the formidable competition of the plantation product. Developments in the general position are purely problematic until peace is restored, after which it is tolerably certain that big quantities will be required by the Central Powers, whose stocks are utterly exhausted.

Electricity in Agriculture.

Next week the annual meetings of the I.M.E.A. will be held at the Institution of Electrical Engineers; the function, as last year, will be on a modest scale, but we sincerely hope that the weather conditions will be much better than those which prevail at present, in order that the meeting may be as successful as is possible under war conditions. The programme, which we published in our issue of April 7th, shows that papers will be read on boiler-house design, on the economic aspect of area of supply, and on the application of electric power to agriculture; all these are subjects of extreme interest and importance, and should lead to good discussions. The effect of area of supply is the key-note of the movement inaugurated by Mr. E. T. Williams towards the reorganisation of electricity supply in this country, and has figured prominently in our columns of late; we anticipate that it will be discussed with keen interest by the members of the Association. The use of electricity on the farm is, we may say, a "pet subject" of ours; for some years past we have missed no opportunity of bringing it before the notice of our readers, for we have satisfied ourselves—and wish to satisfy them—that it is a matter of the first importance to supply engineers, and offers surprising possibilities. We are glad to be able to add that some of those engineers have begun to realise the facts in this connection. Apart from the author of the paper, Mr. W. T. Kerr, whose enterprising and successful work in this direction were described in our issue of June 11th, 1915, we have recently received letters from other engineers, stating that the farm load, which had appeared unpromising, had turned out very desirable, and that "the enthusiasm of the farmers on the subject is really remarkable." We venture to urge upon the members of the I.M.E.A. whose areas include farming districts the value and importance of this load, and to assure them that they will find it well worth cultivating.

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MUNICIPAL ELECTRICAL EXTENSIONS AT KILMARNOCK.

The electricity undertaking of the Kilmarnock Corporation commenced operations in 1904 for lighting, power and tramway supply. Up to the year 1912 the largest consumer of energy was the Corporation tramway, but in that year the Council offered very reasonable tariffs to the factories, and now 90 per cent. of the mills and engineering works in Kilmarnock take the whole of their power from the public mains.

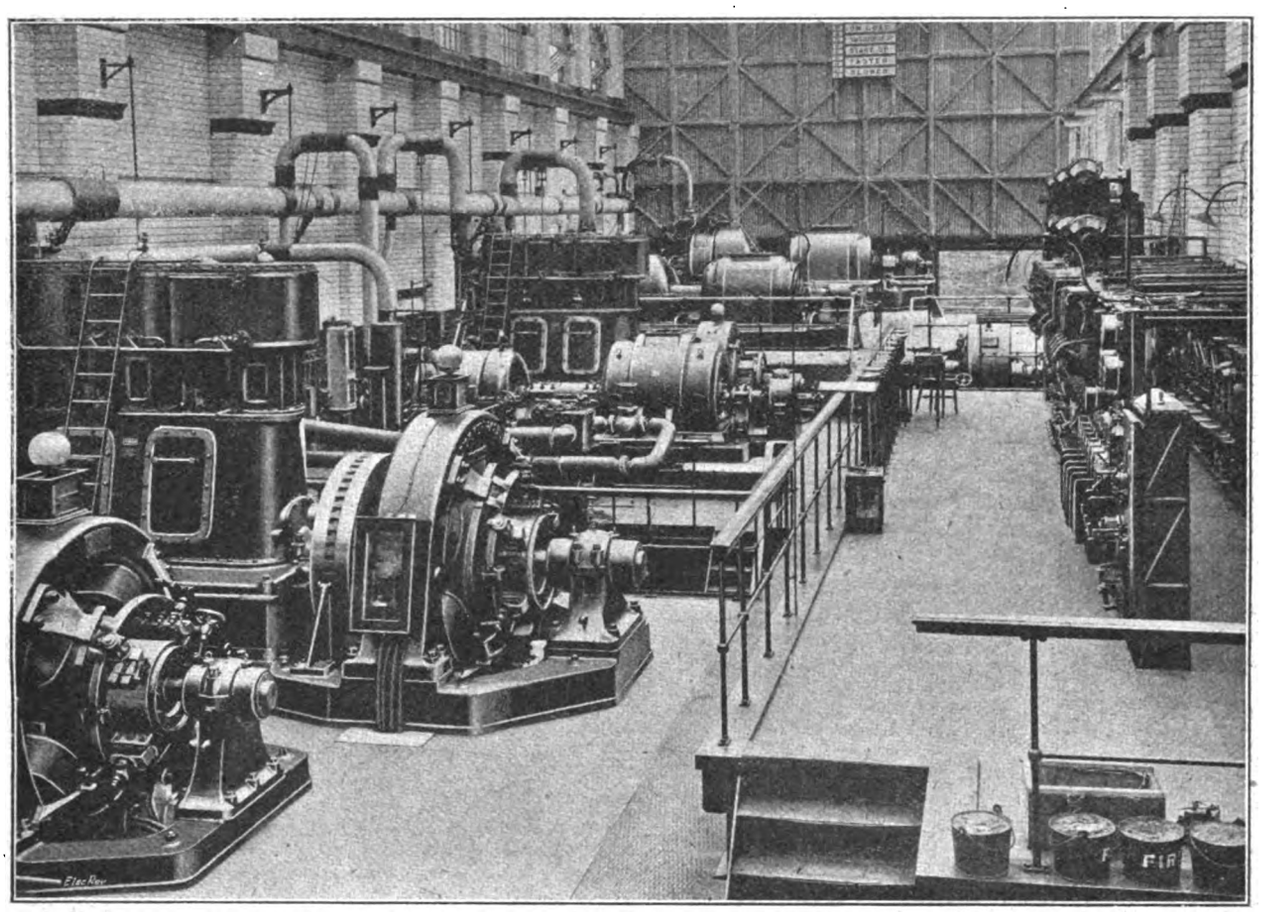
In the year 1914 the Town Council obtained powers to extend its area of supply, and this now includes the Burghs of Troon, Irvine, Galston, Newmilns, and Darvel, and a few villages and parishes; the whole area covers approximately 160 square miles, Kilmarnock being situated in the centre. In order to meet the new conditions efficiently, a three-phase H.T. supply was introduced, and the various localities are now linked up to Kilmarnock. The industries of the town are varied; Troon is one of the noted Ayrshire residential seaside towns, and has but one engineering works of any size, viz., the Ailsa Engineering and Shipbuilding Co. Irvine is also situated on the coast, but is a purely manufacturing town, with shipbuilding, forge works, block works, hosiery works, chemical, and smaller engineering works. The shipbuilding industry was started some two years ago, and is turning out to be of great importance.

The chief industry of the Burghs of Galston, Newmilns, and Darvel, is lace manufacture; there are approximately 36 lace mills in these burghs, each usually driven by a 60 or 80-H.P. steam engine, and in one or two cases requiring 120 H.P. The chief industry in the county is mining, for which Ayrshire is noted.

Although the Burgh of Kilmarnock has a population of only 36,000, there are numerous industries—blanket mills, yarn spinning, and engineering works. Three large engineering works are those of Messrs. Glenfield & Kennedy, Ltd., hydraulic engineers; Dick, Kerr & Co., Ltd., mechanical engineers; and A. Barclay, Sons & Co., Ltd., locomotive engineers.

The supply to Messrs. Glenfield & Kennedy is given through a ·2 sq. in. 3,300-volt cable and a 500-KW. Bruce Peebles motor converter, which is wound on the D.C. side for 240 volts. This machine is capable of developing 25 per cent. overload for two hours, and 50 per cent. for a short period, and displaced four reciprocating generating sets of 150-KW. each. Off the same feeder an overhead transmission line is run to give a supply to other works.

A direct-current supply is given to Messrs. Dick, Kerr and Co., Ltd., and Messrs. A. Barclay, Sons & Co., Ltd., from the main Langland Street sub-station. One ·2 sq. in. and one ·06 sq. in. cables feed this sub-station, and in it are installed one 250-KW. and one 300-KW. Bruce Peebles motor converters; foundations are available for a further 300-KW. machine. The D.C. side of the converters is wound for 480-540 volts, and the machines run in parallel with existing low-tension D.C. mains which feed through the town. The L.T. D.C. switchboard in this sub-station consists of two machine panels, three feeder panels, and one middle-wire panel, and was built and erected by the works staff. Off the ·2 sq. in. feeder a ·12 sq. in. main is run to another industrial part of the burgh, where transformers are installed and L.T. and A.C. supply is available.



KILMARNOCK POWER STATION: GENERATING PLANT.

Owing to the distance between Kilmarnock and the outer burghs, an 11,000-volt overhead transmission system was adopted. Immediately outside the main power station a transformer house is erected, wherein are installed one 800-K.V.A. and one 600-K.V.A. transformers. The larger transformer supplies the western section, and the other the eastern section, but arrangements are made whereby both transformers can be run in parallel. No switchgear is installed on the 11,000-volt side of the transformers, these being operated on the 3,300-volt side by switchgear in the main power station.

Inside the transformer house protective apparatus is installed on each outgoing wire, consisting of isolating switches, horn gaps, static dischargers, and resistances. The spark gaps on each phase consist of 12 non-arcing metallic bobbins in series with a horn-type gap, and a

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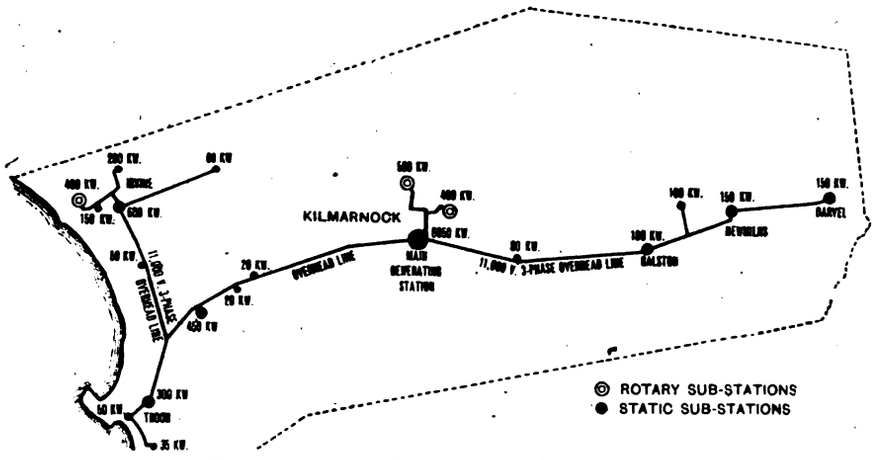
limiting resistance of the non-inflammable and non-heating type.

The overhead transmission lines commence immediately outside the main power station. The conductors are triangularly spaced, and for the greater part of the route are carried on single creosoted wood poles, the height of the pole being sufficient to provide a clearance of 20 ft. between the conductors and the ground in the centre of the span. In addition, the poles carry two telephone wires. At angles in the transmission line the angle pole is adopted. Each pole is provided with the usual number plate and barbed wire climbing guard; a galvanised



SUPPLY AREA OF KILMARNOCK CORPORATION.

earth-plate is buried at the foot, and put in metallic connection with each insulator pin.

On terminal and tee poles, channel-iron cross-arms are substituted for oak in order to give the necessary strength.

Near Hillhouse Quarry the transmission line crosses over ground so soft that a stick can be pushed down 20 or 30 ft. without effort. When the moss litter composing the top surface has been removed to a depth of 18 in., the ground is so treacherous that considerable care has to be exercised in continuing the excavation, and in some of the holes the "ground" was practically a semi-fluid. Tests were made, and it was found impossible to erect wood poles in ground of this nature, while concrete, if supplied in order to give additional strength, disappeared in the course of a few days, and made its way to the bottom of the moss. To meet these conditions, Callender's patent steel towers were used on this part of the route. These poles provide a very wide base, with lightness, and practically float on the surface of the moss. During the winter, heavy gales have been experienced, but the steel towers to-day are absolutely vertical, and in a dead straight line. In addition to the bad weather, the undergrowth on the moss took fire last summer, and flames swept across the moss in some places at a considerable height, but the supply was not interrupted, and the line remained unaffected.

When the transmission line crosses private or public roads, the duplicated insulator system with earth brackets is adopted, no cradle-work being used. Neither are lightning arresters placed on the tops of the poles, but where the overhead line is connected to underground cable, as at railway crossings, choking coils are put in circuit.

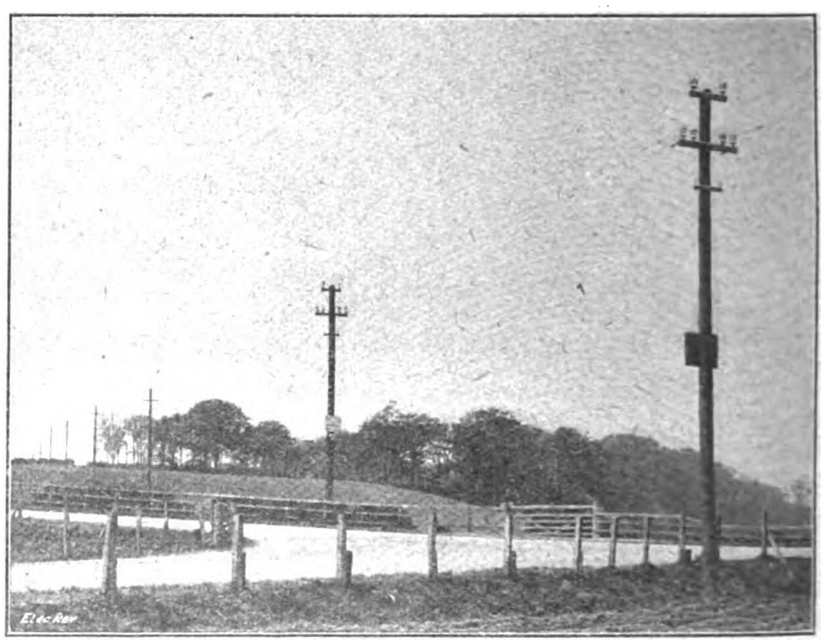
The whole of the transmission line is designed for 20,000 volts, but is only working at 11,000 volts at present.

Immediately on the boundary of the Burgh of Troon a sub-station is erected, and the overhead 11,000-volt transmission line terminates; at this sub-station the pressure is reduced to 3,300 volts. B.T.H. truck-type switchgear is employed on the 11,000-volt side of the transformer, and the same makers' ironclad switchgear on the 3,300-volt side, from which 3,300-volt mains are laid underground to various distribution centres. The latter consist of high-tension disconnecting pillars and kiosks containing H.T. oil switches, transformers and L.T. fuses. As far as possible, low-tension mains are laid between these points to provide against a fault occurring on any one transformer. Practically the whole of the load at Troon is lighting, but high-tension mains are laid of sufficient capacity to give a supply to the Ailsa Engineering and Shipbuilding Co., who at the present time generate their own supply by means of two 150-KW. Belliss-Westinghouse sets. The householders at Troon have taken advantage of the electricity supply, and the people living in the residential part of the burgh have installed all the latest cooking and heating apparatus and water-heating appliances. The supply has only been available since last March, but a good revenue is promising.

At a point in the overhead transmission line, viz., Gateside Bridge, a tapping is taken off to supply the Burgh of Irvine; the distance between this section point and Irvine is about three miles. Between these two points a 50-K.V.A. transformer is installed to supply a training centre, some 4,000 30-watt lamps being in use.

Immediately on the Burgh Boundary of Irvine, a sub-station, similar to the one at Troon, is erected, where the pressure is also reduced from 11,000 volts to 3,300 volts. The whole of the switchgear is similar to that installed at Troon. From the sub-station, underground H.T. mains are laid to the various works and distributing centres.

At the Irvine Shipyard, one 420-KW. Bruce Peebles motor-converter is installed to supply direct current at 480/540 volts. The sub-station at the Caledonian Forge contains one 3,300/415-volt, 150-K.V.A. transformer, and at Messrs. Laird's Blockworks one 200-K.V.A. transformer of similar ratio is installed. In the centre of the town



ROAD CROSSING.

a transformer-kiosk is erected, containing one 50-K.V.A. transformer, and L.T. mains are now laid between the other two transformer stations.

The whole of the underground mains, 11,000-volt, 3,300-volt, and L.T. mains, are paper-insulated, lead-covered, and armoured, laid direct in the ground, and covered over with stout wood boarding in accordance with the Board of Trade regulations. All L.T. distributing mains are 4-core (·1, ·1, ·1, ·05) cables.

The neutral point of such transformers is connected to earth by means of a separate earth-plate buried in the

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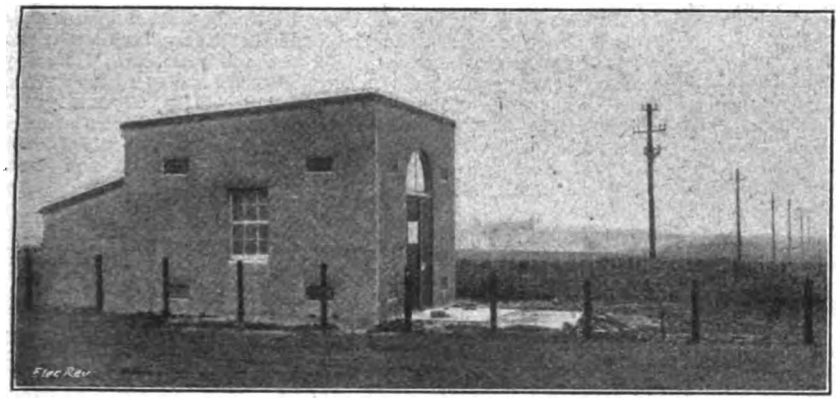
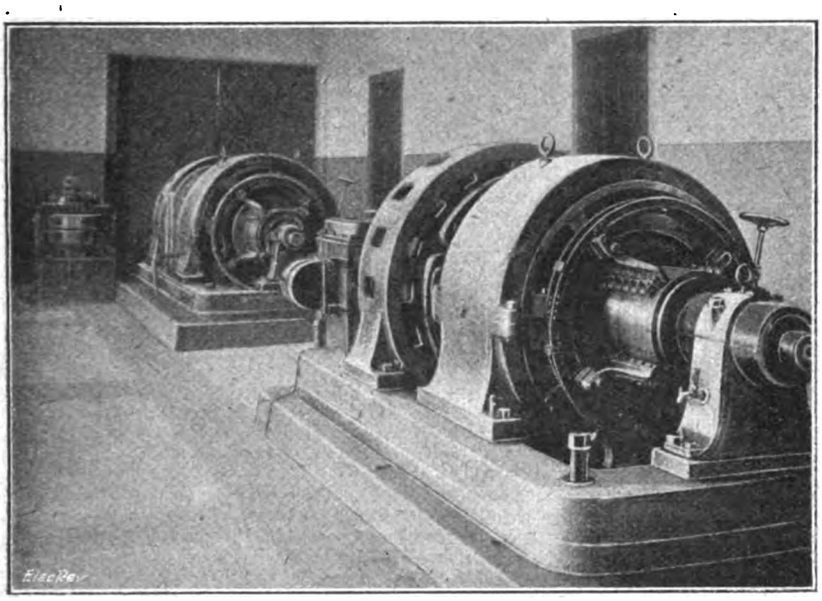
ground. At various places *en route* tappings are taken off the transmission lines to supply works, the chief of which



Sub-station and Overhead Line.



Motor-Converters in Langland Street Sub-station.

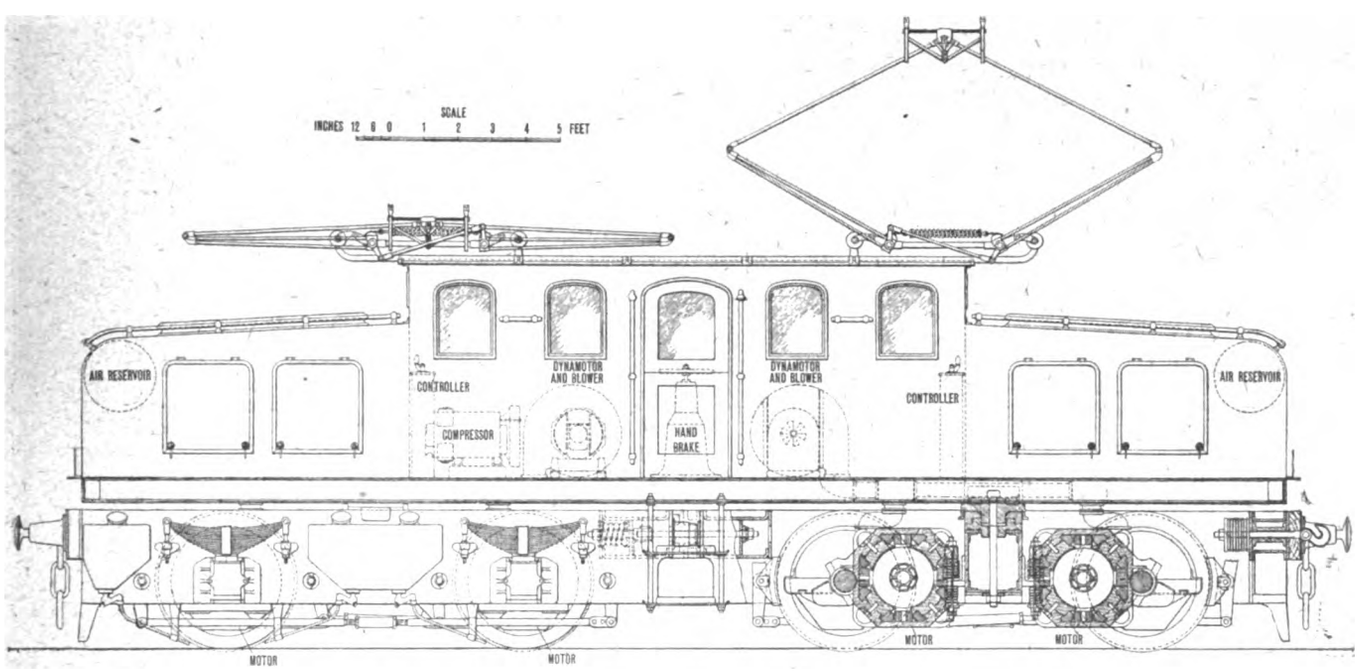
is the Hillhouse Quarry Co., where some 450 H.P. of variable-speed A.C. motors are installed. The farmers on whose land the transmission lines are run have taken advantage of the electricity supply, both for lighting and power; and to give a L.T. supply, small concrete buildings are erected at the foot of section poles, wherein are installed the necessary transformers, &c. Electricity is used on a number of farms for lighting, ironing, heating, motor-driving, and, in one case, milking, having been adopted in view of the prevailing labour shortage; experience so far shows that, contrary to expectations, the revenue derived from farm supply is a very good one. The transmission line was designed to carry 1,000 KW., but the line is already working at 800 KW. A new transmission line is now in course of erection, which will run direct to Irvine, thus forming a ring main. Already on the proposed new line applications have been received, one coal master requiring 256 KW. for pumping purposes.

(*To be continued.*)

NORTH-EASTERN RAILWAY ELECTRIFICATION.

Through the courtesy of Messrs. Merz and McLellan, consulting electrical engineers for the work, we are able to publish the outline drawing below, showing the arrangement of the North-Eastern Railway electric freight locomotives used on the Shildon-Newport route of that company, the electrification of which formed the subject of an illustrated article in our issues of May 26th and June 2nd. While we must refer our readers to the description there given for full details of these locomotives, we may here point out that the equipment includes four 275-B.H.P. totally-enclosed motors, each driving an axle through twin-gearing; the motors are fitted two in each truck, wound for 750 volts, the two on each truck being connected permanently in series, and the pairs or units controlled on the usual series-parallel system.

The sloping ends of the cab contain the resistances, contactors, &c., and all H.T. electrical apparatus.



North-Eastern Railway 1,500-Volt Direct-Current Electric Freight Locomotive.

In Two master-controllers are fitted in the cab, which also contains auxiliary switches for controlling the air com-

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pressor and two dynamotors shown, and for the lighting and heating circuits. The locomotive is mounted on two four-wheel trucks, and is 39 ft. 4 in. in length over the buffers, having a total wheel base of 27 ft.; it weighs about 75 tons, and its rated horse-power is 1,100.

It is designed to haul 1,400-ton trains at a speed of not less than 25 miles an hour on the level, and will exert an average pull of 28,000 lb. at the tread of the wheels when starting under normal rail conditions, with, of course, a considerably greater maximum pull.

The locomotives were designed and built at the company's locomotive works, and the electrical equipment was supplied and fitted by Messrs. Siemens Bros. Dynamo Works, Ltd., the work being carried out under the supervision of Mr. Vincent Raven, chief mechanical engineer to the company.

INTERNAL-COMBUSTION-DRIVEN ELECTRICAL SETS.

By W. A. TOOKEY, M.I.Mech.E.

(*Abstract of paper read before the* ASSOCIATION OF SUPERVISING ELECTRICIANS.)

ONE very frequently hears that a gas engine should be selected to work at a load 15 per cent., more or less, lower than the makers' ratings. This presupposes that gas-engine makers have agreed upon a standard basis of rating amongst themselves, but, as far as the author is aware, this is not the case. Practice in this matter varies very considerably.

There is one important item which a makers' catalogue very rarely gives, and that is the diameter of the engine piston and its length of stroke; it is upon this dimension that the whole output of the engine depends and comparisons are made possible. In his practice, the author pays no regard whatever to the makers' ratings, and considers only cylinder dimensions. Knowing these, the engineer can select his own engine to suit the job, and allow such margin as he thinks is necessary. Then, knowing the speed of rotation of the engine crank shaft, and the limit of pressure behind the piston that it is advisable not to exceed, he has all the elements which enable him to exercise a wise discretion in making a selection from engines of various types and construction. The necessary information is given in the following table:—

PISTON PRESSURES (LB. PER SQ. IN.) OBTAINABLE FROM INTERNAL-COMBUSTION ENGINES FOR USE IN CALCULATION OF B.H.P AND KW. OUTPUT.

1 Piston pressures and volumes.		Town gas.	Producer gas. Anthracite.	Producer gas. Coke.	Fuel oil.	Kerosene.	Petrol.	2-stroke liquid fuel crank case compression.
Maximum load.								
2	Pm	95	80	75	80	75	90	54
3	Pn	81	66	61	66	61	76	40
4	Em	·85	·825	·814	·821	·814	·841	·74
5	Pw	54	44	40·7	44	40·7	50·6	26·6
Normal full load.								
6	Pm	90	75	70	75	70	85	47
7	Pn	76	61	56	61	56	71	33
8	Em	·845	·813	·80	·813	·80	·835	·70
9	**Pw**	**50·6**	**40·7**	**37·4**	**40·7**	**37·4**	**47·3**	**21·8**
10	Vn	3	3·75	4·1	3·75	4·1	3·22	7·0
11	Vw	4·5	5·6	6·1	5·6	6·1	4·84	10·5
Long periods full load.								
12	Vw	5	6·2	6·7	6·2	6·7	5·3	11·5
13	Pw	45·8	37	34·2	37	34·2	43	20

Pm = Mean effective pressure = Indicator diagram positive loop. (I.H.P.)
Pn = Useful piston pressure available at engine shaft. (B.H.P.)
Pw = Useful piston pressure available at generator terminals. (KW.)
Em = Mechanical efficiency of engine = Pn ÷ Pm.
Vn = Piston displacement in cb. ft. per minute per B.H.P. developed (impulse strokes).
Vw = Piston displacement in cb. ft. per minute per KW. developed (impulse strokes).
(Values for Pw and Vw based on full-load generator efficiency of ·89.)

The head-lines of the table differentiate between the different fuels used in internal-combustion engines.

The second line (P_m) refers to the maximum piston pressure that is procurable from fuel mixtures of full strength for short periods of operation, and is, in fact, the mean effective pressure measured from an indicator diagram.

The third line (P_n) gives figures representing the force which is utilised in giving out power, and the difference between the figures in the second and third line represents, empirically, the amount of pressure absorbed by the friction of the mechanism within the engine itself.

In the fourth line (E_m) the ratio of line 3, divided by line 2, is given; in other words, the "mechanical efficiency" which the two sets of figures represent. P_n in line 3 can be calculated from any maker's catalogue, if the cylinder dimensions and speed are known, by the use of the well-known formula: PLAN /33,000 = B H.P.

Line 5 (P_w) represents the amount of piston pressure in terms of KW, when current is generated by a dynamo having an efficiency of 0·89, this figure being selected as a reasonable and usual efficiency of electrical machines of moderate output.

Lines 6 and 7 show the piston pressures comparable with lines 2 and 3, but with fuel mixtures of lesser value, upon which it is possible to rely whilst the engines continue in operation for, say, eight-hour periods.

Line 8 is the relative mechanical efficiency of the figures in line 7 divided by line 6. Line 9 shows the useful piston pressure utilised in conversion of H.P. into KW. as working loads, and really represents the maximum figures upon which supervising electricians should rely, and upon which they should base all their computations, in the manner afterwards demonstrated.

So far, all figures noted in lines 2 to 9 in the table refer to piston pressures in terms of lb. per sq. in., and it is important to realise that these pressures alone decide the output of any engine whose cylinder dimensions and speed are known. But, as they stand, they are insufficient to those who require to have a basis of comparing engine outputs, inasmuch as no indication is given as to the actual capacity that such pressures imply, according to cylinder dimensions and number of impulses obtained per unit of time.

By dividing 229·16 by either of the values of P, as noted in lines 2, 3, 5, 6, 7, 9, a figure is obtained which represents the number of cb. ft. of piston displacement required per minute to produce one I H.P., B.H P., or KW., as the case may be. In lines 10 and 11 will be found figures which, when multiplied by P_n in line 7 and P_w in line 9 respectively, will give 229. Taking the quantity 4·5 in line 11, under the heading of Town Gas, for example, we have the knowledge that for every KW. required as output from a certain dynamo, the engine cylinder dimensions and number of impulses obtained in a minute must be such that for each KW. generated, at least 4·5 cb. ft. of engine piston displacement must be allowed if the output required is to be maintained for several hours on end; and, further, that if the set is to continue in operation throughout the whole of the 24 hours, even a larger allowance of piston displacement per KW. is advisable—say 10 per cent. more (see line 12). With such an additional margin of 10 per cent, one can feel sure that temporary derangements, say of valve setting, which may result in reduced power from the engine; or temporary abnormalities, such as reduced strength of gas mixtures; or increased engine friction, due possibly to slightly-heated bearings; or any similar occurrence due to operation, will not affect the running to such an extent as to produce either a slowing-up of the engine, or an actual stoppage under full load.

To show the practical application of the figures given in the table, one or two examples of their use are added:—

(*a*) An engine has four cylinders, each 8 in. in diameter and 7 in. stroke, and runs at a speed of 600 R.P.M. It is served with town gas. What is its output capacity in KW. as a normal working full load?

Answer:—Area of 8-in. piston = 50 sq. in.
Piston displacement = 50 × 7 ÷ 1,728 = 0·2025 cb. ft.
V_w (displacement per min. per KW.) = 4·5 cb. ft.
Therefore:—0·2025 × 600 × 4 ÷ 2 × 4·5 = 54 KW.
NOTE.—For longer periods of operation at full load, say, 50 KW.

(*b*) A four-stroke, two-cylinder engine, 5 in. diameter and 6 in. stroke, specified to run at 800 R.P.M., is worked on kerosene (refined oil), and is offered by the makers as a suitable engine to drive a dynamo for eight hours at full output of 100 amperes and 135 volts, and to be capable of giving a first battery charge for 24 hours. Is this a fair rating?

Answer:—Area of 5-in. piston = 19·6 sq. in.
Output 100 × 135 = 13·5 KW.
Piston displacement = 19·6 × 6 ÷ 1,728 = 0·068 cb. ft.
Therefore:—0·068 × 800 × 2 ÷ 2 × 13·5 = V_w = 4·0.

But the table shows that for refined-oil engines V_w (see line 11) should equal 6·1 cb. ft. displacement per min. per KW., and, therefore, a three-cylinder engine of the same cylinder dimensions and speed would be necessary to give adequate margin.

(*c*) A single-cylinder two-cycle oil engine, 14 in. diameter and 15 in. stroke, runs at 300 B.P.M. What is its output:—(1) maximum B.H.P.; (2) working B.H P. (normal full load); and (3) KW. rating—the latter assuming a dynamo efficiency of 0·89—at normal working full-load output?

Answer:—Area of 14-in. piston = 154 sq. in.
Piston displacement = 154 × 15 ÷ 1,728 = 1·337 cb. ft.
Therefore:—
1·337 × 300 ÷ 10·5 (line 11) = 38·2 KW.
÷ 7·0 (line 10) = 57·3 B.H.P. normal full load.
÷ 5·7 = 70·4 B.H.P. maximum.

It is to the shirking of what are, after all, but simple arithmetical problems, that troubles with internal-combustion-driven

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dynamo sets are often due. The subject is essentially practical, and should certainly be given much more attention than it usually receives.

A piston-pressure basis of rating as suggested in the table accords generally with practical results obtained. The author has found the method of comparison extremely useful, and for this reason now presents it to his engineering colleagues for what it may be worth.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

White's Patent Corrosion-Proof Fitting.

The latest addition to the series of corrosion-proof fittings developed by the St. Helens Cable and Rubber Co., Ltd., of Warrington, for use in connection with their cab-tire sheathed cable, is a lampholder specially designed for situations in which it

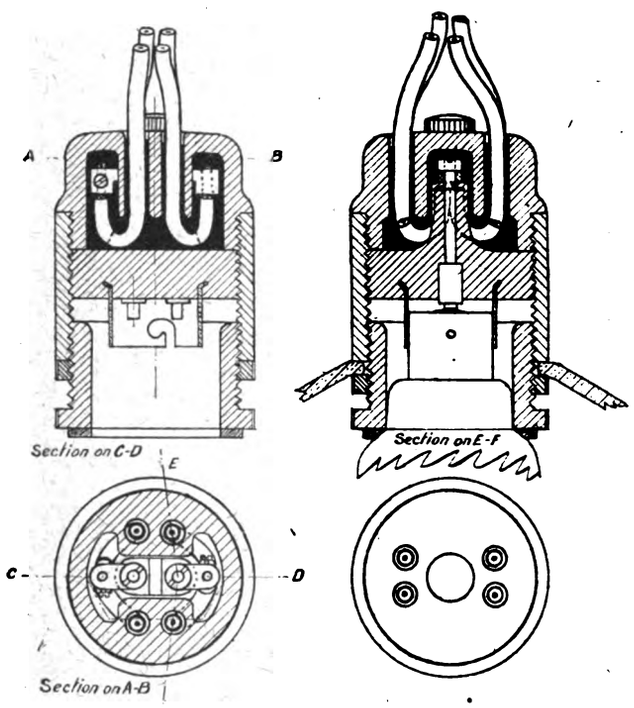

Fig. 1.—Sections of White's Corrosion-Proof Lampholder, "Loop-in" Type.

is not convenient to install the corrosion-proof ceiling-rose. The construction of this device is illustrated in figs. 1 and 2, and is on the same lines as that of the company's standard C.P. holder, having their U seal in the top and their special collar, with cushion to protect the terminals and lamp cap. The holder, it will be noted, protects not only the terminals and cable ends, but also the whole of the lamp cap, from corrosion. In fig. 1 the method of looping-in is clearly shown, and it will be seen that the compound with which the top of the holder is filled (shown black) completely protects all metal parts in that chamber, while provision is made for excluding water from the lower chamber with rubber washers. Fig. 2 shows the parts as photographed, and fig. 3 the complete fitting in position. These holders have been tested by total submersion under water, with the lamps burning, for periods of 144 hours, and under battery acid for 24 hours. Mr. White's C.P. fittings, we understand, are being largely used by the Ministry of Munitions (Explosives Department), and are approved by the Home Office for use in Explosive Danger buildings. The body of the holder is made of a special insulating material of the ebonite class, the interior being fireproof and the exterior of a special acid-resisting quality.

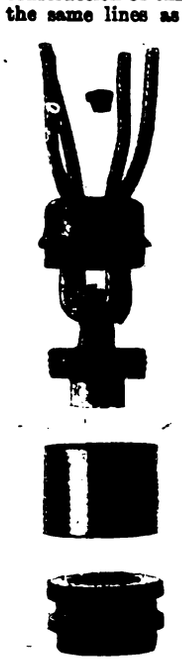

Fig. 2.—Parts of Lampholder.

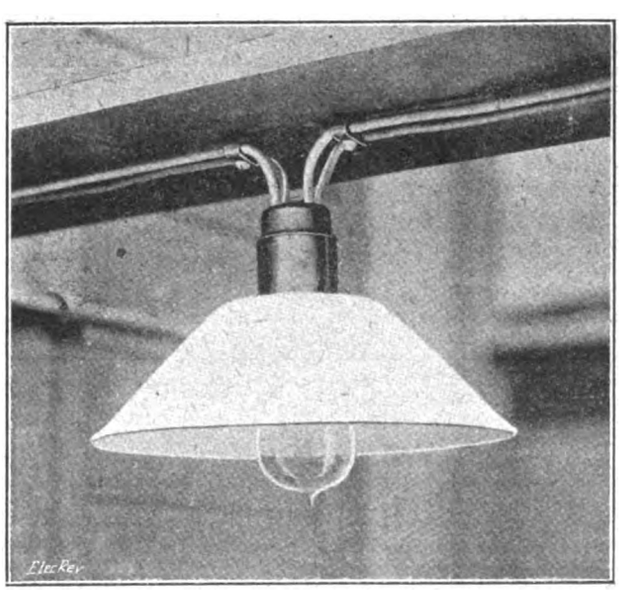

Fig. 3.—Corrosion-Proof Fitting Complete.

Hotpoint Cooking Appliances.

We have received a 1916 pamphlet on the subject of electric ranges, from the Hotpoint Electric Heating Co., of 38, Poland Street, W., which, in addition to general information on the subject of electric cooking, particularises Hotpoint apparatus and its use.

Mention may be made of five new ranges, models D to H, which are being introduced by the company, and of which D and E represent apparatus suitable for large family cooking, while the others are on a less ambitious scale. We illustrate in fig. 4 the Model G range, which most nearly resembles the usual type of English apparatus, and includes a baking oven 18½ in. × 16 in. × 11½ in. high, with drop-down door, and upper and lower heating elements controlled by three heat-indicating snap switches. The upper element is for broiling, and a broiling-pan is provided. Three three-heat circular boiling-plates, giving nine different loadings, from 200 to 1,500 watts, are fitted, of the "glowing coil reflector" type; similar rectangular elements are fitted in the oven. The top of the range is hinged, and the boiling-plates are easily removable. A heat indicator is provided on the oven door, which can be used as a guide to cooking temperatures in conjunction with a chart; the indicator registers a number, not degrees.

Fig. 4.—Hotpoint Electric Cooker, Model G.

Amongst other matters referred to in the pamphlet is the Hotpoint water heater, suitable for 15 or 30-gallon tanks; this is in the form of a hollow cylinder, through which the water circulates, and is made for two loadings, 500-watt, 8 in. long, and 1,000-watt, 12 in. long, with the heating element guaranteed for two years. The company has recently issued a neat little push-button switch for use with table-cooking appliances, shown in fig. 5

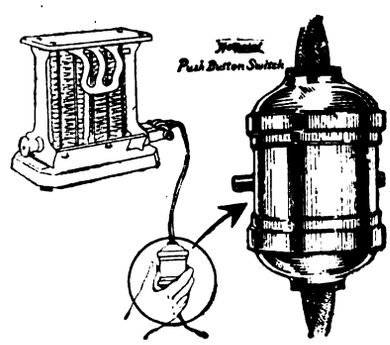

Fig. 5.—Hotpoint Switch.

D

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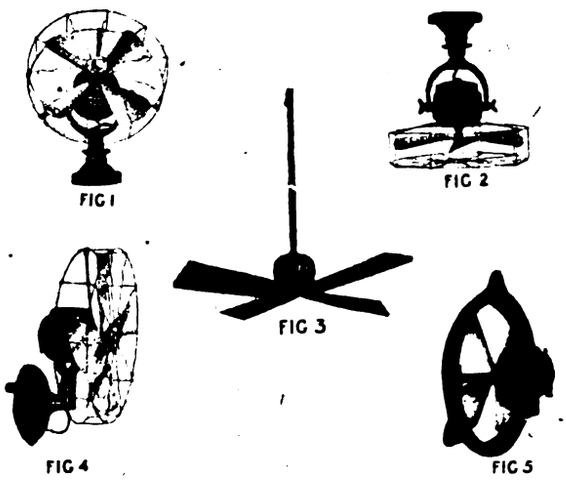
This switch has a simple and effective movement, giving a quick make and break, and bears the Underwriters' inspection stamp. It should be quite suitable for table appliances.

Electric Fans.

Notwithstanding the fact that in the early days of this week office fires had to be switched on, to prevent the editorial soul from freezing hard in this merry month of June, we are assured that there is every indication of a good fan season. On that assumption, in anticipation of the good times in store, firms that are in a position to supply are being advised to circularise during the next few weeks the local hospitals, doctors, nursing homes, authorities, &c. The Edison & Swan United Electric Light Co., Ltd., Ponder's End, have issued a new fan list illustrating a number of their leading lines, some of which we show herewith.

Figs. 1 and 2 show their steamship and train fan (D.C.), in two different positions; its essential feature is its special combined supporting device and connection. One or more supports can be fitted in each cabin or saloon, so that the passenger can fix the



Ediswan Electric Fans.

fan to suit his own requirements, whilst by means of the swivel and trunnion movement the fan can be set to blow in any desired direction, from the roof, floor, or table. Fig. 3 shows a ceiling fan (D.C.), which is specially built for large halls, kinema theatres, clubs, institutions, &c., for energetically moving the air over a large radius without noise. An oil-well fitted inside the body prevents oil from getting into the windings. Fig. 4 is a popular model of convertible fan for convalescent homes, private houses, &c.; it can be used either as a bracket fan or on the table or floor. It is a silent fan, and is fitted with a regulator giving three speeds. The porthole fan (D.C.) shown in fig. 5 is specially built for factory ventilation, and can be easily fitted to all standing buildings—the cast-iron ring may be inserted into a suitable aperture in the wall, window or ceiling.

LEGAL.

Charges Against a Colliery Manager.

In the Sheriff Court at Falkirk, on Friday, before Sheriff Moffatt, John Grierson, colliery manager, Falkirk, was charged with a number of breaches of the Coal Mines Act at No. 7 Pit of Callendar Colliery Co., in which the haulage is worked by mechanical power. It was alleged in the indictment—"You did place, or permit to be placed, electric cables across the entrances to No. 18 and No. 22 refuge holes of the inner set of haulage road, so as to impede ingress." The indictment also charged him with failing to have in use at the mine the code of signals prescribed by No. 92 (*a*) of the General Regulations, and failing to keep exposed and dangerous parts of the machinery securely fenced. Grierson tendered a plea of guilty, and on his behalf an agent stated that in regard to a number of the counts he could have pleaded not guilty, but to have done that would have necessitated the closing of the pit for a whole day. Immediately the inspector drew his attention to the matter, Mr. Grierson had additional fencing put up. The haulage engine was started and stopped by a lever operated from a separate winding engine house, which had two doors, and the engineer only visited the haulage engine when stopped for oiling purposes. It might be, however, that his client had committed a technical breach of the law, and the engine-room in question had now been provided with two doors. Further, the agent explained that the colliery was supplying mine-sweepers and public works engaged in the manufacture of explosives, grenades, electric-power works, and others, and that the manager was unable to cope with the national demands. In the circumstances he elected to go on working his haulage road, under the honest conviction that in doing so he was really assisting in the national needs.

The Sheriff said it was a question whether the Act of Parliament was to be disregarded in times of national emergency. Addressing the accused—he said he could not hold that the provisions of the statute or of the regulations could be altered in this case. If it was necessary that the work of making the necessary alterations could not be gone on with, as a result of national emergencies, he (the Sheriff) was sure that those who prosecuted would have taken that into consideration. The accused had contravened the regulations laid down by Parliament, and consequently he would impose a penalty of £15.

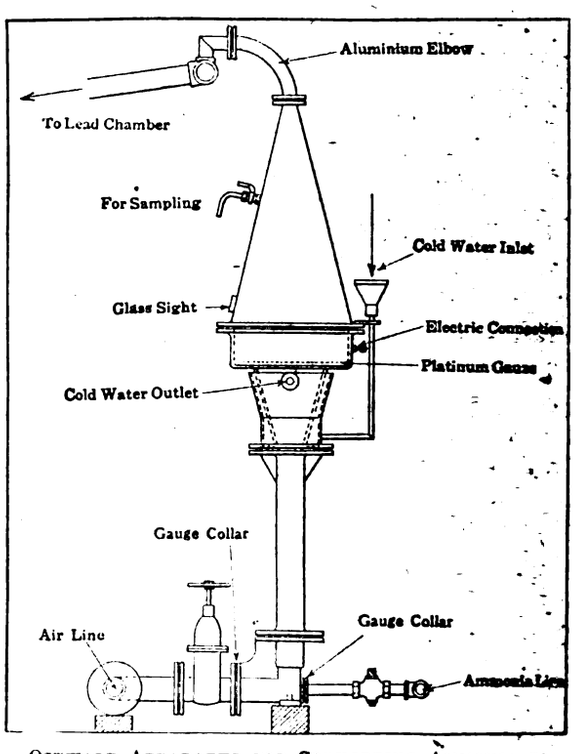
The Leiston Street Lighting Case.

In the Court of Appeal, on June 9th, the appeal by the defendants in the case of the Leiston Gas Co., Ltd., *v.* Leiston-cum-Sizewell U.D.C. (recently commented upon in our pages) was dismissed.

THE FIXATION OF NITROGEN IN THE U.S.A.

The fixation of atmospheric nitrogen with the aid of water power has recently been under discussion in the United States Congress. The importance of providing a supply of nitric acid in time of war, as well as of artificial fertiliser in time of peace, from the country's own resources, is gaining appreciation, but the various interests involved are pulling in different directions, and no definite result has been attained.

In *Metallurgical and Chemical Engineering*, a pamphlet issued by Mr. F. S. Washburn, president of the American Cyanamid Co., is quoted on the relative merits of the arc and cyanamide processes of fixation of nitrogen; the former depends upon direct combination of nitrogen and oxygen by the high temperature of the arc, whereas the latter is based upon the conversion of calcium carbide to cyanamide by combination with nitrogen, the cyanamide being afterwards converted to ammonia by treatment with steam, and the ammonia, if desired, to nitric acid by oxidisation. Mr. Washburn states that the arc process requires between five and six times as much electrical energy as the cyanamide process, for the same result; for the production of 180,000 tons of concentrated nitric acid per annum 540,000 continuous horse-power is required by the arc process and 100,000 continuous horse-power by the cyanamide process. With the cost of power installation at the moderate American figure of $100 per continuous horse-power on the switchboard, a plant for 180,000 net tons of concentrated nitric acid per



Ostwald Apparatus for Converting Ammonia to Nitric Acid.

annum by the arc process would cost $30,000,000, and under the same conditions a plant of the same capacity by the cyanamide process would cost $30,000,000. For the production of fertilisers alone, the disproportionate cost of plants of equal capacity is much greater than is indicated by the figures given above for the production of nitric acid.

The world production of nitrogen by the arc process is 32,000 net tons, and by the cyanamide process 200,000 tons per annum. The former has been confined mainly to Norway, whereas the cyanamide process has found application in Norway, Sweden, Germany, Austria, Italy, France, Japan and Canada.

There are a number of processes for the oxidisation of ammonia. The particular process in the development of which the American Cyanamid Co. collaborated has application in Germany equivalent

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to the production of 120,000 tons of concentrated nitric acid per annum.

The chemical efficiency of the process is over 90 per cent., and an English company is establishing plants in the allied countries of Europe with this efficiency guaranteed. The cost of production is about 70 per cent. of that of nitric acid by way of Chile nitrate. The art was quite new when the war began, and the enormous demand for nitric acid has given it an extraordinary impetus, and led to improvements which might otherwise have taken years to accomplish. All military explosives are made from and with nitric acid. Germany's supplies of Chile nitrate of soda were consumed early in the war, and she is said to have expended 20 million pounds sterling on the air nitrogen industry, increasing the power employed by 300,000 H.P., whilst the Allies, though able to obtain Chile nitrate, are employing 500,000 H.P. continuously in the fixation of atmospheric nitrogen. Again, Germany produces twice as much food from half the area devoted to grain and potatoes in the United States, by employing seven times as much fertiliser to the acre. Mr. Washburn, at the request of the U.S. War Department, submitted a plan for assuring to the Government an ample supply of nitric acid in the event of war, according to which the Government was to develop 100,000 hydro-electric H.P. (with a reserve of 25 per cent.), costing 2½ millions sterling, the plant remaining the property of the Government; private capital would pay the Government 3 per cent. on the cost of the plant and the operating costs, and would construct a fertiliser plant at a cost of 4½ millions, producing fertiliser equivalent to 2,200,000 tons of standard fertiliser; private capital would also install plant costing £200,000 to manufacture 20,000 tons of nitric acid per annum, the Government's peace requirements, while the Government would install, at a cost of £1,000,000, plant to manufacture 90,000 tons of nitric acid per annum, the latter plant to stand idle, but ready, and have all preparations made to double this output within three months.

Regarding the production of ammonia from by-product coke ovens, Mr. Washburn considers the output variable, and says that it is absorbed by industries from which it could not be withdrawn without great disadvantage in time of war. He points out that Germany, producing 90 per cent. of her coke in by-products plant, turned to atmospheric nitrogen in war time. No private interest can afford to prepare itself in time of peace to manufacture nitric acid to meet war demands, owing to the amount of idle capital on which there would be no return. Cheap water power is the chief requisite in the fixation of atmospheric nitrogen, but the United States is not a country of cheap water powers; the annual cost of a hydro-electric H.P. in the United States is $12 to $20, compared with $3 to $6 in Norway. The markets of the United States can be best filled from manufactories situated on the cheap Canadian water-powers. Only by Government ownership, and a lease at low rates to the user, can power be supplied to the latter cheaply enough to manufacture nitrogen from the air, and as the industry is new to American investors, to be relieved of the necessity of providing capital for power plant amounting to about one-half the total investment would greatly assist in raising the capital for the purpose. Mr. Washburn also states that the American Cyanamid Co. is representative of one of the four industries which must have an extraordinary amount of extremely cheap water power, the others being the carbide industry, the aluminium industry, and the arc process. The Union Carbide Co. is the sole representative in the United States of the carbide industry, and it has secured water powers in Norway for future developments. The Aluminium Co. of America, the sole representative of the aluminium industry in the United States, is confined to the use of those powers which are within range of the necessary raw materials, and has secured the cream of the large cheap powers in the United States. The arc process has not, so far, found its way outside of Norway except in an experimental way. The Du Pont Co. states that it is its purpose to establish the arc process in Canada. The Cyanamid Co. is in Canada, and has laid its plans for remaining there; it is engaged in extensive developments for the purpose of providing for the use of the farmers of the U.S.A. a great supply of a concentrated chemical compound of nitrogen and phosphoric acid, constituting a fertiliser of superior merit.

In the same issue of *Met. and Chem. Engineering* is an abstract of an article by G. Schüphaus, in *Metall und Erz*, on the Ostwald process, which is the one employed for converting ammonia into nitric acid. Broadly speaking, impure ammonia liquor is first purified, and then pure ammonia gas from this liquor is conducted to a catalyser apparatus, where it is mixed with air and passed over a heated catalyser, forming nitric oxide and steam. The catalysing chambers are arranged in groups of three elements, of which two are in use and the third is in reserve; one is shown on p. 672. At the bottom the ammonia gas enters on one side and air on the other. The air and ammonia, before they meet each other and mix, pass through gauge collars as indicated, whose diameters are so selected that a proper mixture of air and ammonia for burning will be obtained. For further adjustment a valve is placed in each line. The air and ammonia are mixed by a rotating aluminium plate, and pass then through a narrower iron wire screen.

The air-ammonia mixture now goes to the platinum gauze, which is heated to about 700° by electricity. At this temperature an almost quantitative conversion of the ammonia to nitric oxide and water takes place. The platinum gauze takes about 120 to 150 amperes, at 24 to 26 volts, for heating. In order to prevent breaking up of the ammonia by radiation and conduction from the glowing platinum gauze before it reaches the hot zone, the lower half of the casing surrounding the gauze is cooled by water. For conducting away the oxide of nitrogen, an iron hood is fastened to the burning chamber. This hood rapidly diminishes in cross-section, and is lined with sheet aluminium on the inside, in order to prevent iron oxide particles from falling down on the platinum gauze. The elbow leading from the iron hood is also of aluminium.

The three elements provide nitric acid for the manufacture of 10,000 tons of 60° suphuric acid per annum, on the lead-chamber system. On the other hand, the process can be worked so as to produce ammonia-nitrite or nitrate, the latter being an excellent fertiliser.

THE SELLING SIDE OF ELECTRICITY SUPPLY.—VII.

Advertising, like politics, is a subject that everybody feels himself capable of criticising, and it therefore behoves one to be wary in offering suggestions. There are, however, one or two points worth a little more consideration than they generally receive, both in the matter and in the distribution of publicity literature.

As regards the matter itself, unless great care is taken with its form, a very large percentage finds an immediate resting-place in the waste-paper basket. Especially is this the case when it is in the shape of advertising matter pure and simple. Progressive advertisers discovered many years ago that, in order to avoid its premature destruction, it was necessary to give their literature some practical or artistic value. This they did by embodying it in a calendar, a diary, or some such thing, which would render it of use, or else giving it an artistic embellishment that would save it from an untimely end. The latter, or a combination of the two, is usually prohibitive on account of expense, and one therefore leans to the utilitarian method for achieving the purpose at a minimum cost.

It has most frequently been the object of electricity supply managers to direct their efforts towards the conversion of the householders, yet all who have had much experience in pushing "other users" of electricity have found that the servants are almost as important.

If the cook, for instance, has made up her mind that she will not like electric cooking, an attempt to force it upon her is foredoomed to failure. There have been many cases where it has been installed in defiance of the autocrat of the kitchen, and one complaint has followed another, until it has been removed. A good deal of diplomacy is required to get her majesty's sympathy and co-operation, but it is well worth the effort, for plenty of cooking installations have been brought about by her advocacy. As time goes on good servants are becoming rarer, and to those lucky enough to possess them, priceless, which in itself suggests a variation in our *modus operandi*.

Supply authorities are, of course, in the habit of reading their meters quarterly, and we offer the suggestion for what it is worth, that in addition to sending advertising matter with the bill—not always a happy moment—the meter-reader should be provided with a supply, and should present a copy to the servants.

We have always believed that the finest introduction to other uses is the electric iron; there is nothing to touch it in convenience or cheapness, and no residential installation can be regarded as satisfactory that does not include one or more.

For a meter-reader to waste his time canvassing is neither necessary nor desirable, but no doubt a little of his time goes in a friendly chat here and there with, perhaps, a pretty maid. With a little encouragement this might be made to take the form of a pleasant inquiry as to whether she has an electric iron. A list could be made of the premises without one, and a mark placed on the meter-card. It might then be possible to offer each meter-reader a bonus, or a small increase of sixpence or so on his weekly wage, for every 25 or 50 irons installed in his district from the date the scheme starts. It would not take him a moment, whilst he is being admitted and escorted to the meter cupboard, to present his publicity matter and suggest the advisability and interest of paying a visit to the show-rooms where demonstrations are being given.

We have mentioned that the advertisement might take the

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form of something useful. A calendar is a thing often referred to, and it might be made for a portion of the year, say, the period between the meter reading visits, so that, having supplied a reminder about irons for a time, the next of the series would deal with vacuum cleaners and so on. Other ideas suggest themselves for ensuring frequent reference to the advertisement; for example, spaces beside each day could be provided, wherein to record the quantity of milk and bread delivered.

The scheme should be backed up by every possible means; those interested will find a plan for an iron campaign outlined in our issue of March 19th of last year. The co-operation of manufacturers can always be obtained for providing advertising matter, and possibly for a special display stock.

It is important to make sure that apparatus does not get out of order and become shelved. The meter-reader's advance, when earned, might well be made conditional on his seeing that this does not happen, by making an occasional inquiry as to how it is found to be working.

One other point about irons: there is still room for a very light iron of 2 or 2½ lb. weight for lace and fancy work. Many ladies would be inclined to purchase such an iron for their own use, in addition to one for the kitchen.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Support of Home Industries.

I was pleased to note your Leaderette in reference to the example of the Oxcroft Colliery Co., Ltd., who propose giving out contracts only upon the distinct understanding that the company, firm or individual to whom they are sent is not in any way under the influence or control, directly or indirectly, of any German, whether naturalised or otherwise, and that none of the payments or profits arising from the execution of the contracts will pass into the hands of Germans as shareholders, partners, or otherwise.

For your information, I may say that I believe a municipal authority endeavoured, when advertising for their annual contracts in the early part of this year, to follow the same principle, by issuing, at the time of inviting tenders, forms on which they were asked to fill in the following information:—

1. State as to whether you have directors on the board of alien enemy origin, naturalised or not; if so, the number.
2. As to the shares held by such directors or/and by shareholders of alien enemy origin, naturalised or not, and the percentage of such shares to the total capital.
3. As to the number of staff and employés of alien enemy origin, naturalised or not, receiving payment.
4. As to whether any of the goods or material which it is proposed to supply will be manufactured or obtained from abroad, and, if so, the town and country of origin, with the name of the firm supplying same, must be given, and not the country from which they are imported.

I am informed however, indirectly, that instead of getting the support it was hoped the British manufacturers would give, many firms refused to have anything to do with it. It is hoped, however, now that such an important and influential industry as the coal trade (which at the present moment is all-powerful in the country) has taken the matter up, that it will be possible to enforce conditions which other purchasers, even a municipal body, are unable to do.

It is to be regretted that an Association of which the word "British" forms such a large part should not be starting some active propaganda towards the end which should be the aim of all British-born subjects.

Station Engineer.

June 12th, 1916.

[It is satisfactory to learn of one more municipal authority that is prepared to embody in its conditions of contract the views held by the majority of the British people on this matter, when it is possible to do so. Several important corporations expressed themselves very plainly on this question some time ago—will the others follow?—EDS. ELEC. REV.]

THE RÖNTGEN SOCIETY.

AT the meeting of the Röntgen Society on June 6th, Prof. J. W. NICHOLSON read a paper on the homogeneity of visible radiation, and gave an account of spectroscopic researches which he had been conducting at King's College, London. Although the paper was almost wholly concerned with physics, the discussion took a more immediately electrical turn, Major ROBERT WILSON, of the Canadian Medical Service, raising the question as to the possible homogeneity of X-rays, which homogeneity, he said, was the philosopher's stone of the radiographer. The radiographs obtained to-day by means of high-power transformers were of a totally different order from those obtained with the simpler apparatus of years ago. Not merely was the apparatus more powerful, but the action was different. In taking radiographs of the frontal sinus sideways it was found that with a static machine or coil as the means of excitation a clear-cut image of the bone resulted, but with the high-tension transformers now in use a different type of ray was forthcoming, and one which revealed not only the bones clearly and perfectly, but also the nimbus of flesh, and in some instances on the same plate an image of the very skin itself. He never got these with his static machine. He felt that there was a very definite ratio between the character of the ray which was produced and the strength of the current.

Dr. G. W. C. KAYE said that Prof. Barkla originally laid it down that every element had at least one homogeneous X-ray of its own, and in some cases two, one of which was called the K radiation, and the other the L radiation; but then came the workers on crystals (Bragg and others), and it was found that the X-ray was not by any means homogeneous, and at present the X-ray investigator was in the same position with regard to the number of spectra as was the worker in optics. Dr. Kaye said that previously to the war he had been engaged in analysing the beams of rays obtained from a hard tube under ordinary conditions, and although the work was suspended, he did enough to show that the chances of obtaining homogeneous X-rays were extremely small. The proportion of L radiation got out of an ordinary tube under ordinary working conditions was trifling, perhaps about 5 per cent. If the tube were run "soft"—so soft as to be probably of not much use, except for therapeutic work—it was possible to get a fairly large proportion of homogeneous rays. No matter how much the quantity of radiation were cut down, although a ray almost homogeneous could be obtained, it was never quite homogeneous. The results in this direction were certainly not such as to make one optimistic.

Prof. NICHOLSON said that he had no certain results along this line of investigation at present, but he promised that the Society should hear something about it later on.

WAR ITEMS.

To be Wound-up.—The Board of Trade has ordered more businesses to be wound-up, making the total down to date 196. The latest lists include the following:—

Union Electric Co., Ltd., Park Street, Southwark, S.E., electrical engineers. Controller: P. D. Leake, 25, Abchurch Lane, E.C.

Quarzlampen Gesellschaft m.b.h., 62, Red Lion Street, W.C., dealers in quartz lamps and accessories. Controller: R. W. Brown, 12, Old Square, Lincoln's Inn, W.C.

Coke Oven Machine Co., Ltd., London, manufacturers of coke oven machinery. Controller: J. Duncan, 158, Fenchurch Street, E.C.

Chas. H. Blume, Western Road, Mitcham, Surrey, varnish and enamel manufacturer. Controller: J. W. Barrett, 19a, Coleman Street, E.C.

"Made in ——."—The Chamber of Commerce of New South Wales at a recent conference resolved:—"That, with a view to preventing the general use of enemy goods after the war, the Commonwealth Government be approached with a request that legislation be introduced, requiring that all imported goods be indelibly marked with the name of the country or origin."

Empire Trade.—At the annual conference of the New South Wales Chamber of Commerce, the following motion was carried unanimously:—"That this conference places on record its desire to co-operate with any practical proposal for the encouragement of trade within the Empire, and believes that the imposition of a surtax on goods manufactured within the territories of the nations now at war with us would be the most effective means of attaining that end, and thereby to some extent ease the enormous financial burden likely to occur through this disastrous war; that the British and Australian Governments be urged to co-operate with the manufacturing industries by establishing laboratories and centres of scientific research, such to be available to manufacturers throughout the Empire; that these opinions be conveyed at the proper time to the Federal Government, the High Commissioner, the Agent-General for New South Wales, and the London Chamber of Commerce."

At the conference of the British Imperial Council of Commerce, in London, a resolution was carried, with three dissentients (one of whom was Sir Albert Spicer), urging that arrangements should be made at the earliest possible moment to provide for preferential reciprocal relations between all parts of the British Empire; for reciprocal trading between all parts of the Empire and the allied countries; for the favourable treatment of neutral countries; for restricting by tariffs and otherwise trade relations with all enemy countries so as to render dumping, or a return to pre-war conditions, impossible.

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Exemption Applications.—At the Yorkshire East Central Tribunal, Messrs. J. T. & J. Taylor, Ltd., woollen manufacturers, of Batley, applied for exemption for the engineman and factory electrician at Blakeridge Mills. They said an untrained man could not be trusted with the work without great risk to person and plant at the mills, where 1,050 people were employed. Their present assistant was the only one to share responsibility with the chief engineer for 200 electric lights and 22 dynamos and motors in five different mills and warehouses. As illustrating the man's importance, it was mentioned that last week 400 people were idle for three and a half hours owing to a slight electrical mishap. Members of the Tribunal are to investigate the requirements at the mills, and the case was adjourned.

At St. Albans, on June 3rd, the North Metropolitan Electric Power Distribution Co., Ltd., appealed for Mr. C. Hocker, electrical engineer. It was stated by Mr. Hind, assistant to the general manager and engineer, that Mr. Hocker was indispensable. His principal work was to look after the requirements of consumers with regard to wiring of power installations, and at present, owing to the shortage of labour, he assisted the resident engineer in case of breakdown, and had control of a contract with the military. He added that out of a staff of 29 they had let 12 go. He admitted that there was no installation work for the military going on at present. No exemption was granted.

At Poole, Mr. Edwin Chas. Newman (23), electrical engineer, of Sandy Lane, Broadstone, claimed exemption on the ground that it was expedient in the national interest that he should remain in business. He was the only partner in the concern, and contended that he was in a certified occupation. He was allowed until September 1st.

At Swindon, Bays & Co., electricians, appealed for the exemption of Walter John Moran (34), engaged on the repair of wires, motors, &c., and the only electrician left with the firm. Mr. Bays said that if the man went they would have to close the electrical department, electricians being very difficult to obtain just now. Mr. Crewe Wood: Did not the Minister of Munitions put his hand on him? Mr. Bays: He volunteered for munition work, and we received a notice from the Ministry of Munitions asking if he could be spared. We said we could not spare him, as he was the last electrician we had. Conditional exemption was allowed.

At Dartford, Mr. S. K. Fergusson, manager of the Light Railway Co., appealed for exemption for a motor-man, and, with the assent of the military representative, the request was acceded to.

At Southend-on-Sea, two electricians sought exemption. One said he was carrying out several contracts, and it would be a serious hardship to give up the business; he had serious financial obligations to fulfil. He was passed for home service only. Exemption was granted until September 1st. The other appellant, a contractor for electric lighting, telephones, &c., said he would have to give up business entirely if he went. As he stated that he suffered from a tubercular complaint, he was directed to go before the Army Medical Board.

Hemel Hempstead Tribunal has given total conditional exemption to Mr. T. Hall, fitter and electrical engineer, appealed for by Mr. H. Martineau.

At Altrincham, an electrician and plumber sought exemption for two men, asking that exemption should be conditional on their remaining in their present employment, or similar work, and that the exemption should not be used to demand an increase of wages, or accept any bribe or offer from any other firm without the usual consent. He was engaged with important sanitary and electrical contracts at private houses, shops, munition works, and flour mills. The Tribunal pointed out that they had nothing to do with wages, and could not deal with the applications in the manner apparently desired by the employer. Eventually temporary exemption for three months was granted to one man, and the other was ordered to go forward when called upon.

At Oldham, on June 8th, Mr. S. Stapleton, electrician, of Hollinwood, was granted temporary exemption to September 1st. Mr. Stapleton also appealed for two employés, but these were disallowed.

At Stretford, three employés at the local electricity station, whose services were said to be indispensable to the maintenance of the electrical supply and distribution, were exempted until August 31st.

At Rochdale, last Friday, Messrs. Fryer & Hartley appealed for Mr. T. Hartley, a member of the firm, who was stated to be engaged on electrical contracts, and temporary exemption to the end of August was granted.

Middleton Tribunal granted conditional exemption to a tramway pavior on the application of the tramways manager.

At Southwark, Messrs. Alexander Hawkins & Son, electrical engineers, of London Road, S.E., applied for the exemption of their manager at Richmond. He was the only man left at their Richmond works, and was a fully-qualified wireman, capable of undertaking repairs at Army camps and depôts. He was granted conditional exemption on joining the Volunteer Training Corps.

Hastings Tribunal has granted three months' temporary exemption to Mr. C. G. Winter (40), electrician at the Albany Hotel, appealed for by Sir Henry Lunn.

At Whitehaven, a local electrician appealed to retain his son (18 years and 8 months), apprenticed to electrical work, and the only one left to assist in the business. Three months were granted.

Boston Tribunal granted exemption until September 1st to Mr. C. E. Clare, engaged by Mr. R. W. Sandars, of Queen Street, as a cabinet-maker for electric coils, &c. Mr. Sandars said he was one of the largest coil makers in Great Britain.

Folkestone Tribunal has given conditional exemption to Mr. R. Carr (39), electrician with Messrs. Webster & Son.

At Maidenhead, the manager of the electric light undertaking of the T.C. appealed for exemption for a shift engineer, and engine driver and fitter, a switchboard attendant, and a cable jointer, all essential. With military assent, each was exempted until October 1st.

Three months' exemption, with leave to appeal again, has been granted to Mr. S. A. Stock (24), electrical engineer, in charge of the business of Mrs. E. Storey, whose husband died last year. Mrs. Storey stated that three employés had joined the Forces, and she had a lot of contract work in hand.

An electrician with a firm of caterers at East Grinstead, having 2,000 lights to look after, has been exempted until September 30th.

A Runcorn firm of electrical engineers has been granted exemption for a storekeeper on releasing a single "badged" employé.

At Oxford, Messrs. Hill, Upton & Co., electrical engineers, applied for two electric fitters and wiremen, employed in installation work. It was stated that 17 of the staff had been released. Both men were conditionally exempted.

Mr. Gilbert Clark (34), electrical engineer, of Combe Down, Bath, has received three months' exemption.

The Tudor Accumulator Co., Dukinfield, appealed last week for a number of married men who were said to be indispensable. Several of them were engaged on work which, prior to the war, was done in Germany. One appeal was disallowed, another met with a temporary exemption for three months, and the rest of the men concerned were conditionally exempted, being in reserved occupations.

At Denton, the Oldham, Ashton & Hyde Electric Tramways Co., Ltd., appealed for a number of employés, and it was stated that if any more employés were taken away the car services would have to be further curtailed. Prior to the war the company employed 155 men and nine boys, and now they had 100 men, 13 boys, and 29 women, although more passengers were being carried. In all cases except four conditional exemption was granted, and it was recommended that the four should not be called up before July 31st. It was announced that the company would appeal to the higher tribunal in respect of the four men who were not granted conditional exemption.

Before the County Appeal Court, the Midland Electric Light and Power Co., of Warwick, appealed for Mr. A. E. Pritchard, clerk and collector of electricity accounts, and two months were allowed, leave to appeal to the Central Tribunal being refused.

An electrical engineer at Sutton (Surrey), who appealed, said that if called up he would have to sacrifice the business he had built up, which included work in a "controlled" establishment at Chelsea. A final month to settle his affairs was allowed.

Tonbridge Tribunal, on June 8th, granted conditional exemption to Mr. F. A. C. Tabberer, electrician.

The Kent Appeal Court has allowed exemption to Mr. A. W. Groombridge, electrician, of Ramsgate, on condition that within a month he secures and keeps an engagement with the Government as an electrician.

A Northampton electrical engineer, previously given two months in which to arrange for a manager, applied for further exemption. He stated that he had £500 in the business which had a turnover of £1,500 a year, and was still engaged on contracts. The Tribunal allowed him a month in which to "clear up."

Stoke-on-Trent Tribunal has given three months' exemption to an electrical engineer engaged on the erection, supervision, and maintenance of plant for manufacturers and firms engaged on munition work.

Nuneaton Tribunal, on June 6th, granted conditional exemption to the acting borough electrician, Mr. H. Hodges.

Sevenoaks Tribunal has given three months' exemption to Mr. J. Pink, electrician with Messrs. S. Young & Sons.

Two lead burners were appealed for at Woking by the Accumulators, Ltd., on the ground that they were essential to the completion of Government contracts. It was stated by the military representative that the men had been "combed out" of a reserved occupation. The Chairman observed that, according to an official circular, lead burners were very scarce, and were urgently needed in munition works. A month was given in each case.

At Nuneaton, Mr. F. A. Newdegate, M.P., of Arbury Hall, appealed for Wm. Mitchell (35), electrician, in charge of the plant there, and exemption was allowed until November 1st.

Electric Steel Rails.—Dealing with the rail tonnage of the United States, *Met. and Chem. Engineering* says that statistics of electric steel rails began with 462 tons in 1911, the output rising to its maximum, 3,455 tons, the next year, while 2,436 tons was produced in 1913 and 178 tons in 1914, not a ton being reported for 1915. It may be, however, that judgment is suspended until time has elapsed for a complete try-out of the experimental rails.

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BUSINESS NOTES.

Patent Restoration.—Letters Patent No. 6,831, of 1911, granted to J. R. Hannan, for "Improvements in or relating to side flues and downtakes for boilers" have been restored.

Hawaii: Electrical Imports.—The imports of electrical machinery into Hawaii during the fiscal year 1914-15 attained a value of only £66,606, as compared with £116,944 in 1913-14.

Book Notices.—"Engineering as a Career." By P. and A. W. Marshall. London: Percival Marshall & Co. Price 6d. net.

"Groupes Electrogènes en Régime Troublé." By L. Barbillion. Paris: Gauthier-Villars et Cie. Price 11 fr.

Trade Announcements.—Messrs. J. J. Roche & Co. have removed to larger premises at 47, Golden Lane, E.C. Telephone-number and telegraphic address unaltered.

Mr. Hanson Perry, electrical engineer, of North Quay, Douglas (I of M.) has had his stock, &c., sold by auction.

Catalogues and Lists.—British Thomson-Houston Co., Ltd., Rugby.—Descriptive list No. 4,120, detailing, with full dimensional particulars their isolating switches for H.T. systems.

Messrs Broom & Wade Ltd, High Wycombe.—Sixteen-page illustrated catalogue, No. 9, giving description and prices of Hyatt's roller bearings as applied to line shafting.

Bankruptcy Proceedings.—Herbert Page (Smeaton and Page), electrical engineer, London, E.C.—Trustee released June 7th.

A. F. Hawdon, electrical engineer, Gosforth.—A second dividend of 1s. 2d. in the £ is payable June 16th, at the Official Receiver's office, 30, Mosley Street, Newcastle-on-Tyne.

Patent Extension.—A petition of F. G. Creed, W. A. Coulson and Creed, Bille & Co., Ltd., for extension of Patent No. 22,653, of 1902, granted to F. G. Creed and W. A. Coulson, is not to be heard before July 18th.

Export Prohibitions.—The Privy Council has approved certain amendment in the schedule of export prohibitions. The entry "electric lamps" is deleted and in place thereof is included: "Electric lamps, except carbon filament lamps and arc lamps for street lighting."

Board of Trade Inquiries.—The Board of Trade Commercial Intelligence Branch has received applications from firms at home for British makers of two and three-cell flash lamp batteries, and electric baling presses.

Liquidations.—*Re* Cedes Electric Traction, Ltd., 112, Great Portland Street, W.—The report of Mr. H. E. Burgess, Official Receiver and Liquidator, upon the affairs and failure of this company has been issued to the creditors and shareholders. The statement of affairs was briefly summarised in our issue of May 26th. The deficiency as regards contributories is returned at £47,834. According to the report of the Official Receiver the company was incorporated as a private company on May 18th, 1910, with a nominal capital of £2,000, to manufacture and sell motor vehicles of every description. The capital was subsequently increased to £50,000. The issued capital at the date of the winding up was £7,001; 6,995 shares were allotted to the Oesterreichische Daimler Motoren Actien Gesellschaft, of Vienna, or its nominees. The directors of the company have been Wilhelm Strauss, George Frederick Underwood, Henry Ichenhauser, Ludislaus Jonasz, Felix Burmann, Kerbey D. Bowen and Francis M. Luther. The two last-named constituted the board at the date of the winding up. Charles Janin was the secretary throughout. Previous to the incorporation of the company they were acting in similar capacities for the Austrian Daimler Motor Co., Ltd., and Trackless Trolley, Ltd. (companies controlled by the Vienna company). On their taking office with the Cedes Electric Traction, Ltd., it was arranged that a portion of their salary should be subscribed by the latter. Bowen was appointed managing director on January 1st, 1913. Under an agreement dated May 18th, 1911, the company, in consideration of certain royalties, acquired from the Vienna company the sole rights for the sale and manufacture for the United Kingdom, its Colonies and dependencies, of electrically-driven vehicles made under their patents. At the commencement of its operations the company obtained its supplies from the Vienna company. Subsequently arrangements were made with a firm of engineers in this country for the manufacture of vehicles. Delay occurred in delivery and the vehicles were otherwise unsatisfactory, and considerable expense was incurred in putting them in proper order. Proceedings were taken against the company by the firm referred to in respect of additional work, and they were compromised by the company agreeing to pay the sum of £1,500. Part only of this amount has been paid.

At an extraordinary general meeting on November 29th, 1912, the directors were authorised to negotiate for the purchase of the business of Trackless Trolley, Ltd. The necessary documents were apparently prepared, but the purchase was not completed. In anticipation of this being done, the company, who had taken works at Stamford Hill, commenced to manufacture trackless buses. Contracts for these vehicles were carried out for various public bodies, but the buses were not satisfactory, and heavy losses were sustained in effecting replacements and rectifying defects. One of the contracts was executed for a firm of contractors engaged upon works in South Wales. In consequence of the vehicles failing to meet requirements, a considerable portion of the price has not been received by the company. It is understood that the receiver for debenture-holders has come to an arrangement with the contractors for their taking over and completing this contract. According to Bowen, the principal trouble in connection with these vehicles was due to the motors not being sufficiently powerful, and failing to perform the work which the Vienna company assured him they would do. He also states that recommendations and suggestions made by him with a view of avoiding the trouble were disregarded. Towards the end of 1913, the financial position of the company was such that liquidation was contemplated. The Vienna company, however, were advised that there were prospects of successfully carrying on the business, and it was determined to transfer the undertaking, together with that of the Trackless Trolley Co., to a new company. A prospectus was prepared, but the outbreak of war prevented the matter being proceeded with. While these arrangements were pending negotiations took place with the Direction der Disconto-Gesellschaft and a credit account was opened for an amount not to exceed £32,000, guaranteed by a Vienna bank. The bulk of the drawings against this account were remitted to the Vienna company on account of the company's indebtedness to that company and to the Austrian Daimler Motor Co., Ltd., in respect of advances made, &c. Bowen states that he understood the account was to be used for the purpose of providing working capital until the new company was formed, and that he was not aware until some time later that remittances had been made to Vienna. In August, 1915, the directors created an issue of debentures for £4,000. These were allotted to the Austrian Daimler Co to secure £2,000 alleged to be then owing, and further advances to be made by them. In November, 1915, a creditor having obtained judgment against the company, the debenture-holders took steps to protect their security, and on January 14th, 1916, the Court appointed Mr. J. W. Barrett, of 19A, Coleman Street, London, E.C., receiver on their behalf. The company's business has been carried on at a loss throughout, the result of the trading, as shown by its accounts, being as follows:—

From May, 1910, to Jan., 1911.	Loss,	£821;
„ Feb., 1911, „ Jan., 1912.	„	£1,274;
„ Feb., 1912, „ Dec., 1912.	„	£518;
„ Jan., 1913, „ Dec., 1913.	„	£6,875;
„ Jan., 1914, „ Dec., 1914.	„	£7,395;
„ Jan., 1915, „ Jan., 1916.	„	£14,061.

The failure of the company is attributed to its resources being too limited to produce on a remunerative scale, to heavy losses in connection with the various contracts referred to, and to friction between the management in London and the Vienna company.

Krupka & Jacoby, Ltd., London.—Creditors should send particulars of debts or claims, &c, to the controller, Mr. T. Wise, Bassishaw House, Basinghall Street, E.C., by July 10th.

Union Electric Co., Ltd., London, S.E.—Creditors should send particulars of debts or claims, &c., to the controller, Mr. P. D. Leake, 25, Abchurch Lane, E.C., by July 22nd.

Scorch Electrical Co., Ltd., 35, Basinghall Street, E.C.—Creditors should send particulars of their debts or claims to the controller, Mr. C. E. Barker, 21, Finsbury Pavement, E.C., by July 14th.

LIGHTING AND POWER NOTES.

Australia.—The Melbourne City Council has adopted the recommendation of the Electric Supply Committee, to reduce the present tariff for the supply of electricity in bulk to the municipalities of Footscray, Port Melbourne, Brunswick, and Williamstown, and to the Brunswick and Coburg Tramways Trust, as from November 1st, 1916, as follows:—For a demand up to, but not exceeding, 500 KW., a reduction from the present rate of £5 a KW. a year, to £4 10s.: for any excess above 500 KW. a charge of £4 a KW. a year, plus the present rate of 0·65d. a unit for a consumption up to 1,000,000 units a year, 0·6d. for the next 1,000,000 units a year, and 0·55d. a unit for any excess above 2,000,000 a year.

Barnes.—The Council's electrical engineer, Mr. C. S. Davidson, estimates that there will be a loss of about £900 on the electricity undertaking during the summer months owing to the "daylight saving." The Council has decided to increase the charge for power by 10 per cent., and for private lighting and heating (now 3½d. per unit) by 15 per cent.

Bedford.—Loan Applications.—The L.G.B. having informed the T.C. that no ordinary extensions of E.L. mains should be undertaken at present, the town clerk has pointed out that persons in the statutory area have a right to the service. In their reply the L.G.B. state that the cases appear to be covered by the expression "ordinary extensions of mains," and add that they will not be prepared to sanction a loan for any extensions, except such as are necessary for war purposes. The R.D.C. and the B. of T. are to be asked to consent to electricity being supplied to the new works to be established by Messrs. W. H. Allen, Son & Co., Ltd.

Birkenhead.—The chairman of the Electricity Committee states that the charges for electricity will have to be increased in consequence of the Summer Time Act. An increase of 5 per cent. to ordinary consumers would bring in £794, which, with other amounts, would total £2,000.

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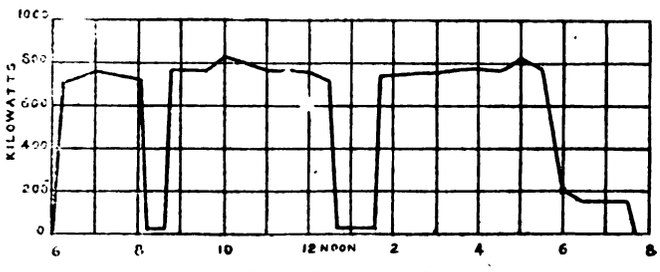
Barnet.—The Guardians last week decided to purchase and install electrical apparatus in connection with the new infirmary.

Blackburn.—Year's Working.—The annual report of Mr. Wheelwright, the borough electrical engineer, refers to the difficulties encountered during the past year, particularly as regards coal supply. The total units generated during the year for lighting, power, and traction, amounted to 7,829,477, an increase of 336,454 on the previous year, due to power supply. The receipts were £51,110, and the expenditure was £26,650, leaving a



Typical Mill Day-load Curve.

gross profit of £24,460; after payment of interest and sinking fund there was a net surplus of £3,132, compared with £2,348 in the previous year. The nature of the mill load on the three-phase extra-high-pressure mains is well shown by the accompanying diagram, reduced from one of Mr. Wheelwright's.

Canterbury.—Price Increase.—The T.C. has not adopted the recommendation to charge an extra ½d. per unit for energy supplied for power. There is to be an increase of ½d. per unit for lighting.

Carnarvon.—Plant Extension.—Owing to the increasing demand for electricity, the Corporation has decided to extend the plant at the works by the addition of a Diesel engine set, at an estimated cost of £2,380.

Continental.—Spain.—The Sociedad Fuerza Motrices y Riegos, of Pamplona, has applied for a concession to establish a plant to utilise the water-power of the River Ebro for the generation of electrical energy for lighting and power purposes in the district.

Crewe.—Price Increase.—The T.C. has increased the charges for energy by 10 per cent.

Ealing.—During the first week of the operation of the Summer Time Act the Council electricity station generated 6,820 units of electricity less than in the previous week, equal to a 25 per cent. decrease.

Eton.—Street Lighting.—The U.D.C. has decided to ask the Windsor Electric Installation Co., Ltd., to reconsider the charges made for public lighting, which has been reduced by about 40 per cent. The company had intimated that they were unwilling further to reduce the charges, and the Council's Lighting Committee expressed dissatisfaction with this decision.

Grays.—The U.D.C., on June 8th, decided further to increase the charges for energy for lighting and power by 15 per cent., making a total of 25 per cent. since the outbreak of war.

Hereford.—Price Increase.—The T.C. has adopted the following new scale of charges for energy:—All lighting units charged at 4½d. per unit before the war to be 6d.; ditto charged at 3d., to be 6d.; all other units 25 per cent. extra, making, with the 10 per cent. advance last year, a total of 35 per cent. on pre-war charges. Discounts remain unaltered.

Ilkeston.—Sale of Undertaking.—The Council has approved the proposed sale of the electricity undertaking, on which there has been a total loss of £4,555, to the Notts. and Derbyshire Power Co.

Keswick.—Price Increase.—The Keswick Electric Light Co., Ltd., is increasing the charges for electricity for lighting as from July 1st by 10 per cent.

Leeds.—Year's Working.—The report of the manager of the electricity department, Mr. C. N. Hefford, on the results of the past year's working, shows that the revenue from private lighting was £75,100, from street lighting £1,188, from power £91,886, from heating £2,672, from traction £15,181, and from residential bulk supplies £1,539. The total receipts were £187,724, an increase of £17,703. The working expenses were £75,143, an increase of £9,522, and the gross profit was £112,581, an increase of £8,481. While private and public lighting showed a decrease, power sales increased by 26 per cent. Allowances to dependents of employés on active service absorbed £2,041, income tax £1,974, interest £35,845, sinking fund £55,631, and contributions to capital expenditure £8,374, leaving a surplus of £8,716. No increase in the price of energy was made last year, but an increase of 10 per cent. has been considered necessary for the current year. The total energy sold increased from 43 to 44·8 million units, the growth of ·26 per cent. in the output for power being almost wiped out by the decrease in sales for other purposes; the largest item was a reduction of 3·9 million units for traction. The motors connected to the mains have an aggregate capacity of 38 054 H.P., and the revenue from the power load, for the first time on record, has exceeded that from any other source. The "residential bulk system" of charging, which was introduced on January 1st, 1915, and is growing in popularity, is that otherwise known as the assessment system, with a charge of ½d. per unit. The number of consumers of electricity for heating purposes has increased by 19·5 per cent., the capacity of the heating apparatus installed by 35·3 per cent., and the energy consumed by 53 per cent., in addition to that supplied to residential bulk consumers. The average net price per unit for lighting was 2·93d., for power 0·8d., and for all purposes 1d. The extensions of the generating plant are approaching completion, and will bring up the total capacity to 44,600 KW.

Lincoln.—The working of the Corporation electricity department for the year ended March 31st resulted in a revenue of £17,448, including £9,635 for power supply. After meeting working expenses, a gross profit remained of £6,904; interest and sinking-fund charges amounted to £5,214, leaving a net profit of £1,690 to be carried forward. The energy sold totalled 3,152,831 units, an increase of 861,717 units or 38 per cent. over last year.

London.—Fuel Economy.—A conference of representatives of Metropolitan Municipalities owning electricity supply undertakings was held on June 8th, to consider the letter of the Board of Trade with regard to the interconnection of systems for the purpose of saving coal. A resolution was passed pledging the authorities that were represented to do all that was in their power to carry out the object of the Board of Trade.

Hammersmith.—The Electricity Committee has reported upon the letter from the Board of Trade, and reminds the Borough Council that in June last a scheme for linking-up the generating stations of Battersea, Fulham, and Hammersmith was approved in principle. H.M. Treasury, however, only sanctioned such capital expenditure on the scheme as was then alleged to be urgently necessary for the effective maintenance of existing supplies, and the County Council therefore decided that loans must at that time be limited to the cost of linking-up the undertakings of Battersea and Fulham. Accordingly, Hammersmith had no alternative but to withdraw from the scheme. Having regard to the terms of the Board's letter mentioned above, the Committee reports that it has now directed the town clerk to re-open negotiations with the Government Departments concerned with reference to the desirability of completing the original scheme of linking-up.

Loughborough.—Loan Application.—The T.C. has decided to apply to the L.G.B. for sanction to borrow £1,400, or such other sum as may be necessary, for the laying of a special electric cable to works in Great Central Road and Windmill Road.

Maidenhead.—It is reported that since the Summer Time Act came into force, the sale of lighting units from the Corporation electricity works has been seriously reduced.

Manchester.—At a meeting of the City Council last week, a long-standing notice of motion with regard to the inability of the electricity department to meet demands for energy for proposed new works (which subject was referred to in these columns some time ago) was withdrawn by Councillor Ross Clyne, who said he had received assurances that the Electricity Committee had a complete answer to the points raised by the motion. A war bonus of 2s. per week has been granted to certain workmen in the electricity department.

Year's Working.—The report of the Electricity Committee to the City Council for the past year shows that the sales of energy brought in a revenue of £606,056, made up of £475,839 for lighting and power, £126,966 for traction, and £3,251 for public lighting, which, together with £13,944 from other sources, made a total of £620,000, as compared with £543,546 in the previous year. The expenditure amounted to £371,514, as compared with £295,444, leaving a balance of £248,486, practically the same as in the previous year. Deducting £67,919 for interest, £118,393 for sinking fund, £7,302 for repayment of a loan, and £25,419 transferred to renewals, there remained a net surplus of £29,453; this was made up to £30,000 from the reserve fund, and handed over in aid of the rates. The expenditure included £11,110 for war service allowances and £11,308 additional income-tax. The renewals suspense account stands at £191,215, and the reserve fund at £11,335. Borrowing powers amounting to £426,420 were secured during the year; the total outlay stands at £3,112,406, and the mortgage debt at £1,738,726. The energy sold exceeded 141 million units, an increase of 14 millions; the items were:—Private consumers, 113·3 millions; traction, 28·1 millions. The energy used on works amounted to 13·1 millions, and that used in distribution, &c., to 26·7 millions, the total quantity generated being 181·3 millions, compared with 162·7 millions in 1914-15. The maximum demand was, for lighting and power, 42,976 KW.; for traction, 10,000 KW.—total, 52,976 KW., compared with 50,460 KW. in 1914-15. The average price obtained per unit was 1·03d. The curves on the following page are reproduced from the report.

At Stuart Street station a 5,000-KW. turbo-alternator has been installed by the British Westinghouse Co., Ltd., and a repeat order has been placed with the makers, which will displace another of the Yates & Thom-A.E.G. 1,500-KW. reciprocating sets. Two B. and W. boilers have been installed, and pending the commencement of the Barton Works, additional B. & W. boilers have been ordered

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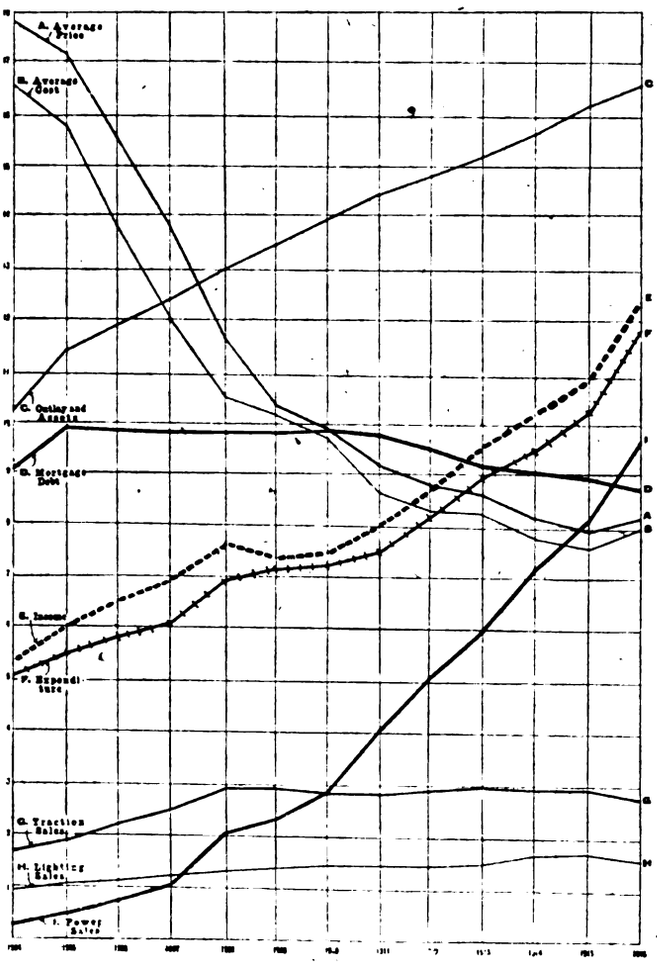
as well as a 15,000-KW. turbo-generator from Messrs. Richardsons, Westgarth & Co., Ltd., with the necessary auxiliary apparatus



KEY TO INDEX NUMBERS:—A and B, scale unit 0·125d.; C and D, unit £200,000; E and F, unit £50,000; G, H and I, unit 10,000,000 KW.-hours.

PROGRESS OF MANCHESTER ELECTRICITY SUPPLY.

from other firms. Many new sub-stations have been installed on power consumers' premises, and 11¼ miles of new mains have been laid.

Oldham.—YEAR'S WORKING.—The report of the joint managers of the Corporation electricity department, Messrs. W. C. Chamberlain and F. L. Ogden, for the past year shows an increase of 2½ million units sold; the increase would have been much greater, but certain cotton mills which had contracted for a power supply were unable to obtain the necessary plant, making a difference of 3 or 4 million units. Receipts from private lighting were £24,519, from power and heating £18,818, from traction £19,441, and from other sources £930, making a total of £63,920, compared with £52,293 last year. The power and heating receipts were almost doubled. The total costs were £37,222, compared with £27,006, and the gross profit was £26,698. The sales of energy amounted to 10,487,235 units, compared with 7,985,859, and the average price obtained was 1·441d. per unit. The net profit was £5,107, compared with £3,550 in 1914-15.

Perth.—POWER SUPPLY.—The Caledonian Railway Co. propose to introduce electricity for power and lighting into their workshops, and at a meeting of the Corporation Electricity Committee a communication was received from the company as to terms of supply. The matter has been remitted to the convener and the electrical engineer, to meet the representatives of the company.

Rathmines.—The U.D.C. has adopted the Lighting Committee's report recommending that the public electric lamps remain unlit during the current month.

Redruth.—LIGHTING CONTRACT.—The U.D.C. is to inquire from the L.G.B. whether in view of the restricted lighting, the existing contract with the Electric Supply Co. still holds good. It is asserted that whereas the contract price per lamp is £2 4s. per annum, the Council is really paying over £6, owing to the reduced number of lamps.

Rotherham.—EXTENSIONS.—The town clerk has been instructed to approach the Minister of Munitions with reference to the immediate requirements of the Corporation for extensions of feeders and cables, in order to provide supplies of energy to factories. Upon receiving the Department's approval, it is proposed to take the necessary proceedings to secure sanction to borrow not exceeding £10,000, this being the estimated sum required for main extensions during the ensuing six months.

Salford.—YEAR'S WORKING.—Speaking at a meeting of the Council last week, Councillor Billington said the year's financial results of the electricity department were the best in the history of the undertaking. Since the end of the previous financial year the units sold had increased from 20,650,000 units to 24,856,000 units, or 20 per cent.; the revenue had increased from £115,847 to £133,764; the gross profit from £50,807 to £63,325, and the net profit from £8,406 to £16,598. This was the largest net profit recorded, the nearest being the profit of 1906 (£14,800), when, however, coal was 7s. 9d. per ton, as against an average of 15s. 1d. per ton during the past year. The excellence of the year's result was mainly attributable to the introduction of modern plant and the consequent economies in operation. In coal alone a comparison with two years ago showed a saving equal to 15,000 tons per annum, and all other heads of working expenditure, including wages, repairs, distribution, oils and stores, had been reduced. The increased output and the modernisation of the works were being carried out without any increase in the amount of their capital indebtedness, the expenditure being met out of the renewals fund. In referring to the scheme for interconnecting electrical undertakings in this part of the country, Councillor Billington said the Committee would shortly be called upon to consider the scheme, which, it was hoped, would prove of mutual advantage.

Sheffield.—LOAN SANCTION.—The L.G.B. has sanctioned the borrowing of £75,000 for mains and £30,000 for sub-stations and equipment, transformers, &c. Of the sum sanctioned for main extensions £10,000 will be appropriated from the reserve fund. The Treasury has intimated its decision not to withhold sanction to the proposed loan of £137,104 for the purchase of additional plant for the power station.

St. Helens.—YEAR'S WORKING.—At the meeting of the T.C. last week, Sir J. Beecham said the electricity sold during the year ended March last totalled 6,335,906 units. There was a decrease of 18 per cent. in the units for lighting purposes, and a decrease of 10 per cent. in the units sold to the tramway company, but as against these there was an increase of 21 per cent. in the number of units sold for power purposes, and in the total number of units sold there was an increase of 9 per cent. The revenue increased from £30,179 to £33,979, and the expenditure increased from £29,641 to £32,470. A proposal to advance the prices for energy by 20 per cent., instead of the 10 per cent. advance at present in force, was referred back.

Stretford.—POWER CONTRACT.—The Electricity Committee has agreed to a compromise with the United Brassfounders and Engineers, Ltd., in regard to the agreement for the supply of energy to their premises at Old Trafford, viz.:—(1) Electricity to be supplied at ordinary rates plus 15 per cent., subject to a minimum of 50 and a maximum demand of 100 KW., the minimum to apply during working hours only; (2) in the event of the total consumption for the period ending December 31st next exceeding 400,000 units, the Council will refund 25 per cent. of the cost of the cable; (3) any further reimbursement of the cost of cable to be entirely at the discretion of the Council, which will favourably consider the same on an application from the company, if, in the opinion of the Council, the extent of the company's demand for energy in the ensuing 12 months is reasonable in the circumstances.

Swinton and Pendlebury.—The Lancs. E.P. Co. has received permission from the D.C. to lay a cable for the supply of energy to Dean's Mill, Swinton. The company is stated to have ordered a 300-KW. rotary converter for the sub-station, in order to meet the increased demand, and also to provide sufficient stand-by plant. At a meeting of the D.C., last week, it was reported that next winter, in some parts of the district, the cables would be fully loaded, and it might not be possible to accept certain applications for supply, particularly for power purposes. In view of this, it was recommended that people contemplating the adoption of the use of electricity should ascertain whether energy would be available before they ordered machinery or installation work. The electrical engineer is to report on the rates charged to consumers, with special reference to power consumers and the cost of electricity purchased by the Council. Lighting on main roads is to be discontinued during the next five or six weeks.

Tasmania.—The Government's Great Lake Hydro-electric scheme was officially opened by the Governor-General of the Commonwealth at the commencement of last month. The present plant will generate 9,000 H.P., and owing to the demand for electricity for power purposes extensions will have to be made almost immediately.

Uruguay.—It is reported that the State Electrical Department contemplates a considerable reduction in the present price of electrical energy in order to generalise its use. The price talked of is about 2 cents (1d.) per unit. It is proposed to import a large quantity of cheap electrical cooking stoves from the United States. The construction of new power houses at various towns in the interior is being hurried on.—*Review of the River Plate.*

Weybridge.—PRICE INCREASE.—Representatives of the U.D.C. are meeting the B. of T. with reference to the proposal of the Urban Electric Supply Co., Ltd., to discontinue the use of the maximum demand system. The D.C. protests against the increase of price proposed as being excessive, considering all the circumstances, and suggests that, if any alteration is made, the price to the consumer should be regulated by the cost of coal, and that any increase of price should be in force only up to the termination of the war.

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Wakefield.—Loan Application.—The City Council has decided to make application to the L.G.B. for sanction to borrow the sum of £5,620 for proposed extensions to the electricity undertaking.

Wigan.—Loan Applications.—The T.C. has decided to amend its resolution of May 3rd last (authorising application to be made to the L.G.B. for sanction to borrow the sum of £53,920 for extensions at the electricity works) by the addition of £3,517 for stock, boiler, and accessories.

The Council has further decided to amend its resolution of April 5th last (authorising application to be made to the L.G.B. for sanction to borrow £781, the estimated cost of cable, switchgear, and transformer, in connection with the proposed supply of electricity to the Northern Coarse Spinners, Ltd.) by the substitution of £961 for the sum of £781 above mentioned.

Winchester.—The T.C. has decided to apply to the Ministry of Munitions to certify the 500-kw. turbo-generator set ordered last year from Messrs. C. A. Parsons & Co., Ltd., as necessary to maintain the continuity of the supply of electricity over next winter. The plant can be installed by next September if released.

Windermere.—Price Increase.—The Windermere and District Electricity Supply Co. is increasing the charges for electricity for lighting purposes by 10 per cent. from July 1st next.

Worcester.—Year's Working.—The report of the city electrical engineer, Mr. C. M. Shaw, for the past year, states that the total income was £21,225, an increase of £365: the working costs were £9,968, leaving a gross profit of £11,257, out of which was paid £3,851 interest and £6,801 redemption of capital, the final trading surplus being £604. But as works of a capital nature were paid for out of revenue to the amount of £726, there was a net deficit of £122. Private and public lighting and tramways showed a decreased consumption, but the power demand increased by nearly a quarter of a million units; 42 motors and 32 heating devices were connected.

TRAMWAY and RAILWAY NOTES.

Aldershot.—New Tramway Scheme.—A local conference of public bodies interested, is to be arranged to consider the question of a tramway scheme to link up Aldershot with Farnborough and Farnham.

Continental.—Spain.—The Sociedad Minera y Metalurgica de Penarroya has applied for a concession for the construction and working of a narrow-gauge electric railway between Conquista and Puertollano.

Croydon.—The T.C. is to renew the tramway track between Selhurst New Road and Selhurst railway bridge loops, strengthen the foundation, and construct a double line of track in continuation of the existing double line. The cost is estimated at £2,156.

Ilkeston.—Sale of Tramway.—The Council has approved the proposed sale of the tramway undertaking to the Notts. and Derbyshire Power Co. There has been a loss of £32,498 since 1904, when the tramways were opened.

Liverpool.—War Bonus.—The Tramways, Electric Power, and Lighting Committee recently decided to recommend an increase of pay for certain employés of ½d. per hour, but at a meeting of the City Council, on June 9th, the Finance Committee recommended that this be not approved, but that a war bonus of 1s. 6d. per week be given to all men of 18 years and over in receipt of a weekly wage. This, with the proviso that no one should receive by such bonus more than £3 per week, was carried.

Loughborough.—Electric Truck.—The T.C. has decided to apply to the L.G.B. for sanction to borrow £600 for the purchase of a two-ton electric truck for the Electricity Committee for carting purposes.

Ramsbottom.—The D.C. has rescinded resolutions respecting free travelling facilities on the cars, and has decided to confine these facilities to tramway employés going to or returning from duty, policemen in uniform, and wounded soldiers.

Stretford.—Extension of Time.—The Board of Trade has sanctioned a further extension for two years of the period for completing the lines authorised by the Stretford Light Railways Order, 1906, and Railway No. 10 authorised by the West Manchester Light Railways (New Lines, &c.) Order, 1906.

Warrington.—Year's Working.—Mr. W. H. Woodcock (assistant borough treasurer) reports that during the past year the tramway undertaking had an income of £24,670, and the expenditure amounted to £16,617. The gross profit was £8,053, and the net profit £2,620. The income in respect of the motor-bus undertaking was £3,129, and expenditure £2,910. The gross profit was £219, loan charges amounted to £615, and the net loss was £396. Passengers carried on the 'buses numbered 846,883, as against 771,510 in the previous year.

London and South-Western Railway Electrification.—On Tuesday a trial run was carried out on the recently-electrified section to Hampton Court.

L. & Y. Railway Breakdown.—Between eight and nine o'clock on Monday night a breakdown occurred on the L. & Y. Railway Co.'s electric system between Bury and Manchester. Some inconvenience was caused to passengers by the stoppage, which lasted about an hour. Steam trains were put into service as soon as possible.

Manchester.—According to certain authorities close upon 1,000 women are now serving as conductors on tramcars in Manchester, Salford and adjoining districts of South-East Lancashire. So far, we believe, no female drivers have been employed.

Weston-super-Mare.—Extension of Time.—The Electric Supply Co., Ltd., has applied to the B. of T. for an extension of time until August 6th, 1918, for the completion of the tramways authorised by the order of 1900.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Perth.—July 19th. P.M.G. Supply of insulators (Schedule 510). See "Official Notices" June 9th.

August 16th. P.M.G. Distilling apparatus (Schedule 502), telegraph and measuring instruments (Schedule 498). See "Official Notices" to-day.

Melbourne.—July 26th. Victorian Railways Commissioners. 400 signal lighting transformers.*

Sydney.—August 17th. Portable internal combustion engine and dynamo (2½ kw.) for the Departmental Stores, Sydney, for P.M.G.*

August 24th. P.M.G. Automatic switchboard and apparatus for North Sydney Exchange. Schedule No. 511.*

Brisbane.—July 31st. P.M.G. Power board and accumulators. Schedule No. 381.

Brighton.—June 20th. Electrical fittings, for the B. of G. Mr. H. Burfield, Clerk, Prince's Street.

Halifax.—June 17th. Steelwork over the dam at the electricity works. Mr. James Lord, Borough Engineer, Town Hall, Halifax. Deposit £1 (returnable).

Hull.—June 19th. Electrical requirements for six months, for the B. of G. Mr. R. H. Winter, Clerk, St. Mary's Chambers.

London.—L.C.C. June 19th. Asylums and Mental Deficiency Committee. Electric lamps for three months. Mr. H. F. Keene, Clerk, 2, Savoy Hill, Victoria Embankment, W.C.

New Zealand.—Invercargill.—September 28th. Borough Council. Steam turbo-alternator, condensing plant, and switchgear. Specifications from the Tramway Office.

Rotherham.—July 3rd. Corporation. Twelve months' supply of tramway stores and materials, coal, cable, meters, &c. See "Official Notices" to-day.

Salford.—June 26th. Corporation. Coal conveyors and bunkers, for the Electricity Department. See "Official Notices" to-day.

Spain.—June 27th. Municipal authorities of Albox (Province of Almeria). Concession for the electric lighting of the town for 12 years.

Tenders have lately been invited by the municipal authorities of Zaragoza for the concession for the electric lighting of the town, and by the municipal authorities of Pobla de Lillet (Province of Barcelona) for a similar concession for ten years.

Torquay.—June 19th. Corporation. 5,500 tons of coal, for use with mechanical stokers, for the Electric Lighting Committee. Mr. F. S. Hex, Town Clerk.

Warrington.—June 27th (noon). (1) Coal elevator; (2) vertical steam boiler feed pump. Specifications, &c. (£1 1s. each, returnable), from Mr. F. V. L. Mathias, Borough Electrical and Tramways Engineer, Howley.

West Ham.—June 22nd. B. of G. Electrical fittings for three months. Mr. T. Smith, Union Offices, Union Road, Leytonstone, N.E.

Wigan.—June 20th. Extensions to electric works, for the Electricity Committee. Deposit £1 1s. (returnable). Mr. A. T. Gooseman, Borough Engineer.

Wolverhampton.—June 16th. Electricity Department. Coal and ash-handling plant. See "Official Notices" June 9th.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

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CLOSED.

Australia.—Accepted tenders :—

P.M.G.'s Department, Victoria.—Four sections of a lamp-signalling trunk-line switchboard at Melbourne Central Exchange, £1,414, Western Electric Co. (Aust.), Ltd.

Victoria Railways Department.—Three-core cable for Newport workshops, £2,866 per mile, B.I. & Helsby Cables, Ltd.

25 battery signal machines for signal shops, Newport, £925, Aust. General Electric Co.

Metropolitan Board of Water Supply and Sewerage, Sydney.—Electrical sundries for one year, Edison & Swan U.E.L. Co., Ltd.

Bradford.—Electricity Committee. Two 150-K.V.A. three-phase transformers, and one 250-K.V.A. three-phase transformer: Brush Electrical Engineering Co., Ltd.

Cheltenham.—Corporation. Electrical Apparatus Co., Ltd.: Renewal of contract for one year's supply of electricity meters.

Dublin.—Dynamo for Crooksling Sanatorium, Brittas :—

General Electric Co.	(recommended)	£54 10
British Thomson-Houston Co., Ltd.	..	54 9

—*Irish Builder.*

Guildford.—T.C. Boiler coal-furnace with forced-draught blowers and special fire-bars, for the refuse destructor :—Meldrums, £100.

London.—Twelve-month contracts have been booked by the "Z" Electric Lamp Manufacturing Co., Ltd., as follows :—

Great Northern Railway.—"Z" drawn-wire metal-filament lamps.

Metropolitan Water Board.—"Z" drawn-wire lamps.

The following installation contracts were secured by the Alpha Manufacturing Co. during May :—

H.M.O.W.—New offices for Ministry of Munitions, Whitehall Gardens.

L.C.C.—The "Victoria" Elementary School, Hammersmith; Senior Street Elementary School, Paddington; Star Lane Elementary School, Fulham; Woolmore Street Elementary School, Poplar.

Metropolitan Asylums Board.—Ventilating and lighting at South-Western Hospital, Stockwell; electric heating at Head Office, Embankment.

Rotherham.—Electric Light Committee. Rees Roturbo Manufacturing Co., a turbine boiler feed pump, at £322.

Sheffield.—Electricity Supply Committee :—

T. W. Ward, Ltd., M. C. Burnby & Sons, G. Turner, and Longbottom and Co.—Total quantity of approx. 42,600 tons of coal over a period of 12 months.

E. Taylor, Ltd.—Ash-hoist foundations, £257.

Sunderland.—Electricity and Lighting Committee. Tenders accepted :—

Ferranti, Ltd.—E.H.T. switchgear and meters.

Stewart & Lloyds.—Pipework.

P. A. Mudd & Co.—Pipe and boiler lagging.

Tonbridge.—U.D.C. Electricity meters for a year :—Electrical Apparatus Co., Ltd. 200 tons of Dean Forest coal for the electricity works: Medway Coal Co., 29s. 4d. per ton.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, June 16th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Ordinary meeting.

Incorporated Municipal Electrical Association.—Thursday, June 22nd. At 10 a.m. At the Institution of Electrical Engineers, Victoria Embankment, London, W.C. Annual Meeting. Presidential Address by Mr. A. C. Cramb. Papers on "Boiler House Design and Operation," by Mr. W. W. Lackie; "The Generation of Electricity on a Small Scale or Bulk Supply," by Mr. H. S. Ellis; and "The Application of Electricity to Agricultural Purposes," by Mr. W. T. Kerr.

Friday, June 23rd. At 10 a.m. Council Meeting; at 10.30 a.m., Annual General Meeting.

NOTES.

The British Association Meeting.—The annual meeting of the British Association for the Advancement of Science will take place at Newcastle-upon-Tyne from Tuesday, September 5th, to the following Saturday. Sir Arthur Evans, F.R.S., is the president. The sectional presidents include the following :—

Mathematical and Physical Science: Dr. A. N. Whitehead, F.R.S.

Chemistry: Prof. G. G. Henderson,

Economic Science and Statistics: Prof. A. W. Kirkaldy.

Engineering: Mr. G. G. Stoney, F.R.S.

There will, of course, be no excursions, garden parties, &c., but the papers and discussions, as last year, will be concerned with problems arising out of the war, in its scientific, its technological, and its social aspects. The reception room will be at the College of Medicine, and the sections will meet in rooms not far afield. The presidential address will be delivered in the Town Hall.

Indian Notes.—Our special correspondent writes :—

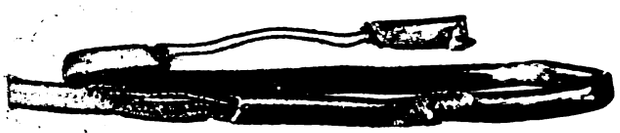
Kabul.—H.M. The Amir's electrical engineer, Mr. G. Murray, has recently returned to India on a two months' holiday at the end of two years' service. The large hydro-electric scheme, which was commenced there a few years ago, has not yet been put into operation, mainly due to shortage of labour and material, and the difficulties of the climate. Mr. Jewett, the chief engineer for the contractors, is still in charge, courageously working against heavy odds to ensure the success of the operation.

Calcutta.—Mr. H. D. F. Jacob, lately of the British Westinghouse Co., has been appointed by the Bengal Government as Executive Engineer, Electrical Division P.W.D., to take the place of Mr. A. K. Taylor, who has been appointed Electrical Inspector under the Indian Electricity Act. Mr. Jacob is a sound engineer of ripe Indian experience; his knowledge of electrical work from a contractor's point of view should be an excellent asset to him in his new sphere.

Japanese Supplies.—The sinking of the s.s. *Chantala* not long ago has been a serious loss to many Calcutta electrical firms, and has given a further chance to the astute and enterprising Japanese traveller to push his wares. Being unable to procure supplies from England in reasonable time and in sufficient quantity, electrical dealers are now buying largely from Japan goods such as cables, wires, lamps, motors, and so on. It is said that Japanese supplies are improving in quality, the Far East manufacturers being now able to turn out a surprisingly good article with prompt dispatch and at a not unreasonable price.

American Fans.—American ceiling fans hold a good grip of the Indian market, but the deliveries this season are woefully late; it is somewhat astonishing that America has not pushed the electrical accessories business more strenuously in India. The big American companies have hitherto done well in a big machinery way; but they appear to have neglected the smaller lines—in which there is money to be made.

Rats and Lead-Covered Cable.—The sample of lead-covered cable illustrated herewith, which Messrs. Electrical Installations, Ltd., have kindly sent us, was recently taken from an installation in a City restaurant. The lead sheathing and the insulation of the wires have been completely gnawed away by rats, the marks of their teeth being distinctly visible, not only on the lead, but also on the copper wires, of the sample. The insulation in this case was of vulcanised rubber. We do not know which



restaurant harboured these ravenous rodents, but seeing the straits to which they were reduced, we should think it hardly the most promising place in which to look for "satisfied consumers."

As regards the technical aspects of the matter, it is clear that lead sheathing is an inadequate protection for wiring in places to which rats have access, such as warehouses, farm buildings, workshops, &c., and in such places conduit seems to be the only sure protection; but rats should never be found in inhabited buildings—not even in a "City restaurant"—and the present instance need not deter contractors from using lead-covered wire there.

Runaway Car.—In Oldfield Lane, Wortley, Leeds, on Tuesday morning, a Corporation tramway goods hopper car, after being unloaded, ran away owing to the brake being prematurely released by a workman, and dashed down the track, which is on a gradient, at a furious pace. The driver, who was engaged in changing the trolley pole, was knocked on one side in trying to board the car. After running for a mile, the hopper car crashed into a passenger car, shattered the whole of the rear portion, and swerved it half-way round across the pavement, driving it through a five-foot wall and partly into a field. The wagon driver and the driver and conductor of the passenger car were severely injured; a lady passenger was able to proceed home after treatment at the Leeds Infirmary, and the remainder of the half-dozen passengers suffered from shock and minor hurts.

Device for Preventing Collision at Sea.—At the meeting of the Marconi International Marine Communication Co. Ltd., on Wednesday, Mr. Godfrey Isaacs stated that Senator Marconi had authorised him to announce that he would shortly introduce a simple apparatus, to be worked from the bridge of a ship, which would put an end to the danger of collision in darkness or fog.

Volunteer Notes.—1ST LONDON ENGINEER VOLUNTEERS.—Orders for the week by Lieut.-Col. C. B. Clay, V.D., Commanding.

Monday, June 19th.—Technical for Platoon No. 9, 46 Regency Street, S.W.; Squad and Platoon Drill, Platoon No. 10; Signalling Class and Recruits.

Tuesday, June 20th.—School of Arms, 6 to 7; Recruits, 7 to 8.15.; lecture, 7.15, "Sketching and Reconnaissance," Mr. E. J. Finch.

Wednesday, June 21st.—Platoon Drill, No. 3 Platoon.

Thursday, June 22nd.—Platoon Drill, No. 7 Platoon; Shooting for No. 10 Platoon; Miniature Range; Recruits, 5.45 to 7.45; Instructional Class, 5.45.

Friday, June 23rd.—Technical for No. 10 Platoon, 46, Regency Street, S.W.; Squad and Platoon Drill, No. 9 Platoon.

Sunday, June 25th.—Entrenching duties: Parade, Victoria Station (S.E. & C. Railway Booking Office), 8.35 a.m.

MACLEOD YEARSLEY, *Adjutant*.

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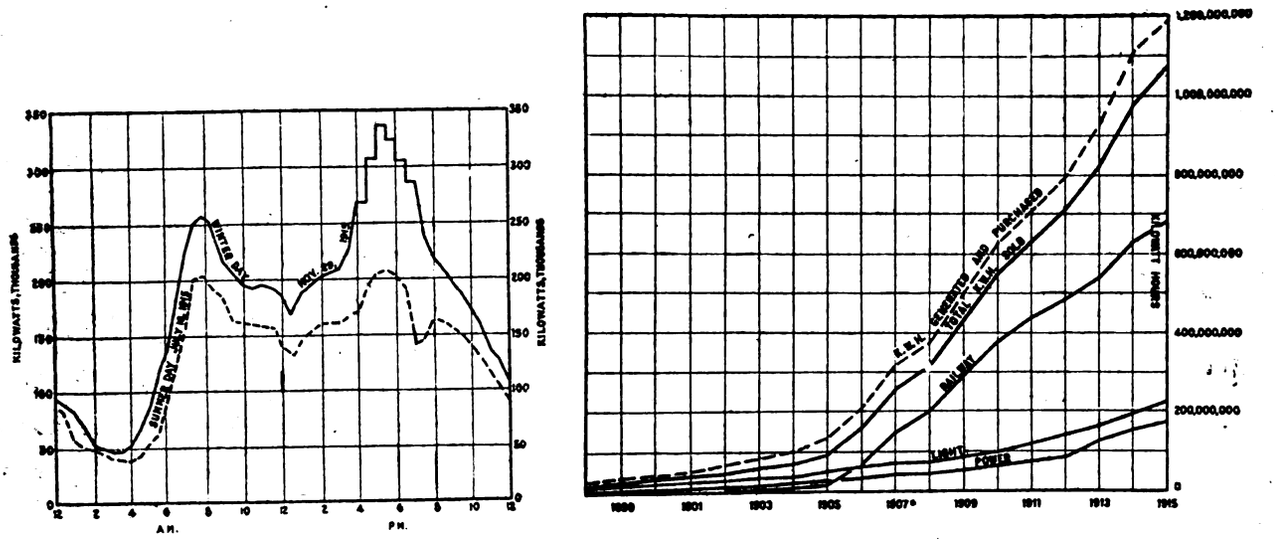
The Largest Supply Undertaking in the World.—In the *Electrical World*, of May 20th, there is a statistical account of the development of the Commonwealth Edison Co. of *Chicago* from small beginnings in 1881 to the present huge concern, which has a capital of 18 millions sterling and an annual income from the sale of electricity of more than 4 millions. Mr. *Samuel* Insull, an Englishman, has been President of the company since 1892 (when it was the Chicago Edison Co., and its capital was £150,000), and has guided its progress to its present condition *of extraordinary* prosperity. Some idea of the rate of development may be gained from the following figures:—

	1900.	1905.	1910.	1915.
KW.-hours generated, millions	39	131	626	1,198
Revenue from sale of electricity, millions sterling ...	·452	1·07	2·43	4·17

It will be seen that the output increased 30-fold in the 15 years, whilst the revenue increased nine-fold, showing a great reduction in the prices charged. One of the most impressive and significant features of the article is the fact that the energy supplied to electric railways in 1915 exceeded 670 million units—nearly two-thirds of the total output sold; the length of electric railways (largely composed of tramways) supplied was 1,500 miles. Regular customers numbered 286,202. The maximum day's output, last Christmas Eve, was 4¼ million units, and the maximum connected load on December 31st was 834 056 KW. The peak load occurred on November 29th, 1915, 337,900 KW., the total rating of the eight generating plants being 377,150 KW. The load factor was 42·5 per cent., and the average income per KW.-hour 0·97d.



CHICAGO ELECTRICITY SUPPLY: TYPICAL DAY-LOAD CURVES AND PROGRESS CURVES.

It was in 1905 that the railway supply began to assume important dimensions; in that year it was about 10 million units, and in 10 years it steadily rose to 670 millions. The consumption of coal per KW.-hour fell from 7 lb. in 1903 to 2·8 in 1909, rose to 3 lb. in 1911, and is now 2·7. The average retail lighting rates fell from 7d. in 1903 to 3·4d. in 1915, and the lighting revenue in 1915 formed more than half the total income, although the annual load factor was 42·5 per cent.; the power and railway returns were almost exactly equal at one-fourth the total each. The present returns are per KW.-hour for lighting 2½d., for power 1·45d., and for traction 0·35d. The company owns 133 electric vehicles, and serves a total area of 199 sq. miles, being "the one accepted source of generation and distribution in Chicago for energy." It possesses a 50-year franchise dating from 1897, when the "Commonwealth Electric Co." was formed to acquire various properties operating in the outlying sections of the city; in 1907 the two companies, which had been closely interconnected, were combined under the present title. The accompanying curves show graphically the rapid development of the undertaking.

Russia's 1886 Company: Ministerial Action.—A Special Council has been held in Moscow, presided over by the President of the Council of Ministers, Mr. B. V. Sturmer, to consider the question of the liquidation of the 1886 Electric Lighting Co. General Shebeko, the Moscow Town Governor, and a number of leading citizens were present. The chairman stated that the 1886 Company was the kernel of German enterprises in Moscow. No one could contradict that contention. Those present unanimously approved of this remark; even the representatives of the temporary board of the company, Messrs. Sventorzhitzky and Kuchelbeker, did not contradict it. Thus, continued the chairman, they did not need to consider the constitution of the company, but must prepare the programme for clearing up other important questions in connection with the matter. He explained the most important points. First of all it was necessary to show what was to be done in the future with the 1886 Company. The second question was of serious importance—namely, to whom the concern should be transferred for exploitation, when once transfer was decided upon. And, finally, there was the question whether there were technical and economic obstacles should the concern be handed over to the Moscow Town Council. The subsequent discussion was conducted along these lines. The chief of the town, Mr. Chelnokoff, expressed the desire of the town concerning the future of the company. This desire went no further than it had already been considered necessary to go against the company by Senator Ilyashenko's Committee—namely, the liquidation of the company by means of a special liquidating Committee, and the purchase of the concern by the Town Governor. Mr. Chelnokoff explained that it would not take more than a month to fix the value of the concern, whether by striking a balance of the accounts, or by an actual valuation. On the question to whom the undertaking of the company should be transferred, the town's representatives explained that there would be no financial trouble incurred by the transfer of the company to the town of Moscow. If it should be necessary for the town to pay the company out all at once, or in instalments, it was all the same to the Moscow Government, which could arrange for such a settlement. This opinion was also emphatically held by the representatives of the Financial Committee of the Town Council, Messrs. Katuar and Gutchkoff. In order to pay the company in one sum, the town would have to raise a loan, but for buying up such a concern the raising of the loan presented no difficulties. On the question of technical or economical obstacles to the transfer, the representatives of the town, referring to the practice in connection with their other important enterprises, showed that technical obstacles were non-existent. The town managed very well with its own public works. Touching the question of obstacles of an economic character, the representatives of the town showed that the danger to society or to manufacturers in the form of a rise in price for energy, and especially of strikes in the electrical works, which had been particularly frequent in municipal concerns, was not groundless. Mr Chelnokoff and other town representatives showed further, however, that the town was not afraid of these undertakings. Strikes easily broke out in works where there was a large number of workmen, and especially where there were various groups of workmen, as, for example, in the town tramways, where 9,000 men were employed. But in concerns where a small number of workmen were engaged, or where they were technically competent, strikes were not so frequent. The representatives of the town referred also to their experience with their waterworks, sewers, and finally their own electrical station. The representatives of the temporary board of the 1886 Company observed that in view of the immense importance of the station for the service of numerous concerns working for the national defence, it would be unwise to transfer it from one control to another. Notwithstanding this, the town representatives held that the defence of the country would be better served if the concern were in Russian hands, and not in German hands. Then, in a short *résumé*, the President of the Council of Ministers said that the question of the liquidation of the 1886 Company was quite ripe for the consideration of the Council of Ministers. Subsequent points for consideration would be the time and method of liquidation, and the formation of a liquidation committee. The Council of Ministers would decide the question to whom the company concerned should be transferred, either to the town of Moscow alone, or to the town along with the government, or whether it should be given to the highest bidder at a special auction. With this the conference closed. Whilst considering the question of the liquidation of the company, the representatives of the Gruzin and Narozhnitzky district councils said that in connection with the decision as to the disposal of the 1886 Company, the question should also be decided of the liquidation of the Electric Transfer Co.; for their interests were identical, and the decision respecting both should follow the same course.

Lighting the Statue of Liberty.—The American *Electrical Review* is inviting dollar (or less) subscriptions to a fund for electrically illuminating the statue of Liberty in New York Harbour by flood lighting. It is considered that this will be the most significant public demonstration of the effectiveness and beauty of electrical illumination in which the industry has ever had the opportunity of assisting.

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Australian Metals Developments.—The Australian newspapers have recently contained very full particulars of the scheme under which practically all the companies interested in silver, lead, and zinc in the Commonwealth are brought together. The Australian Zinc Producers' Association has been formed, through which the products of the whole of the companies will be marketed for a term of 50 years. The companies are extending their works, and according to a statement issued by Mr. Mahon, Acting Attorney-General, who, in the absence of Mr. Hughes, is dealing with the metal question in the Commonwealth, everything points to the conclusion that in the near future Australia will be self-contained in regard to the production of metals in a finished state. Mr. Mahon says:—

"In order that the public may have some idea of what has been performed since the Commonwealth Government adopted the wise policy of prohibiting the exportation of all minerals and metals that can be treated in Australia, it may be stated that the following named companies have enlarged their works, installed new plant and appliances, and generally increased the capacity of their various metallurgical establishments:—

Broken Hill Associated Smelters Pty., Ltd.:
Extensions to smelting and refining works, Port Pirie, for the treatment of lead concentrates and refining of lead bullion, costing £250,000

The Electrolytic Smelting and Refining Co. Works, Port Kembla, N.S.W.:
Additions and extensions to plant and installation of five refining furnaces £150,000

Sulphide Corporation, Cockle Creek Works:
Extensions to acid and superphosphate works for the utilisation of sulphurous fumes from metallurgical operations £50,000
There is also the probability that this company will erect a silver, lead, and gold refinery in the near future, the cost of which will exceed £50,000

The Wallaroo and Moonta Mining and Smelting Co., Wallaroo, S.A.:
Extensions to treatment plant and the installation of an additional large copper refining furnace £25,000

The Broken Hill Proprietary Co.:
Important additions and extensions to its new iron and steel works.

The Mount Lyell Mining and Railway Co.
is conducting large experiments for the recovery of sulphur. This company also has an option over a group of mines in Tasmania, and it is very probable that large works will be erected for the treatment of mixed ores from these properties.

"Several new companies have been formed to further develop the metal industries, viz.:—

Metal Manufactures, Ltd.: Capital.
The operations of this company will cover the drawing of copper and brass wire and cables; manufacture of tubes, plates, and all descriptions of bronzes and alloys £200,000
A company (not yet registered) for the production of electrolytic zinc £250,000

Australian Electric Steel, Ltd.:
The objects of this company are the working up of scrap iron and scrap steel, and the manufacture of ferro-alloys in electric furnaces £40,000

"Several small plants have been installed for the separation of bismuth minerals from wolfram and molybdenite. Also, there has been restarting of the smelting of auriferous and non-auriferous antimonial ores for the production of fine gold and 'Star' antimony. The question of alkali manufacture has not been neglected, and plans are progressing satisfactorily for the establishment of this industry on a large scale. Carbide of calcium plant is being installed by the Hydro-Electric and Complex Ore Companies. These companies also intend to work the 'Gillies' process for the production of electrolytic zinc."

Fatality.—BELFAST.—On the evening of the 8th inst., Wm. Macdonald (31), foreman electrician, was discovered in a state of collapse, at No. 2 switchboard in the engine-room at Belfast electricity works, where he was on duty. The surmise is that his foot having slipped, he threw out a hand to restore his balance, thus inadvertently establishing the contact that cost him his life. Deceased was the eldest son of Mr. David MacDonald, who is overseer in the electricity department. At the inquest the jury found that death was the result of accidental shock, and expressed the opinion that the use of gloves should be enforced in such work as shifting shunts.

Institution Notes.—Association of Teachers in Technical Institutions.—An open meeting will be held on Saturday, June 17th, at 2.30 p.m., at the Day Training College, Southampton Row, W.C., at which Dr. William Garnett will deliver an address, and resolutions will be put to the meeting stating that: (1) The Association views with grave concern any diminution in expenditure which would impair the efficiency of technical education, and thereby react injuriously upon industry at a time when the country should be making every effort to improve its industrial position. The Conference, therefore, urges the Government to take all possible steps to make technical education more effective, not only in relation to existing industries, but in the development of new industries.

(2) The Conference urges the desirability of compulsory attendance for further education of employés until the age of 18 years for not less than six hours per week. The instruction should be given preferably in the day time, and to this end the Conference urges that adequate facilities should be provided in the conditions of employment.

(3) It is of the greatest importance that the conditions of employment of a technical teacher should provide him with the opportunity of keeping himself in close touch with the development of his subjects.

(4) The Conference notes with great regret the inadequacy of the sum (£40,000) which the Government intends to devote to scientific and industrial research during the present financial year. The Conference is of the opinion that the existing conditions require the expenditure of a much larger sum.

The Association of Consulting Engineers (Inc.).—The report of the Committee for the past year, states that the restrictions which, owing to the war, the Treasury has caused to be placed on the borrowing powers of Local Authorities and on the issue of fresh capital by public companies, coupled with the increasing necessity for devoting the whole energies of most engineering works to the production of munitions of war, have had a very great effect on professional work during the past year; while a considerable number of members are either serving directly with the Forces or engaged on work connected with the supply of munitions.

A deputation from the Association interviewed the L.G.B. in July last year, with a view to obtaining some mitigation of the conditions, and in March last, representations were made to the authorities to the effect that they should employ consulting engineers with local experience when possible, rather than use the services of the servants of public bodies. Protests were also addressed to local authorities which allowed their electrical engineers to advise other local authorities. Negotiations are proceeding with the British Electrical and Allied Manufacturers' Association with a view to agreeing to a standard set of conditions of contract. The total membership now stands at 74. The accounts for the year 1915-16 show a credit balance of £128, compared with £78 last year.

At the annual general meeting on May 31st the report and accounts were unanimously adopted. The new members elected to serve on the Committee were Messrs. A. A. C. Swinton, F. Gill, W. V. Graham, E. P. Hill, A. Hindle, and C. D. Lomax.

The Chemical Society.—The adjourned meeting of the Society to deal with the question of alien enemy membership, is to be held on Wednesday, June 21st, at 8 p.m. The Council has issued a voting paper with the notice of the meeting, inviting the Fellows to indicate their views with regard to three propositions, contemplating respectively the unconditional removal of the names of alien enemies from the roll of members, the retention of the names with suspension of judgment till after the war, or the removal of the names of nine such members (including those of Nernst and Ostwald) during the war, the position to be reconsidered at the end of the war. The voting, as in the case of the I.E.E., will not be binding, but will no doubt influence the voting at the meeting.

Industrial Research.—The Standing Committee on Engineering appointed by the Advisory Council for Scientific and Industrial Research held its first meeting on Wednesday, June 7th. The Committee has been so constituted as to represent both the scientific and the industrial sides of engineering, and includes the following members nominated by the professional associations:—

Institution of Civil Engineers, Sir Maurice Fitzmaurice, C.M.G.
Institution of Electrical Engineers, Mr. J. S. Highfield.
Institution of Mechanical Engineers, Dr. Dugald Clerk, F.R.S.
Institution of Naval Architects, Sir Archibald Denny, Bart.
N.E. Coast Institution of Engineers and Shipbuilders, Mr. Herbert Rowell.
Manchester Association of Engineers, Mr. Alfred Saxon.
Institution of Engineers and Shipbuilders in Scotland, Mr. James Brown.

The following members have been appointed directly by the Advisory Council:—Mr. F. R. Davenport; Mr. Alfred Herbert, Prof. Bertram Hopkinson, F.R.S; Mr. C. H. Merz; Mr. V. L. Raven; Mr. A. A. Remington; Mr. G. Gerald Stoney, F.R.S.; Mr. Douglas Vickers; Prof. Miles-Walker. The Advisory Council has appointed Sir Maurice Fitzmaurice, C.M.G., to be chairman.

The Committee was welcomed by Sir William M'Cormick, chairman of the Advisory Council, and Dr. H. F. Heath, administrative secretary of the Council. Sir A. Selby-Bigge, secretary to the Committee of the Privy Council for Scientific and Industrial Research, also attended, and emphasised the importance attached by the Government to the need for greatly increased activity in research in connection with industry. In Sir Maurice Fitzmaurice's opening statement, as chairman of the Standing Committee, several important aspects of the Government scheme, as issued in July, 1915, were referred to, and attention was directed in particular to the necessity for securing that British industries should get as large a share as possible of the full value of the results of any successful researches, and should retain at least the initial advantages derived from them. Applications for aid must be dealt with on as broad lines as possible, without red-tape, and with a constant regard to the ultimate object of the Government scheme, which was to help the industrial community of the Empire in the contest with the common trade enemy. Much time and money had been spent upon research in the works of individual firms, whose aggregate expenditure for the purpose far exceeded the sums at the disposal of the Committee of Council, and from the industrial side such work by firms appealed to him as the most hopeful arrangement. Too much must, however, not be expected from research and experimental work in themselves, for these alone would not win back the industries which should never have left us, or even retain those we still possessed; individual and combined efforts were needed to secure that the products of this country should find their way to those who needed them at home and abroad, and to see that what was wanted was supplied by our industries.

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Electrical Man's Court-Martial.—John M'Entee, electrical engineer, Belfast, who was employed at the Dundalk electricity works from January, 1914, until near the end of April last, was tried, with several others, by court-martial on Friday and Saturday last, at Richmond Barracks, Dublin, for the murder of a constable, and attempted murder of a lieutenant in the Grenadier Guards, and taking part in the rebellion, in County Louth, on April 24th. Mr. P. A. Spalding, resident engineer and manager, of Dundalk electricity works, gave evidence as to M'Entee's high character as an engineer, and as a young gentleman of education and intelligence. M'Entee made a lengthy statement absolutely denying and disavowing the charge of murder. He also denied other charges, and repudiated the allegation that he was assisting the King's enemies, directly and indirectly. He said that any action he had taken was actuated only by love of Ireland. He was an enthusiastic Volunteer, but his whole aim on Easter Monday was to resist the suppression of an organisation the maintenance of which he regarded as a great safeguard against the repeal of the Home Rule Act. He was not aware of the plans for the insurrection. Mr. Alexander, a member of the Belfast Corporation, gave evidence in M'Entee's favour, as did also Alderman Magowan, Mr. J. Devlin, M.P., and others. The President announced that the proceedings in open Court were concluded, and the accused was removed.

It was announced in Dublin on Wednesday, that M'Entee was sentenced to death, but that his sentence had been commuted to penal servitude for life.

Appointments Vacant.—The following are required for military electric power stations in Yorkshire and Staffordshire:—

District electrical engineer; station engineer; shift engineers; station fitters and linesman-jointers. See our advertisement pages for particulars.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—By 11 votes to 8, the Gillingham (Kent) T.C. has agreed to Mr. RITSON, assistant electrical engineer, joining the Colours. The minority, which included the Mayor, considered that they would be placing themselves in a very awkward position by letting Mr. Ritson go. Mr. CHALMERS, the electrical engineer, has undertaken to take charge of the works for the period of the war without a substitute for Mr. Ritson, three applicants for the position being deemed unsuitable.

In view of the large amount of additional work and responsibility which has been cast upon the general manager of the Sheffield undertaking owing to the war, the Electricity Supply Committee has recommended the City Council to grant him a bonus of £100 The Establishment Committee does not approve, and the Electricity Committee is appealing to the Council.

General.—Mr. ERNEST E. KELL, chief electrical assistant engineer P.W.D., Government Factory, Colombo, Ceylon, was sailing for home last month on short leave. His address here is: Clifton Villa, Clifton Terrace, Hayle, Cornwall.

Gazette Notice.—Territorial Force. Royal Engineers. *Tyne Electrical Engineers*: Sergt.-Major FRANK T. HAMILTON to be Second-Lieutenant (on probation).

Mr. T. N. VAIL, president of the American Telephone and Telegraph Co., was awarded the Elliott Cresson medal at a meeting of the Franklin Institute on May 17th, and Mr. J. J. CARTY, chief engineer of the company, was presented with the Franklin medal.

The marriage took place on June 10th, at Penarth, of Mr. R. L. BOOTH, managing director of Booth & Bomford, Ltd., electrical engineers, Cardiff, and Miss Margaret Lewell.

Roll of Honour.—Many of the friends of Mr. WILLIAM ARTHUR PRICE will desire to join us in an expression of sympathy with him and Mrs. Price and the members of the family in the loss of his second son, Sub-Lieutenant WILFRED BARTHOLOMEW PRICE, in the North Sea Battle on May 31st. Mr. Price's eldest son was at the battle of Mons, and has been a prisoner in the hands of the enemy ever since.

Electrical-Wireman JOHN LUTY, of *H.M.S. Conqueror*, who took part in the North Sea battle, and was uninjured, was formerly an electrician at the municipal power station at Batley.

Sergeant G. H. WOOD, one of the senior inspectors of the Blackburn Corporation tramways department, who has been shot in the head, is in a serious condition.

First-Class Stoker HENRY PARKER, who, prior to joining the Navy in August, 1914, held a position in the electrical department of the North-Eastern Railway, was lost in the *Queen Mary*.

PERCY LAWLEY, lost in *H.M.S. Queen Mary* in the North Sea fight, was formerly an electric wireman with Messrs. Callenders, at Birmingham.

It is feared that Mr. W. F. MURRAY, electrical engineer, was lost in the North Sea battle. He was an engine-room artificer on *H.M.S. Indefatigable*. He was formerly electrical engineer at the Workington Iron & Steel Co.'s iron ore mines.

Captain A. F. MARCHMENT, of the 1/1st London Regiment, who was, when the war broke out, in the engineering department of Callender's Cable & Construction Co., Ltd., has been awarded the Military Cross.

CHARLES CLIFFORD MASSEY, of *H.M.S. Black Prince*, killed in the North Sea battle, served his apprenticeship in the electrical department at Crewe Railway Works, and was later engaged at the Marconi Works, at Chelmsford. He entered the Navy three years ago.

Artificer GEORGE ADAMS MORPHEW, E.R.A., one of the victims in the *H.M.S. Hampshire* disaster, was formerly on the staff of Messrs. Siemens Bros., Ltd., of Charlton, S.E. His mother, who lives at Walmer, received a letter (dated June 4th) from him on June 8th, enclosing his will, and stating that in the North Sea battle his vessel rammed a submarine, and sunk another and a light cruiser by gunfire.

DONALD HERBERT JENNINGS, of *H.M.S. Tiger*, who was severely burned on the face and hands in the North Sea action, was a wireman of the armoury, and, prior to the war, was with Messrs. Tamplin & Makovski, electrical engineers, of Reigate.

Electrical Engineer W. G. WATERMAN, reported lost in *H.M.S. Hampshire*, was formerly mains superintendent at the Doncaster Corporation electricity works, where he served as a pupil for three years. He joined the Navy last July.

Private HIRAM HART, Loyal North Lancashires, formerly an electrician with the Bolton Corporation, has been killed in action.

Electrician J. W. VASEGARDEN, aged 33, is believed to have gone down with the *Hampshire*.

Private FREDERICK MONTIER, formerly engaged at the electricity generating station at Clifton, near Manchester, has been killed in action.

Leading Stoker JOSEPH GRAVES, aged 24, formerly in the employ of Messrs. J. P. Hall & Co., electrical engineers, of Oldham, was lost in the *Indefatigable*.

Sergeant JAMES MUSCROFT, formerly employed at the British Westinghouse Works, Trafford Park, who was reported missing some months ago, is now officially reported killed.

Seaman J. R. STONE, formerly employed by the British Westinghouse Co., Trafford Park, is believed to have been lost in the sea fight. He was serving on *H.M.S. Nestor*.

Electrician HENRY LEWIS DAVEY, *H.M.S. Warrior*, "killed in action," May 31st, 1916 (aged 20 years), was formerly in the employ of Messrs. Edwards & Armstrong, of Bristol.

Electric Artificer JOSEPH SAMUEL PARKER, who belonged to Ipswich, was killed in action whilst on board *H.M.S. Tiger* in the battle on May 31st.

Electrician W. WHARMBY, of Stalybridge (formerly employed by Messrs. Ferranti, Ltd., and later by Messrs. Johnson and Phillips) went down on *H.M.S. Defence* in the North Sea fight.

Obituary.—PROF. SILVANUS P. THOMPSON.—We record with very deep feelings of regret the death of Prof. Silvanus P. Thompson, D.Sc., LL.D., F.R.S., which occurred at his residence at "Morland," Chislett Road, Hampstead, N.W., on Monday last, after two days' illness "without suffering." Prof. Thompson, who had nearly reached his 65th year, was a man of great eminence in the world of physical and electrical science as a scientist, teacher, author, and orator. His prolonged occupation of the position of Principal at Finsbury Technical College, his widely-used standard technical works and biographical writings on Faraday and Kelvin, and his manifold activities in connection with various institutions, had brought him into touch with thousands of men, many of whom recognise how greatly they have benefited from being brought under his influence. We hope to refer to the deceased professor's career in greater detail next week. In the meantime, we tender our sincere sympathy to Mrs. Thompson and her four daughters. Friends of the late professor are invited to a meeting at the Friends' Meeting House, 52, St. Martin's Lane, W.C., to-day, Friday, at 3 p.m. (after the cremation).

MR. WILLIAM STANLEY.—The American *Electrical Review* contains an obituary of Mr. Wm. Stanley, "one of the foremost inventors and engineers in the American electrical industry, and former vice-president of the American Institute of Electrical Engineers," who passed away last month at the age of 58 years. His most notable invention was the transformer which made the A.C. system of long-distance transmission of electrical energy a commercial possibility, the Edison Medal being awarded to him therefor in 1912 by the American I.E.E. The deceased gentleman was a member of the English Institution of Electrical Engineers.

LIEUTENANT J. R. WILKINSON, B.Sc.—Mr. George Wilkinson, borough electrical engineer of Harrogate, has received news of the sudden death of his elder son, Lieutenant J. R. Wilkinson, B.Sc., in Germany, where he had been a prisoner of war for 21 months. Lieut. Wilkinson had gone on to the roof of his quarters at Gnadenfrei, Schlesien, to make meteorological observations, when from some cause unknown he fell to the ground and was instantaneously killed. We tender our sincere sympathy with Mr. Wilkinson in his loss.

MR. W. C. MANSELL.—The death is announced of Mr. Wm. Charles Mansell, who was in business as an electrical engineer at Northampton.

It is officially announced that while employed on special duty SIR H. F. DONALDSON and MR. LESLIE ROBERTSON, both of whom were lost in the *Hampshire*, were to have the relative precedence of a brigadier-general and a lieutenant-colonel respectively. At the instance of the Engineering Institutions a service was held at St. Margaret's Church, Westminster, yesterday, in memory of SIR FREDERICK DONALDSON and MR. LESLIE S. ROBERTSON.

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NEW COMPANIES REGISTERED.

Coleman & Appleby, Ltd. (144,022).—This company was registered on June 5th, with a capital of £3,500 in £1 shares (3,000 6 per cent. cumulative preferred, free of income-tax), to enter into an agreement of sale and purchase between Langbein-Pfanhauser Works, Ltd., and W. Randle, the controller thereof, of the first part, O. J. Neale, W. R. Baker, C. B. Appleby, and H. S. Coleman of the second part, and T. J. B. Hasell (for the company) of the third part, and to carry on in the United Kingdom and its Colonies, or elsewhere, the business of electro-metallurgists, electro-platers, electrotypers, manufacturers of and dealers in dynamo machines, electric motors, switches, and all kinds of electrical apparatus and instruments, machinery, and materials for grinding and polishing, and all kinds of chemicals, electrolytic solutions, &c. The subscribers (with one share each) are: O. J. Neale, 91, Grove Lane, Handsworth, Birmingham, builder and shop fitter; H. S. Coleman, 3, Wyndham Road, Edgbaston, Birmingham, electro chemist; C. B. Appleby, 89, Holly Road, Handsworth, Birmingham, general manager. Private company. The first directors (to number not less than four or more than five) are O. J. Neale (chairman), C. B. Appleby, H. S. Coleman, and one other to be appointed by the subscribers (all life directors). After the issue of 100 ordinary shares to each of the life directors, no further ordinary shares shall be issued by the company without the consent of all the directors. Remuneration of O. J. Neale and such other director to be appointed as above, £75 per annum divided between them. The said C. B. Appleby and H. S. Coleman whilst in the employ of the company, other than as ordinary directors, shall not be entitled to any remuneration as directors, but in the event of either of them ceasing to be so employed, he is to receive £37 10s. per annum. The directors may not allot any shares or register any transfer of shares to a foreigner or a foreign corporation, or a corporation under foreign control, without the consent of the Board of Trade. Another clause provides, however, that "the directors shall refuse to allot any shares or register any transfer . . . which would cause more than 25 per cent. of the issued capital or of the voting power . . . to be held by foreigners and/or foreign corporations or corporations under foreign control." Every application for the allotment of shares, and every transfer, must be accompanied by a statutory declaration as to nationality and allegiance, and a British subject by naturalisation must specifically declare whether he remains for any purpose in the allegiance of any foreign Sovereign or State. The solicitors have made the usual declaration that the company is not formed for the purpose or with the intention of acquiring all or part of the undertaking of a person, firm, or company whose books and documents are liable to inspection under the Trading with the Enemy Act. Solicitors: Jeffrey Parr, Hasell & Parr, 20, Temple Row, Birmingham. Registered office: 23, Great Hampton Street, Birmingham.

South Coast Kearney High-Speed Railway, Ltd. (144,019).—Registered June 3rd, by E. W. C. Kearney, 100, Victoria Street, S.W. Capital, £21,000 in 20,000 ordinary shares of £1 each and 20,000 founders' shares of 1s. each. Objects: To adopt agreements (1) with Charles William Neville and (2) with the Kearney High-Speed Railway Co., Ltd., whereby the said company shall grant to this company the full and exclusive use of the patents and other rights in connection with the Kearney High-Speed System for the purpose of constructing a line of railway on the said system on the South Coast of England. The consideration payable is to be the allotment to the said company of 10,000 fully-paid founders' shares. The signatories (with one founders' share each) are: Miss D. A. Cockle, 6, Great Ormond Street, W.C., private secretary; E. W. C. Kearney, 100, Victoria Street, S.W., civil engineer; H. J. Darby, 59, Bromfelde Road, Clapham, S.W., solicitor; Rev. H. Hughes, 37, Bartholomew Road, N.W.; C. B. Kearney, 95, Cromwell Road, Wimbledon, S.W., mechanical engineer; W. F. Paul, Lorne Cottage, Sutton, Surrey, gentleman; Rev. H. S. G. Walker, The Tower, Easington, Hull. Minimum cash subscription, 100 ordinary shares. The first directors (to number not less than two or more than five) are: E. W. C. Kearney (managing director), C. B. Kearney, and W. F. Paul. The said E. W. C. Kearney is to receive £200 per annum and to have allotted to him or his nominees 2,500 fully-paid ordinary shares in consideration for his services to the company. Qualification of first directors, one share; of subsequent directors, 200 shares. Solicitor: H. J. Darby, 63, Queen Victoria Street, E.C. Secretary (*pro tem.*): Miss D. A. Cockle. Registered office: 100, Victoria Street, S.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Pirelli-General Cable Works, Ltd.—Particulars of £50,000 debs., created April 11th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

James Keith & Blackman Co., Ltd.—A memorandum of satisfaction in full on May 15th, 1916, of debs. dated June 23rd, 1908, May 25th, 1913, and November 2nd, 1914, securing £500, has been filed.

British Electric Transformer Co., Ltd. (76,351).—Capital, £200,000 in £1 shares (100,000 pref.). Return dated March 31st, 1916. 61,988 pref. and 85,498 ord. shares taken up; £1 per share called up on 52,764 pref. and 9,529 ord., and 7s. 6d. per share on 14 ord.; £62,298 5s. paid; £85,179 considered as paid on the remainder. Mortgages and charges: Nil.

Brook, Hirst & Co., Ltd. (95,264).—Capital, £20,000 in £1 shares. Return dated January 12th, 1916 (filed April 20th). 12,500 shares taken up; £12,500 considered as paid. Mortgages and charges: £7,000.

Bridgwater and District Electric Supply & Traction Co., Ltd. (75,429).—Capital, £20,000 in 15,000 ord. and 5,000 pref. shares of £1 each. Return dated May 12th, 1916. 12,899 ord. and 680 pref. shares taken up; £1 per share called up on 4,017 ord. and 680 pref.; £4,707 paid, including £10 on 100 forfeited shares; £8,882 considered as paid on 8,882 ord. Mortgages and charges: £12,950. A further 50 pref. shares were allotted, payable in cash, on May 31st, 1916.

Bromley (Kent) Electric Light & Power Co., Ltd. (54,127).—Capital, £75,000 in £5 shares. Registered September 21st, 1897. Return dated April 17th, 1916 (filed May 9th). All shares taken up. £75,000 paid. Mortgages and charges: £65,003.

Bath Electric Tramways, Ltd. (74,278).—Capital, £230,000 in 75,000 pref., 125,000 pref. ord., and 30,000 def. ord. shares of £1 each. Return dated May 11th, 1916 (filed June 1st). 75,000 pref., 75,606 pref. ord., and 30,000 def. ord. shares taken up; £150,606 paid on the pref. and pref. ord.; £30,000 considered as paid on the def. Mortgages and charges: £155,339.

Beck & Moss, Ltd. (69,298).—Capital, £2,500 in £1 shares. Return dated March 18th, 1916. 2,500 shares taken up; £525 paid; £1,975 considered as paid. Mortgages and charges: £250.

Alderley & Wilmslow Electric Supply Co., Ltd. (47,663).—Capital, £30,000 in 20,000 ord. and 10,000 pref. shares of £1 each. Return dated May 9th, 1916. 15,009 ord. shares taken up; £15,009 paid. Mortgages and charges: £15,000.

CITY NOTES.

British Electric Traction Co., Ltd.

The report for the year ended March 1916, says that, having regard to the state of war, the increased cost of material and wages, and the difficulty of obtaining sufficient labour, the improvement in the revenue derived from the investments is satisfactory. The general conditions have precluded the directors from entering upon new enterprises of any large extent. The gross profit was £244,065, as against £235,508 in the previous year. After deducting the general expenses and the amount written off sundry assets, £34,896, £209,169 remains, plus £71,400 brought forward. Debenture stock interest absorbs £91,200; there is put to reserve £20,328; 6 per cent. on the participating cum. pref. stock for the year absorbs £42,765; 3 per cent. dividend on the ordinary stock requires £39,788, and £86,428 is to be carried forward. The scheme of reduction and re-arrangement of capital has been approved and confirmed by the Court, and given effect to in the accounts. The shares and investments stand at £4,276,857, after deducting £1,001,692 by which amount the capital has been reduced. The revenue from the investments amounted to £222,330, representing an average yield of 5.19 per cent. for the year on the balance-sheet figure. The award of the arbitrator in regard to the sale of the tramway undertaking of the Devonport & District Tramways Co. to the Plymouth Corporation has been made, and it is estimated that this company will receive about £86,000 in respect of its holding in the Devonport Co. The company's main interests in the Metropolitan Traction and Electricity Supply Companies have been merged in the London and Suburban Traction Co., Ltd., in which the Underground Electric Railways Co. of London, Ltd., is also largely interested. The office of the London & Suburban Co., together with its subsidiary companies, have been transferred to Electric Railway House, Westminster. The direction and management of the Bombay Electric Supply & Tramways Co., Ltd., have been transferred to India in view of the heavy burden of double income-tax. The reserve has been reduced by £93,230, the amount applied in paying up in full a like amount of shares for distribution among the holders of the income certificates, in accordance with the scheme of arrangement. The reserve now stands at £410,000. Sir E. C. K. Ollivant has been elected a director. Annual meeting: June 23rd.

United River Plate Telephone Co., Ltd.

Sir G. Franklin presided at the annual meeting on May 30th. He said that during 1915, a whole year of war conditions, they had added 2,714 subscribers; they had now 56,582 stations, and the revenue continued, though slightly, to expand. The gross earnings increased by £10,930 to £641,581. The expenses fell by £7,536, and the net profit increased by £18,466 to £193,771. After referring to the accounts and to the reserves, the chairman alluded to the visit of the consulting engineer, Mr. F. Gill, of Gill & Cook, to the company's properties. His report generally confirmed the values appearing in the balance sheet, and justified in full measure the policy pursued by the directors and the company in the past in making the company strong. In this connection, they were specially indebted to Sir John Gavey, whose wise counsel and technical skill following upon his visits to the Argentine had been of the highest service to the company. Their trunk-line system giving connection to the Federal capital remained as at the beginning of last year, but they had again extended their lines in the Cordoba district by joining up the Belle Ville district to Villa Maria (38 miles), which town was connected to the city of Cordoba; and a short trunk line (25 miles) had also been built in the province of Buenos Aires connecting up the towns of Tapalque and General Alvear. The common battery boards mentioned last year for their exchanges at Flores, in the city of Buenos Aires, and at Lomas and La Plata (a few miles outside the capital) had been completed and, with the exception of the last-named, brought into service. Only two exchanges in Buenos Aires now remained to be converted into the central battery system, and for one (Belgrano) they had recently accepted a tender for the erection of the necessary building. The other (Barracas) would be dealt with in due course. The automatic installations at Rosario and Cordoba were giving excellent services, but the retention of temporary expert assistance so far necessary made true comparative costs of working for the present unobtainable. As to the current year, it was especially hazardous to forecast results in times such as these. The prospects of Argentine trade were such, however, as to lead them to hope for figures quite as favourable for 1916 as those they were now considering. Regarding the conditions prevailing in the great country upon which the prosperity of their enterprise depended, the paralysis of trade with the Argentine caused by the war was almost past. The difficulties of tonnage notwithstanding, there was every indication that Argentina would maintain its position during the current year. The improvement in the gold position at the end of 1915 showed a very strong position for the future of Argentine trade.

Mr. F. Gill, in referring to his visit to the Argentine, directed his remarks to three points—plant, service, and prospects. The plant had been well chosen, well constructed, and well taken care of. The kind of plant in use was very similar

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to that which was now being installed in this and other countries. The chairman had said that Buenos Aires itself was well equipped with modern exchange equipment in the shape of central batteries. A great deal of the capital was invested in underground ducts, underground cables, central battery equipment, and specially designed telephone buildings. All that made for stability. With regard to the service, he thought he might fairly and, perhaps, favourably, compare the service in the city of Buenos Aires itself with that of London, which was not by any means a bad one, and the trunk service was, he thought, a little faster than in this country. No telephone man, however, was ever satisfied with his service; but increasing attention was being given to this very important branch of the work here, and he was sure it was also being given in Buenos Aires, and the service would become still better. With regard to the future, their sphere of operations was the Federal capital, the city of Buenos Aires, the province of Buenos Aires, and Rosario and Cordoba. Buenos Aires itself had a population of about 1¼ millions—a large field in itself—and the province of Buenos Aires had a population of another two millions. That combined population was, roughly, about half the population of the whole country; the population was rapidly increasing prior to the war, though it had fallen off now. As the chairman had said, the trade of Buenos Aires during 1915 was good. During the 10 years between 1904 and 1913 the trade of the Argentine—imports and exports—doubled. For some time prior to 1914 there was a very heavy demand upon the company for telephone facilities, and, although that demand slackened during 1914 and 1915, he was quite sure that a heavy demand was coming on the company again for public service, and that there would be an ample field for a large increase in the company's sphere of operations.

Rangoon Electric Tramway and Supply Co., Ltd.

Sir F. Fryer presided at the annual meeting on June 7th. He said that the share capital remained unaltered. After providing for debenture interest, preference dividend, depreciation and reserves for renewals, there remained £8,094, which was almost identical with the balance available in the previous year. The recommended ordinary dividend was 3 per cent., free of income-tax, the same rate as last year. Twelve months of war in 1915 had caused a decrease in tramway and motor omnibus receipts of £2,800, as compared with 1914 with its five months of war. Under all the circumstances, there was ground for congratulation that the decrease had not been even larger. There had been great dislocation of trade in Rangoon consequent on the closing of certain markets and restrictions on others, and both imports and exports had been greatly reduced, consequently the Burmans had had less money to spend. During the current year the traffic, while keeping steady, did not so far show any marked tendency to improve over the 1915 figures. The experimental motor omnibus service had been continued. The best type of motor omnibus for the streets of Rangoon was still unsolved, and, owing to the fact that all motor factories in this country were engaged on munition work, fresh types of motor omnibuses could not be obtained. The difficulties caused by the frequent closing of the roadways in Rangoon for repairs had seriously interfered with the traffic. Coming to the brighter side of the picture, the gross receipts for current supplied in the private lighting and power department showed an increase of 13.77 per cent., against 11½ per cent. in the previous year. Notwithstanding the increased cost of coal and other stores, the working expenses were 41.64 per cent. of the receipts, as against 43.14 per cent. The public lighting negotiations had made a certain amount of progress, but they had not been able to bring matters to a conclusion. Their chief engineer and the engineer to the municipality would be in this country very shortly, when they hoped to be able to bring the proposed new arrangement between the municipality and the company much nearer to a settlement. The house wiring and supply department continued to be satisfactory; it fulfilled its purposes as a feeder for the supply of current, and continued to return a fair profit. The high cost of coal and of all the materials in the electrical business still continued, and signs were not wanting that the increase was likely to be even more acutely felt during the present year. They hoped that the 10 per cent. increase already made in the rates for current would prove in some measure sufficient to counteract the influence of the cost of materials. The serious rise in the price of copper and other metals pressed heavily. Notwithstanding the influence of the war, unmistakable signs of expansion of electrical supply requirements in Rangoon were observable. To meet the increasing public and private demand further capital expenditure would in all probability have to be incurred in the by no means distant future.

Singapore Electric Tramways, Ltd.

Sir Frank A. Swettenham presided at the annual meeting on June 6th. He said that the traffic receipts showed an increase of £2,340, and the sale of electrical energy £1,305, as compared with 1914. Power expenses fell by £1,600, due to the larger proportion of power generated by the Diesel plant. Traffic and general expenses were about the same as in 1914, but maintenance and repairs had risen by £500, owing to increased cost of materials. The passengers carried per car mile were 7.92, as against 7.43. The expenses of the whole undertaking represented 62.2 per cent. of the receipts, while the Singapore expenses were 59.5 per cent. of the Singapore revenue. These figures in 1914 were 56 per cent. and 54.3 per cent. respectively. In many instances stores were costing more than 100 per cent. above pre-war prices, and the tendency was always to go higher. The new fares came into operation in January, and down to the end of May the passenger receipts were up by 13 per cent., as compared with the same period in 1915, 3 per cent. higher than in 1914, and 7 per cent. higher than in 1913. There had been a large drop in the passengers carried, but the majority of the lost passengers would gradually return. In regard to the urgent question of track renewal to cost £103,000, it was now thought that the work might be extended over a period of eight years, commencing from this year. At the present time, however, it was practically impossible to obtain material, such as rails and other steel work, and the price of cement was too prohibitive. Apparently this state of things would continue until the end of the war, and they had no option but to postpone the commencement of the renewal. The estimate of cost had been drawn up at normal rates. The result of any lengthy delay in commencing the work must be increased cost of track and car maintenance. When the track could be renewed there would be an immediate reduction in these costs, such reduction increasing as the work proceeded, and it would be considerable. The three new Diesel engines had been running for some time. Two were supplying energy for lighting the Tanglin district for the Municipal Commissioners. The municipality had not completed their arrangements for taking the supply, but the delay was automatically extending the ten years' contract.

Lancashire Power Construction Co., Ltd.

In their report for the year ended March 31st, 1916, the directors state that the trading profit of the Lancashire Electric Power Co. for 1915 was £32,235, plus £607 interest on hire-purchase plant, &c., making £32,843 (as against £30,471 for 1914), plus £3,422 brought forward. Debenture interest absorbs £1,500, there is put to reserve £15,000, a dividend of 3 per cent. on the share capital requires £14,700, and £2,064 is carried forward. The following figures indicate the development of the company's business during three years:—

	1913.	1914.	1915.
Units generated	28,191,442	32,157,185	35,768,064
Maximum load in KW. ...	9,720	10,210	10,740
H.P. connected	23,900	27,018	29,000
Receipts	£54,515	£65,433	£72,395
Expenditure	£31,730	£35,472	£40,160
Profit on trading	£22,785	£29,961	£32,235

The revenue account of the Lancashire Power Construction Co., Ltd., shows that the total receipts for the year ended March, 1916, were £19,200, and, after deducting the expenditure of £15,258, the available balance is £3,942, which it is proposed to carry to reserve account. Annual meeting: June 22nd.

Montreal Light, Heat & Power Co., Ltd.—A dividend of 2½ per cent. on the paid-up capital stock, being at the rate of 10 per cent. per annum, is announced for the quarter ending July 31st.

Manila Electric Railroad & Lighting Corporation.—Dividend, 1¾ per cent. for the quarter ending June 30th on the common capital stock.

National Electric Supply Co., Ltd.—Interim dividend at the rate of 5 per cent. per annum (2s. 6d. per share) on the ordinary shares for the past half-year.

Shawinigan Water & Power Co., Ltd.—Dividend of 1¾ per cent., or at the rate of 7 per cent. per annum, for the quarter, to June 30th on the common shares.

Automatic Telephone Manufacturing Co., Ltd.—The preference share and transfer books will be closed from 17th to 24th inst. for the purpose of preparing the dividend warrants on the 6 per cent. preference shares for the past half-year.

STOCKS AND SHARES.

Tuesday Evening.

Conditions continue good, so far as Stock Exchange markets are concerned. The victorious advance of the Russian Army and the later details regarding the engagement in the North Sea have both tended to increase the confidence of investors that the end of the struggle may be nearer than anybody except the pacifists expected. At the same time, what was called "peace talk" has died down a good deal. Peace is not expected to come to-morrow or the next day, but that affairs on land and sea are tending in a direction which may make peace essential for the enemy before the winter is cautiously acknowledged.

The sales of American securities to the Treasury are releasing unexpectedly large sums of money; and those who failed to respond to the appeal on patriotic grounds are touched by their country's needs now that the Treasury proposes to lay an income-tax of 7s. in the £ upon the dividends drawn from various American investments. The Home Railway market has suddenly sprung into a condition of vigour, but the market for industrials is still the most active in the House.

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With Consols up 4 points since last we wrote, other gilt-edged stocks are naturally very strong. The demand for debenture and preferred issues is insistent. The difficulty is to find stock to supply it. One of the few reasonably-priced stocks left is Metropolitan 3½ per cent. debenture, obtainable at 68, with a half-year's dividend due in the middle of July. The company's "A" debenture stock can be bought a little cheaper, the interest dates being the same.

District 6 per cent. debenture stock is changing hands about 109, at which the yield is 5½ per cent. on the money, with interest due this week. Metropolitan 3½ per cent. preference is about 64, and London Electric 4 per cent. preference found a buyer early this month at 65½. Central London 4½ per cent. preference looks fairly tempting at 81, carrying, as it does, six months' dividend in the price, and the return, allowing for this, being 5¾ per cent.

The market for ordinary stocks of the Home Railway companies has risen substantially during the past few days. Metropolitans have put on 1½, and Underground Electric income bonds have hardened to 87½, the £10 shares rising to 36s. 3d. Amongst the Steam stocks, North-Eastern Consols spurted again, on the electrification of part of the goods lines; and the stock occupies the premier position, as regards price, of the active issues in this market—a position which, by the way, used to be held by London & North-Western ordinary.

The British Electric Traction Co. has lately issued its report for the year to March 31st last. It has been received with satisfaction in the market. The 5 per cent. perpetual debenture stock is quoted at 80, and the 4½ per cent. second debenture stock at 70, these prices being respectively 12 and 7½ points lower than the quotations for the securities on the eve of war.

In the electricity supply shares there is not a solitary change to quote this week. At the same time, it is worth noticing that instead of being a dull and depressed market, the position is now decidedly firm, and there is some difficulty in getting the offer of good shares. Cities are being dealt in about 12; and a few Counties changed hands the other day on the basis of 10½, the preference shares being 10½. London Electrics have been done lately at 26s., Metropolitans at 2 7/16, and Westminsters at 5¾. South Metropolitan ordinary are a good market at 16s. 3d., this price comparing with 10s. as the pre-war quotation on July 27th, 1914.

Somewhat a feature in the Kaffir market is the noticeable strength of Victoria Falls & Transvaal Power shares. The preference has risen to 18s., the ordinary to 7s. 10½d., while the 5½ per cent. second mortgage are up to 102—19 points above the price they commanded less than two years ago, and double the lowest figure which they touched since the outbreak of war. The debentures, of course, receive their dividend free of income-tax, which is a considerable attraction; and the bonds are full of interest at this price. The company is doing well, and the ordinary shares should now be within reasonable reach of a dividend.

Matters in Mexico are going badly, and the various hopeful points which appeared a couple of months ago are being extinguished one by one. Hopes of United States intervention are dimmed by the political situation, the approach of an American presidential election being sufficient to divert attention from more ordinary affairs. The prices of most Mexican securities are, therefore, leaning to the heavy side, though there is no quotable change in the bonds of the utility companies.

Canadian General Electrics spurted to 123 on buying which was said to come from New York, and the 7 per cent. preferred stock has hardened to 117. The principal item of interest in this market, however, is the organisation in Montreal of the Civic Investment Industrial Co., with an authorised capital of 75 million dollars, formed to take over the Montreal Light, Heat & Power and the Cedars Rapids Manufacturing & Power Companies, to operate both under an agreement for 98 years. The Montreal Co. is to be taken over on the basis of three shares of the new company for one of its own shares; while in the case of the Cedars Rapids, share for share will be given. Arrangements are made for such proprietors as do not care to exchange their stock, and the new company begins operation on August 1st. The price of Montreal capital stock is about 247, while Cedars Rapids stand at 85.

Brazilian Tractions keep good about 64, the rate of exchange remaining in their favour, while, at the same time, Brazilian issues of all kinds have come into sharp popularity by reason of the substantial change for the better which has occurred in Brazil.

The Telegraph list once more shows a number of important rises. Even West India and Panamas have participated in the general strength, improving 1s. to 1. China shares are ⅛ up at 14½. Eastern ordinary has risen 2 points, and Globe preference hardened to 10½. Both the Anglo-American Telegraph stocks have improved, and in those cases where no changes are shown the difficulty is to get hold of stock at anything like the prevailing levels. United River Plate Telephones are good at 6¾.

There has been further activity in Marconi shares, although the price shows no quotable change at 2 7/16. Expectation looks to a very flattering report, and we understand that the figures are likely to be out early next month. The strength of the parent shares has not had much effect upon those of the subsidiaries, although Marconi-Marines keep good at 31s. Canadians are a little better at 8s., and a bargain is recorded in Spanish and Generals at 6s. 3d.

In the manufacturing group, Callenders are another 10s. up, and Telegraph Constructions at 39 have gained an equal amount, while Henleys and India-Rubber shares are both ½ to the good. A fair volume of business is passing in British Westinghouse preference, the shares receiving a good deal of attention from Liverpool; the disappointment which was felt recently at the dividend of 7½ per cent., showing no increase over that of the previous year, is giving place to pleasurable anticipations in regard to the distribution for the current twelvemonth. Electric Constructions at 14s. 6d. are ex dividend. The iron and steel group remains very firm, and the chemical shares are also well maintained.

In the rubber share market, business is still quiet. The price of the raw material, at 2s. 7d. per lb., is a little better than it has been lately; and all the recent reports and dividends of the good companies have been so satisfactory as to confirm proprietors in keeping their shares. When the price of rubber takes a pronounced turn for the better, it is safe to prophesy that the share market will be quick to respond.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price June 13, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6½	—	£7 13 10
Charing Cross Ordinary	5	5	3⅝	—	7 3 13
do. do. do. 4½ Pref.	4½	4½	3½	—	6 18 6
Chelsea	5	4	2¾	—	6 3 1
City of London	9	8	12	—	6 13 4
do. do. 6 per cent. Pref.	6	6	10⅜	—	6 14 8
County of London	7	7	10½	—	6 13 7
do. 6 per cent. Pref.	6	6	10⅜	—	5 15 6
Kensington Ordinary	9	7	5	—	7 0 0
London Electric	4	3	1 7/16	—	7 11 0
do. do. 6 per cent. Pref.	6	6	4½	—	7 1 2
Metropolitan	3½	3	2⅜	—	6 6 4
do. 4½ per cent. Pref.	4½	4½	3	—	7 10 0
St. James' and Pall Mall	10	8	6¼	—	6 16 4
South London	5	5	2¾	—	8 13 10
South Metropolitan Pref.	7	7	1 7/8	—	8 14 0
Westminster Ordinary	9	7	5⅛	—	6 4 6
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	103	+ ½	£5 17 0
do. Def.	30/-	33/6	28	+ ½	7 10 9
Chile Telephone	8	8	6⅝	—	6 5 6
Cuba Sub. Ord.	6	5	7⅛	—	3 13 4
Eastern Extension	7	8	14½ xd	+ ⅛	£5 13 4
Eastern Tel. Ord.	7	8	144 xd	+2	£5 11 1
Globe Tel. and T. Ord.	6	7	12⅜	—	£5 13 0
do. Pref.	6	6	10⅛	+ ⅛	5 14 8
Great Northern Tel.	22	22	37	—	5 19 0
Indo-European	13	13	19	—	6 13 8
Marconi	10	—	2 7/16	—	4 2 0
New York Tel. 4½	4½	4½	102½	—	4 7 10
Oriental Telephone Ord.	10	10	11⅜	—	£5 8 1
United R. Plate Tel.	8	8	6¾ xd	—	£5 5 6
West India and Pan.	1	Nil	20/-	+ 1/-	3 6 1
Western Telegraph	7	8	14⅜	—	£5 9 4
Home Rails.					
Central London, Ord. Assented	4	4	71	+1	5 12 8
Metropolitan	1½	1	27	+1⅜	3 14 1
do. District	Nil	Nil	19⅞	+ ⅜	Nil
Underground Electric Ordinary	Nil	Nil	1⅛	+ ⅛	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	6	6	87½	+ ½	£6 17 2
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4½	—	6 6 4
Anglo-Arg. Trams, First Pref.	5½	5½	3⅞	+ 1/8	7 14 5
do. 2nd Pref.	5½	5½	3½	—	8 9 3
do. 5 Deb.	5	5	77½	—	6 8 7
Brazil Tractions	4	4	64	—	6 5 0
Bombay Electric Pref.	6	6	10⅜	—	5 15 6
British Columbia Elec. Rly. Pfce.	5	5	59	—	8 9 0
do. do. Preferred	—	Nil	40	—	Nil
do. do. Deferred	—	Nil	38	—	Nil
do. do. Deb.	4½	4½	62	—	6 17 1
Mexico Trams 5 per cent. Bonds	—	Nil	42	—	Nil
do. 6 per cent. Bonds	—	Nil	35	—	Nil
Mexican Light Common	Nil	Nil	20	—	Nil
do. Pref.	Nil	Nil	38	—	Nil
do. 1st Bonds	Nil	Nil	42	—	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	2⅜	—	8 9 1
British Aluminium Ord.	5	7	27/-	—6d.	5 3 5
British Insulated Ord.	15	17½	10½	—	7 2 10
British Westinghouse Pref.	7½	7½	46/-	+1/-	8 10 4
Callenders	15	20	12½ xd	+ ½	8 0 0
do. 5 Pref.	5	5	4½	—	5 17 8
Castner-Kellner	20	—	8 5/8 xd	—	5 16 2
Edison & Swan, £8 paid	Nil	—	10/-	—	Nil
do. do. fully paid	Nil	—	1⅛	—	Nil
do. do. 5 per cent. Deb.	5	5	57	—	8 15 9
Electric Construction	6	7½	14/6 xd	—	10 6 10
Gen. Elec. Pref.	6	6	9⅜	—	6 4 8
Henley	20	25	1⅝	—	8 6 8
do. ½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11⅛	+ ⅛	£8 13 10
Telegraph Con.	20	20	39	+ ½	£6 4 8

* Dividends paid free of income-tax.

W. T. Henley's Telegraph Works Co., Ltd.—In our table last week we showed the dividend in this case as being paid free of income-tax. This was a mistake, the company having ceased, a year or two ago, to pay dividends tax free.

Copper Prices.—The Week's Changes.

F. Smith & Co. report, Wednesday, June 14th:—Electrolytic bars, advance from £140 to £142; ditto sheets, £158 to £160; ditto rods, £147 to £149; ditto H.C. wire, 1s. 5½d. to 1s. 5¾d.

James & Shakespeare report, Thursday, June 15th:—Copper bars, sheet and rod (best selected) unaltered at £164.

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SOME "HYDRO" TROUBLES IN CANADA.

By "ROVER."

The engineer-in-charge of a steam-driven plant is sometimes given to cursing boilers, pumps and engines, and casts envious glances at his hydro-electric brother, who is never worried by bad coal or low vacuum. But the hydro-electric "operator" has his troubles (in Canada, at any rate), and spends much time in abusing the man who designed the plant, and the Canadian winter.

To begin with, Nature rarely plants a serviceable waterfall close to the place where power is needed, and, consequently, the power house is usually situated in the "bush," 20 or 30 miles from civilisation. The power-house men live in a little colony of from 20 to 40, and are mostly agreed that life at the end of a telephone wire is something worse than purgatory.

In some cases rivers have not been under observation long enough to determine the maximum and minimum flow of water, and plants have been installed "on spec.," with the result that during the dry season the gates to the water-wheels are wide open on half-load, or less. It occasionally happens, too, that the high water in spring bursts the dam, and in one case, at least, part of the power house was washed away by the flood.

Water wheels are generally controlled by oil-pressure governors, of which there are almost as many types as power houses. Most governors are belt-driven, and this is the weak spot. A water wheel may be running at full load day and night, and only shut down for an hour or two for inspection on Sunday, or in the mining districts it may run for two or three months without a stop. This is pretty severe on the belts and belt fastenings, and occasionally a breakage occurs and the gate flies wide open. The machine must be put on hand control immediately, and, in some cases, it is hard work for two men to bring the gate from wide open to the normal running position. This does not apply, of course, to governors fitted with electric motors controlled from the switchboard.

Some oil-pressure governors are so constituted that the belt is overworked if the generator switch is tripped at full load and works off the pulley, generally after giving warning with an agonising squeak. The usual remedy is to place a heavy bar or other obstacle to prevent the belt coming off. This does not prevent the squeak, of course, and does not improve the condition of the belt.

The breaking of a governor-belt on an exciter wheel is not so serious a matter, as the hand control gear can usually be attended to by one man. I have known of cases where the exciter governing gear was permanently out of action, and hand control was resorted to. Luckily this was close to the switchboard, but the attendant had to step lively whenever there was a short on the line.

At one power house I encountered a motor-driven exciter, driven off the main bus-bars. This arrangement worked admirably, except that a heavy short circuit sometimes shut us down completely, exciter and all, and we had to run up a small water-driven exciter to get a fresh start.

Shortage of water is sometimes accompanied by another trouble—sand. During low water, the water in the river bed or canal is moving much faster than at normal times, and brings a good deal of sand with it. As a rule, this sand passes through the water-wheels without causing any trouble, but occasionally a sandbank will form in the exciter-wheel passages or other places where the current is slowest. Fallen leaves, sticks, and chips from lumber camps, will accumulate on the racks, but these only come at their accustomed times, and are easily discovered and removed.

During the long Canadian winter, the river or canal flows under ice perhaps 2 ft. in thickness, except at the fore bay and tail race, where the quick motion of the water prevents any ice forming. If the level of the water remains fairly constant, the ice slowly forms during the winter and slowly melts when spring comes without affecting the power plant in any way. But if the water level should vary to the extent of 2 or 3 ft., then large pieces of ice are apt to break away and float on to the racks. The motion of the water causes them to "up-end," and sometimes the opening to one or more machines is completely blocked. I well remember my first experience of ice in mid-winter, with low water, and the plant carrying about half its rated load. Another power plant, situated about three miles down the river, had 'phoned an urgent call for more water, and we opened our waste gate to oblige them, bringing down our level about 2 ft. In half-an-hour we saw big ice-floes bearing down upon the power house, and these were carefully guided to the waste gate. All available help was pressed into service to break up the floes and pass them through the gate, but one big piece quickly settled matters for us by wedging itself and completely blocking up the gate. The remaining floes then arranged themselves on the racks and shut down the three machines we had running. It took about half-an-hour to clear the racks and waste gate, and supply was resumed.

Five minutes after the fresh start our state was worse than before. The shut-down had raised the water-level about 3 ft. and a veritable field of ice broke off and floated down on us. We had two more shut-downs that day, the worst one lasting about an hour and a half. Thereafter, extra "booms" were built across the canal, and the water level was kept as constant as possible. We found that a large piece of floating ice is no respecter of booms, and will dive 3 ft. below the surface when on mischief bent, but by extreme vigilance it is possible to guide it into the least dangerous channels, and after a little experience one gets the knack of breaking up an ice-floe very quickly.

Another trouble, of rather an exciting nature, occurred at a hydro plant in Ontario. This plant works with about 120 ft. head of water, and is fed through 8-ft. iron penstocks, about 800 ft. long. Parts of the penstock were on a very inadequate foundation, owing to the sandy nature of the soil and the extreme difficulty in getting down to bed-rock. About 2 o'clock on a February morning the operator on duty was surprised to find a small stream of water trickling under the front door into the power house. The temperature outside was nearly 50° below zero, and the operator, wishing to study this unnatural phenomenon further, incautiously opened the door, and was swept off his feet by the flood which burst into the power house. He tried to close the door again, but the force of water was too much for him, even with the assistance of his oiler. By this time there was a foot of water on the power-house floor, and operator and oiler were obliged to escape by the back door. Here the noise convinced them the penstock had burst, and the two rushed to the top of the hill, and succeeded in closing the valve—a task which ordinarily took two men half-an-hour, but was accomplished in record time on this occasion.

Coming back, they found it was impossible to enter the power house, and when daylight came the floor was still covered to the depth of 2 ft., upon which a crust of ice had already formed. It eventually froze solid, and was removed by hammer and clink. The penstock was rebuilt, and placed on safer foundations, and electric motors were installed on the pipe-line valves, all of them being controlled from the power house.

Severe lightning storms are another bugbear of the Canadian operator, and in the forest districts "bush fires" occasionally burn down the transmission line, but these troubles affect steam-driven plants also, and are not peculiar to a hydro-electric system.

Flies, again, are a nuisance, chiefly to the operators, who get bitten all over. Occasionally they get into the bearings in such numbers as to close up an oil-pipe and cause a hot box; in one instance I know of, bearings had to be protected with muslin on this account. There are legends, too, of big butterflies and moths tripping the oil switches, but I have been unable to verify these tales. I have, however, known big bats to blunder stupidly into the switchboard when in pursuit of flies and other insects.

Aluminium in Norway.—A large plant for the production of aluminium is contemplated at Höyanfjord, Norway, where hydroelectric power is available to the extent of about 60,000 H.P. It is proposed to develop 20,000 H P. at once to furnish power for the production of 4,000 tons of aluminium per year.

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LABOUR AND INDUSTRY.

(*Continued from page* 660.)

It would not be right to shut our eyes to the effect upon the mind of the general public of the invigorating campaign of the Ministry of Munitions in regard to Trade Union restrictions, slacking, drink, and so forth. Generally speaking, the effect upon the minds and activities of the workers has been very healthy. But this campaign and this effect have been the work of war-time when we have been fighting for our very existence. One consequence of the high wages in the shipyards, noted by a *Times* correspondent a month or two ago, was a "fastening" upon certain workers of the pre-war habit of absenting themselves early in the week. The artificial prosperity of war-time has not in such cases gone into War-Saving Certificates; restricted hours of licensed houses do not prevent home supplies of liquor being laid in, and the Saint Monday habit, which always has affected industry more or less, has been strengthened. Will the "fastened" habit be easily uprooted after the war? We shall be told that these are exceptional cases—that the great bulk of the working men of England are steady, sober, and reliable. We are not in a position to dispute it, but practical experience has shown a thousand times that a small percentage of slackers can hold up thousands of willing workers. Can the workers be induced to see that many things that have been said in regard to winning the military and naval victory will be applicable with almost equal truth and force when we fight industrially and commercially to prevent the enemy from gaining supremacy. The "boys" will not be at the Front then making their own appeal to us to strain every nerve; the public-houses may be open for normal hours again; and there will be a desire for relaxation or taking things easily after a long period of strain. Peace will be the signal for a more or less prolonged cessation—we shall all need a rest; but when that period is over, and demobilisation, with all its re-adjustments and re-transfers, is complete, there will be no room for anybody to idle, for it is becoming pretty generally recognised that we have got to increase the productivity of our industries by every means in our possession, in order to raise our general standard of efficiency, securing more economical production without reducing quality. We shall require all the scientific assistance at our command, shall have to employ machinery for many things that have been extravagantly made without it, and the fullest co-operation of Labour is required to secure the best possible results from these developments. Will Labour be blind to its responsibility, or fail to respond to the call of duty?

Far more frequently than we like to think, it has been necessary to appeal to the workers in certain trades to cease slacking, or to accelerate the rate of production of war requirements. Notwithstanding higher wages and the promises that Trade Unionism would not be adversely affected after the war by the suspension of its conditions during hostilities, the spirit of the old Adam has exhibited itself again and again. At one stage it was complained that Labour was not enlightened as to the real urgency of the munitions question, that the truth had been withheld or concealed, that the real peril of the men at the Front was not understood. It fell to the Minister of Munitions, and others acting with him, to make the matter plain. The deficiencies of Labour must have been a revelation, almost a shock, to those who previously preferred not to recognise the existence of those weaknesses which in times of normal trade had so often embarrassed industrial concerns, but who were now alive to the peril which faced the nation. The lessons of these critical times will not be lost upon the minds of legislators and social reformers, whatever may be the effect upon the workers. Even at this moment the postponement of the Whitsuntide holiday is proving the extreme importance and urgency of everybody continuing to produce to the utmost of his or her capacity the things that are essential to enable the fighting Forces to hasten the defeat of the Enemy. No body of workers can complain to-day that they do not know, for our losses on the sea and on our 80 miles of Front in France and Flanders, and in the other centres of war where we are still engaged, are making a more urgent appeal than any platform orator can pour forth. Is not the iron entering the very soul of the people to-day? Letters sent Home by "boys" at the Front, wounded and others returning from the field of battle, all make their own appeal, not merely that we shall "keep the Home fires burning," but keep the motors running in the factory producing—producing as hard as we can go. Yet it is thought necessary to supplement all these invigorating agencies by means of literature, and in this connection we have received from a firm of publishers a copy of a special edition of a book, "Between the Lines," by Boyd Cable, which, after a successful run as a 5s. work, has now been produced in a paper-cover form, 75,000 copies being run off for free distribution in order that it may be read by munition workers. Its object is to give such workers, if they will read it, a glimpse of the trenches, and especially of what any shortage of munitions means there. When we talk of an "Advance!" of a coming "Push Forward," these truths require to be kept constantly in mind; and we hope that the generous effort of the publishers (Messrs. Smith, Elder and Co.), and of the author, will have the desired effect of convincingly bringing home to the right minds the fact "that the fighters count on the workers to help them to victory, to watch the fight closely round by round, to stand solid behind them, and back them and support them, and give every possible ounce of assistance to see it through."

Mr. Frederick Maddison, addressing the Labour Co-Partnership Association, in London, in April, said that nothing could have been more unfortunate than the false impression given by the Minister of Munitions of the general response of the workmen of this country to war demands. They had sacrificed advantages and positions which had taken generations to build up, and had the great mass of Trade Unionists adhered to those conditions, no power in this country could have compelled them to give them up. Mr. Maddison advisedly said "in this country," because he knew that if Trade Unionists had played the traitor, the enemy, once admitted here, would have played havoc with Trade Union restrictions, indeed with all the principles of Trade Unionism. It is sometimes said by Labour that the Military Service Act was aimed at Trade Unionism. We do not, for a moment believe anything of the kind, but this we know, and Labour knows equally well, that Trade Unionism and Prussian Militarism could not co-exist. Mr. Maddison said that the great mass loyally, heartily, and voluntarily suspended the conditions because of patriotic considerations, and because they felt that it was necessary. The deplorable friction in certain quarters was only due to a very small section. Unfortunately, it is often a small section that causes industrial strife in times of peace; but how do the Union leaders and members deal with the "small section" in normal times? Mr. Maddison said that there must be the recognition of the dignity of craftsmanship. "Men must not come back simply to become pieces of the mechanism of Capitalism. They were entitled to be industrial freemen, and capitalists must be content with more modest profits. Trade Unionists must not be content with merely forcing up wages by might, and must know that the industrial problem would not be settled by the winning of a strike." The other day another public speaker said that when the war broke out we were heading "straight for revolution" at home. The outlook in industry certainly was the blackest that we had known it—there was industrial strife everywhere. Our differences were temporarily set aside. Another public speaker—a social reformer in the East End of London—who paid a tribute to the readiness with which thousands of restive hooligans and others, brought up amid undesirable surroundings, sprang to the help of the country at the outbreak of war, remarked that when these men returned they would want to find a country worth fighting for; he sometimes wondered "what England had done for them"! And this after years of Democratic legislation!

What do such remarks as these portend? Will the men not say that they have saved the Empire and that a larger share in the fruits of Empire belongs to them? They will demand that Capital takes less and Labour has more; but capital in the form of State loans now earns a higher yield, and industry may not possess the same attractions as

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formerly, unless its security is assured. It is industry which must be made more profitable so as to yield a better return for all. How is this to be secured but with the full co-operation of all?

Australia is sometimes spoken of as though it were the very Elysium of Labour, but it must not be imagined that in the Dominion there is freedom from Labour troubles. Strikes are not by any means uncommon, not a few have been recorded during the war; indeed, we believe that the present methods employed there for settling differences between Capital and Labour are considered by some students of the position to be utterly futile. They have not removed the root-causes of the troubles; they have merely devised ways for dealing with them after they have arisen—practically giving recognition to the fact that in the best of all worlds, under the prevailing system, human nature will at times come into conflict. We have received from Melbourne a copy of a book, by Mr. F. Gascoyne Williams, on "Industrial Peace; the Way to Secure Industrial Efficiency, Unity, and National Prosperity." The author holds that the industrial warfare and troublous times ahead are too serious and acute to be treated with indifference. In his opinion, as in that of many other people, the first and great essential is to bring Capital and Labour together. Having long studied the principles of co-partnership and profit-sharing, he says that in building up and developing the huge Continent of Australia it must be recognised that this will be found impossible if there is to be incessant industrial strife. We all recognise that the same remark applies to the case of the future development of British industries at Home. Mr. Williams's observation shows him that, under the profit-sharing system, strikes are rarely known, due to the fact that Labour settles down contentedly when, in addition to the standard wage, it participates in profits. He holds that in Australia other means than Wages Boards, Factory Acts, and Arbitration Courts should be tried, for these methods of conciliation have been operating since 1897 with anything but satisfactory results. "They are supposed to do away with strikes, but, so far, have proved ineffective, and act merely as a temporary expedient." The Arbitration Court is "staggering under its burden"; in October, 1914, its work was two years in arrear; and its awards are being continually flouted. The writer feels that employers generally have failed to note the evolution of Labour during the past 50 years, and are apt to forget that education has taught the workman to appreciate his position as an important factor in the Industrial World, and that he wants to enjoy more of the comforts of life. Labour and Capital are interdependent, and, apart from both of them, management is unemployed. "Profit is produced by the three factors—it should, in consequence, be shared by all three." Mr. Williams concludes one of his chapters by proving that the goals of co-partnership and Trade Unionism cannot be regarded as incompatible. In the next he discusses profit-sharing from the employers' point of view; and in another he illustrates, by British examples of, and chronological notes on, co-partnership and profit-sharing between the years 1895 and 1914, how these means of producing contented Labour and prosperous industry have been successfully practised. The conclusion of the whole matter is that in profit-sharing and co-partnership is to be found the only present method whereby master and man can work together in harmony: "a wise and equitable bond of union between the three great forces in industrial activities—Capital, Management, and Labour." This aspect of the industrial problem has often been discussed in our pages; the principle of co-partnership has sometimes failed ignominiously because of the manner of its application and the suspicion that it was a means to defeat Trade Unionism; but it will doubtless be discussed more and more as we get to grips with the after-the-war Labour problem. Therefore, it may not be out of place to give Mr. Williams's opinions of the essentials of profit-sharing and co-partnership:—

1. It must not degenerate into charity or philanthropy.
2. Its object must be the increased success of the undertaking, with increased prosperity for all connected with it.
3. It must not place Management in the position of servant to Labour through liability to criticism and censure.
4. It must ensure to Labour freedom from control of Management in the enjoyment of the benefits derived from Profit-sharing.
5. Its benefits must be felt by wives and children.
6. It must have a distinctly elevating tendency on Management and Labour, raising them in the social and intellectual scale, and increasing their power for enjoyment and happiness as well as their power of usefulness.
7. Control must remain with those who find the Capital.

(*To be continued.*)

THE ELECTRICAL TESTING OF STEEL CONDUCTOR RAILS.

By C. H. RIDSDALE, F.I.C., F.C.S.

(*Abstract of paper read before the* West of Scotland Iron and Steel Institute.)

Steel is a relatively cheap and plentiful conductor, for when copper costs, say, twelve times as much per ton as steel, a steel rail of such section as would convey an equal current with no more resistance would only cost about one-half as much as the copper.

For many years, when resistance was specified in terms of copper, the "times copper" was always of "equal volume," meaning equal length and cross-sectional area.

Of some 12 railways, one referred the resistance in microhms to that of a stated volume of copper; one gave it in terms of ohms per mile for a stated cross-sectional area; two were for conductivity percentage of copper of equal volume; the rest were for resistance in "times copper" of equal volume; but not one specified resistance in times copper of equal weight.

Within the last few years the term "mass resistivity" began to be met with in reports, and as the ordinary dictionary meaning of the word "mass" does not clearly indicate weight, as contradistinct to volume, and resistance had not been formerly specified in times copper of equal weight, misunderstandings arose. A steel rail of the same weight as a copper one would have about 1.125 times the cross-sectional area of the latter, or of a steel rail of equal volume to the

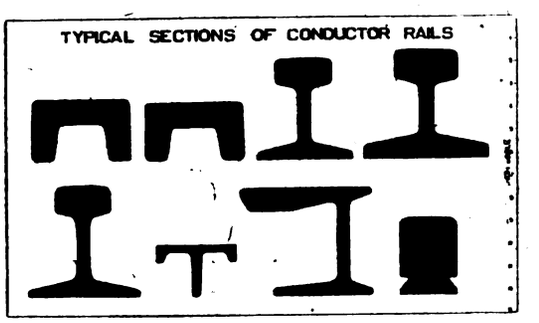

Fig. 1.

copper one; and as resistance varies inversely as the area, a resistance of, say, seven times copper of equal volume is only about 6.17 times copper of equal weight, and the resistance of steel expressed in terms of weight at first sight gives the impression that it has a lower resistance than if expressed in terms of volume. Thus certain makes of steel, tests of which were given in terms of weight described as "mass resistivity," appeared to be better than they really were, and engineers sometimes specified (meaning of equal weight) what appeared to be extremely low resistances (if taken to mean of equal volume), and when they were told these were impracticable, contended that they really got them.

Matters were still further complicated by several slightly differing copper standards being in use, and questions sometimes arose as to the density of conductor steel, the temperature at which the terms of resistance were stated—some being at 15.6 deg. C. and others at 20 deg. C., this alone making about 1¾ per cent. difference—and other points.

In 1913 the author and his son issued a number of tables describing the electrical properties of steel, and the Engineering Standards Committee, which also had recognised the difficulties arising from the want of uniformity in terms, appointed a conference to prepare a report on the subject of a conductor rail standard; the Committee adopted some of the author's suggestions in its "Report on the British Standard method of specifying the Resistance of Steel Conductor Rails," published in 1914 (Report No. 68). In this report it recommended as a standard mode of expression resistance in "microhms per 100-lb. yard of the steel being tested," and also gave various conversion factors for other modes of expression.

Although this introduced yet another standard, differing

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from any of those which had previously been in use, it must be admitted that one universal standard if adopted will be a great advantage.

Pure iron has a resistance about 5.81 times that of copper of equal volume.

Steel for conductivity purposes is, or should be, the softest class of steel made; it has a higher density than other ordinary forms of steel, and also very little segregation. Speaking broadly, the more nearly it approaches in chemical composition to pure iron, the better it is in conductivity.

Sometimes a chemical composition is specified for it, but this, whilst it may tie the maker's hands, can serve no useful purpose for the ultimate object in view, namely, getting in the best manner a steel to satisfy electrical requirements. Conductivity steel is simply the "blown" or "bath" metal (purified by oxidation) with the smallest quantity of deoxidiser or "recarburiser" added that will just enable it to roll. Thus it is metal only just removed from "redshortness."

In the endeavour to keep the steel very soft and low in resistance, makers have to work within such a narrow margin that from time to time they overstep the line, and the steel breaks up in the rolls and yields scrap or defectives. When not so pronounced as this, in steel near the limit, parts of the section which grow cold sooner than the rest are liable to show a number of fine hair cracks close together when they drop to low red, although it will roll quite sound at a bright red heat.

Slight cracks due to redshortness, as, for instance, fine "saw edges" along flanges or corners, such as if present in ordinary track rails (which have to carry heavy running weight) would certainly disqualify them, are no disadvantage for the purpose of a conductor rail which has no weight to carry. Indeed, they should be regarded with favour, as they are an indication that the rails have a very low resistance.

In view of its special suitability for very soft qualities, one of the earliest applications of basic-bessemer steel was for conductivity purposes, and so far back as 1883 or 1884 the North-Eastern Steel Co., of Middlesbrough, made it for telegraph wire, and has continued to make it ever since, mainly for conductor rails.

Although the number of rails which, according to specification, are taken for testing may be only a small percentage, whereas with ordinary track and tram-rails once they are down the manufacturer is not likely to have trouble from them, conductivity rails are liable to be tested as a whole.

Steel wire makers state that its conductivity is not affected by the temperature at which it is rolled or drawn, or the number of holes required to bring it to a given gauge. This corresponds with my own experience on steel in the mass, for this, say in the form of billets 4 in. square, tested in 5-ft. lengths, corresponds quite closely with tests of the wire after it has gone through the various necessary processes.

Rails in the early days were specified to be tested on 20-ft. lengths; a 5-ft. length gives just as accurate results, and this length is now generally accepted. This involves, with what is required for connections, a total length of 8 or 9 ft., say 2 to 2¼ cwt.

The apparatus designed by Messrs. Elliott Bros., of Lewisham, was probably the first for testing conductor rails; both the system of testing and the apparatus have been approved without question by engineers and contractors (see fig. 2).

The testing apparatus on the drop of potential system consists of two or more accumulators, each having 120 ampere-hours capacity, and coupled two in series, and a switchboard for coupling either the charging current to them, or them to the cables leading to the rail being tested, which are connected with an ammeter registering up to 200 amperes.

These cables go first to a reversing switch, from which one branch goes direct to the rail, the other through three or four resistances, enabling, say, 40, 60, 80 or 100 amperes to be taken to the rail, as required.

These cables are each branched for a couple of feet at the end, and terminate in flat copper blocks for clamping against the head and foot of the rail with screw-clamps. Two knife edges, ground sharp and case-hardened, are mounted on large baulks of timber, from which they are insulated by mica sheet. They have under their centre a horizontal bolt so as to allow a slight rocking lengthways. The knife edges should be parallel and exactly 5 ft. apart.

At each end of these knife edges, and in line and level with them, but with an intervening gap of about 1 in. at each end, are carrier rails on which the lengths of rail to be tested can be stacked. The knife edges are each connected to a small cable leading to one terminal of a double-scale millivoltmeter with zero in the centre, and graduated in tenths up to 12 millivolts on each side.

As each length of rail to be tested is pulled forward on to the knife edges, the sliding motion cuts into its under surface and thus makes a good electrical contact. To facilitate this 4 or 5 in. of the under surface of the rail generally are filed bright just previous to testing, and the rail is pulled a few inches backward and forward several times on the knife edges. The rocking-knife arrangement was introduced by the author because rigid knife edges will not adjust themselves to any slight twist which the pieces may have.

The cables are then clamped to each end, and the current can be turned on. The amount passing is read off from the ammeter, as well as, instantly before or afterwards, the millivolts difference in potential due to the resistance of the length of rail between the knife edges.

For 80 to 100-lb. rails, 60 to 80 amperes is the most satisfactory current. If two or three successive tests of the same piece are made, especially with a large current, it becomes heated appreciably and its resistance increases.

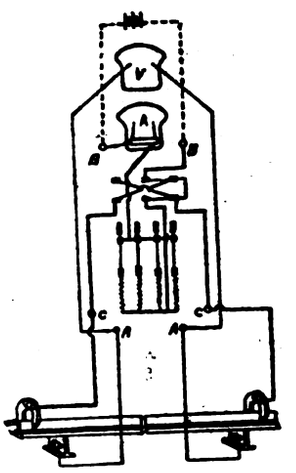
Immediately after taking these readings the current is reversed and a second set of readings is taken. These two tests are often repeated as a further check, giving four sets of readings. From the average of these the resistance is obtained.

The temperature of the rail should be taken, both at the beginning of the test and, if this lasts long, also at its end. A correction may be necessary both for the rail and for the millivoltmeter. The corrections generally specified are 0.5 per cent. per deg. C. for steel, and 0.4 per cent. per deg. C. for copper.

Testing can be done very quickly, and provided the pieces have been filed up just before starting, and the men are accustomed to the work, the calculation for each rail can be done whilst the next is being pulled on, rubbed, and coupled up; 50 or 60 tests can be made in from one and a half to two hours.

If, as may happen, particularly with crop-ends, any of the pieces tested are not of quite true area, a correction for this can easily be made.

In order to avoid misleading results, the insulation of the knife edges, especially in wet weather, should be verified. If one end of the bar being tested be moved so that it rests on the carrier rail (thus completely earthing it), when the current is turned on, although the ammeter will, of course, show it,



A, ammeter; V, voltmeter; A A, pressure terminals; B B, battery terminals; C C, current terminals.

FIG. 2.—ELLIOTT BROS.' RAIL-TESTING APPARATUS.

the millivoltmeter will not move; though if the insulation were bad some current would leak through to the knife edges and indicate it.

To enable the instruments to be readily checked at any time, the author introduced standard copper bars of such cross-sectional area that their resistance falls within the usual range of conductor rails. Such bars once tested and certified by authorities of standing are always available as a check on the whole installation. For convenience, the standard copper bars are mounted on wood. All that is necessary is to put them on the knife edges just as is done with a rail, with—in order to give the necessary weight—a rail laid on the wood backing, and test them, and if they come within a reasonable margin, say 1 per cent., the testing apparatus can be regarded as right.

As regards the minimum distance at each end of the rail at which the contact pieces of the cables should be clamped from the knife edges, although diffusion of the current is very rapid and good tests have been obtained with as little as 3 in., it is better for safety to allow at least 6 in. or more, besides room for handling, clear of the clamps, say 18 in. or 2 ft. overhang altogether at each end.

The effect of variations of thermal and mechanical treatment such as are met with in normal works practice upon the resistance of conductor rails seems to be negligible.

As regards the effect of different impurities on conductivity, taking it very broadly, the relative effects in increasing resistance are, per 0.01 per cent. of the substance present in excess of that in ordinary conductivity steel:—

Carbon from	.05 to .07	"times copper."
Manganese	.05 to .07	,,
Silicon	.08 to .10	,,
Phosphorus	.02 to .03	,,
Sulphur	.01 to .02	,,

The higher value should be taken when within the ordinary limits of composition for conductivity steel, say, not over carbon 10 per cent. or manganese .40 per cent., and the lower value when above this. Too much importance must not, however, be attached to these figures.

As illustrating the effect of composition, the following are

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some actual tests, showing side by side the theoretical resistance calculated on the basis and from the factors given.

Kind of Steel.	Composition.						Resistance at 20° C. of equal area, Times copper.	
	Carbon.	Silicon.	Sulphur.	Phosphorus.	Manganese.	Iron, &c. Difference.		
	%	%	%	%	%	%	By test.	Calculated.
Conductivity steel ...	0·04	nil	0·01	0·06	0·40	99·44	6·87	*
Ordinary soft steel ...	0·08	nil	0·06	0·062	0·49	99·302	7·72	7·73
Medium hard steel ...	0·24	0·02	0·06	0·05	0·45	99·18	8·58	8·43
Hard steel	0·402	0·02	0·08	0·072	0·92	98·488	11·57	11·67
„ (high silicon) ...	0·46	0·33	0·07	0·07	0·72	98·354	13·07	13·07
„ (low manganese)	0·48	0·06	0·04	0·04	0·36	99·02	9·54	9·31

* Taken as basis.

A rail of eight times the resistance of copper and another of six yield the same resistance as two of seven, and specifications therefore allow a proportion of rails with a maximum above the average specified.

At the same meeting a description of the method adopted by the National Physical Laboratory for the determination of the conductivity of steel rails was given by Mr. S. W. Melsom :—

The sample tested should be of sufficient length to admit of the current being led in at some distance from the contact points (knife edges). If, as is convenient, the distance between the knife edges is 1 yd., a suitable length for the sample would be 5 or 6 ft.

The sample is weighed, its total length measured, and the weight in lb. per yard computed. A hole in which the bulb of a thermometer can be placed may also be drilled to enable the temperature to be more accurately determined.

For the electrical measurement the rail is connected in series with a suitable resistance standard, the value of which is unaffected by temperature. The current is usually of the order of 100 amperes, depending somewhat on the section of the rail.

The contact knife edge and the potential terminals of the resistance standard are connected to the double bridge as shown in the diagram (fig. 3). The double bridge is of the type invented by Lord Kelvin, and is now universally used in the accurate determination of low resistances. It consists of four resistances, two of which, P and p, are equal and usually 100 ohms; the other two, Q and q, are variable over a suitable range of values. The effect of having $Q = q$ and $P = p$ is that the resistance of the connecting piece k is eliminated. Q and q can be simultaneously varied by adjustment of a series of dials This is done until on making the galvanometer circuit there is no deflection. The value of $Q = q$ is read off, and this divided by $P = p$ and multiplied by the value of the resistance standard gives the resistance of the sample under test, which is independent of the value of the current used. This completes the electrical measurement.

For the purpose of comparison the result has to be expressed in terms of some standard. This may be (1) the resistance in microhms of a rail of the same material weighing 100 lb. to the yard length measured at 60 deg. F., as defined by the E.S.C. If the weight of the sample is different from 100 lb. to the yard and the temperature other than 60 deg. F., the

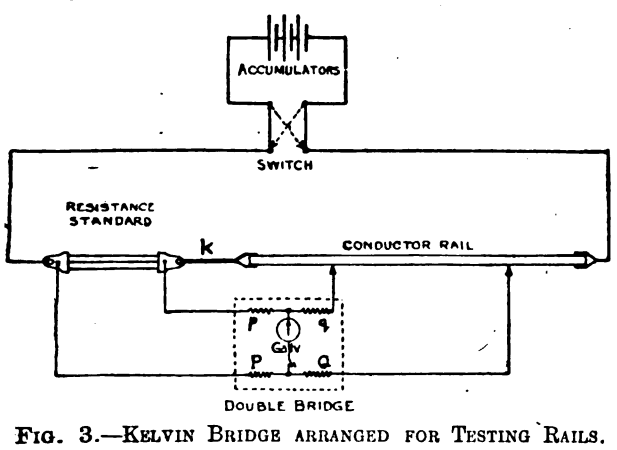

FIG. 3.—KELVIN BRIDGE ARRANGED FOR TESTING RAILS.

resistance value obtained multiplied by the appropriate reduction factor as given in the Tables of Report No. 68 will express the result in terms of this standard.

(2) To express the result in terms of the volume or mass copper resistivity this result is further to be multiplied by 0.360 to convert it into relative mass resistivity, or 0.408 to convert it into relative volume resistivity.

(3) To express the result in terms of the volume or mass copper conductivity standards the result in microhms per 100 lb. yard is to be divided into 277.8 to convert it into relative mass conductivity, or 245 to convert it into relative volume conductivity.

These correction factors are taken from the E.S.C. Specification, which also gives reduction factors so that the value may be reduced to other standard terms.

In some instances, where it is required to compare only such samples as rails of definite weight and length, it is possible that a simple bridge, which I designed some years ago for use in the laboratory, would be preferable. For instance, where a steel maker or user required to test samples of a large batch of rails, if the standard R, as shown in fig. 4, were adjusted to be the specified resistance for a given length of the rail a double dial operated by a single handle, having two sets of 20 studs and varying only a given proportion of the bridge arms, would give the value directly in steps of 1 per cent. from 10 per cent. high to 10 per cent. low.

For a bridge of this sort a reflecting galvanometer is not essential, a portable needle instrument such as is used in steel works for thermo-couple work being amply sensitive for the purpose.

Instead of a copper standard it would be much better to use a standard resistance such as an ammeter shunt, which does not vary appreciably with temperature.

In this question of the development of the use of conductivity steel, it is most important that all concerned should use the same standard. The greatest difficulty in comparing

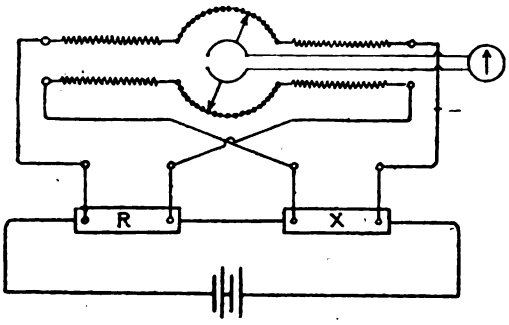

FIG. 4.—MELSOM BRIDGE FOR TESTING RAILS.

two metals is to know whether the comparison is being made in terms of equal volume or equal mass, the results owing to the difference in density between copper and steel being about 10 per cent. different.

In this measurement of steel conductor rails, results which have to be used by electrical people should be stated in terms of the recognised electrical unit. The introduction of the copper standard merely introduces additional calculation, and does not in any way help matters. The engineer who is to use the results is concerned mainly with the loss of energy in his rails. To determine this he has to know the resistance of his line in ohms. At the conference called by the Engineering Standards Committee in 1914, the engineers were unanimously in favour of dropping the reference to copper and of stating the value of the resistance in ohms or microhms.

Steel rails are bought and sold by the ton, and are usually classed by their weight, as, say, 80 lb. per yard, and not by their area. From a testing point of view the comparison of equal mass is made much more easily and accurately than a comparison of equal volume.

The use of several standards, as at present, leaves so much ground for mistakes that I would press most strongly that all concerned should use the method defined by the Engineering Standards Committee's specification, which states the resistance in microhms at a temperature of 60 deg. F. of a rail of the same material as the conductor rail in question, having a length of 1 yd. and a weight of 100 lb.

TRADE STATISTICS OF NEW ZEALAND.

THE following figures, showing the imports of electrical and allied goods into New Zealand in 1914, are taken from the official statistics which have just reached this country. The issue of the statistics has been delayed by alterations in the classification. The figures for the previous year are added and increases or decreases noted. In comparing the 1914 figures with those for 1913 it should be understood that the countries to which the goods were credited in the latter year were not in every case the countries of manufacture, but merely those from which the goods were invoiced. In 1914, however, the country named is to be understood as the country of origin.

	1913.	1914.	Inc. or dec.
Leather belting.—	£	£	£
From United Kingdom ...	3,000	4,000	+ 1,000
„ Other countries ...	2,000	2,000*	—
Total	5,000	6,000	+ 1,000
Belting other than leather.—			
From United Kingdom ...	35,000	27,000	− 8,000
„ Australia	2,000	1,000	− 1,000
„ United States ...	3,000	3,000	—
„ Other countries ...	—	1,000	+ 1,000
Total	40,000	32,000	− 8,000

* United States £1,000.

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	1913. £	1914. £	Inc. or dec. £
Engine packing.—			
From United Kingdom ...	13,000	11,000 –	2,000
,, Australia	2,000	1,000 –	1,000
,, Other countries ...	5,000	6,000* +	1,000
Total	20,000	18,000 –	2,000
* United States £4,000.			
Scientific instruments.—			
From United Kingdom ...	7,000	5,000 –	2,000
,, Germany	1,600	1,400 –	200
,, Other countries ...	2,400	2,600* +	200
Total	11,000	9,000 –	2,000
* Includes United States £1,000.			
Rails.—			
From United Kingdom ...	191,000	106,000 –	85,000
,, Other countries ...	7,000*	5,000† –	2,000
Total	198,000	111,000 –	87,000
* Includes Australia £3,000.			
† Includes United States £4,000.			
Telegraph and telephone wire, iron.—			
From United Kingdom ...	11,000	5,000 –	6,000
Electrical machinery, &c.—			
From United Kingdom ...	307,000		—
,, Australia	29,000		—
,, Germany	24,000	(See	—
,, United States ...	71,000	below.)	—
,, Belgium	5,000		—
,, Other countries ...	39,000		—
Total	475,000	—	—
Generators, motors, and transformers.—			
From United Kingdom ...		55,000	—
,, France		1,000	—
,, Germany	(See	5,000	—
,, United States ...	above.)	23,000	—
,, Other countries ...		2,000	—
Total	—	86,000	—
Electric batteries and cells.—			
From United Kingdom ...	Not	4,000	—
,, United States ...	shown	2,000	—
,, Other countries ...	separately.	1,000	—
Total	—	7,000	—
Carbons and insulating material.—			
From United Kingdom ...		6,000	—
,, Australia	Not	4,000	—
,, Germany	shown	2,000	—
,, Other countries ...	separately.	1,000	—
Total	—	13,000	—
Other electrical material.—			
From United Kingdom ...		65,000	—
,, Germany	Not	7,000	—
,, United States ...	shown	26,000	—
,, Australia	separately.	4,000	—
,, Other countries ...	—	3,000	—
Total	—	105,000	—
Meters, electricity.—			
From United Kingdom ...	33,000	10,000 –	23,000
,, Australia	2,000	— –	2,000
,, United States ...	2,000	— –	2,000
,, Other countries ...	—	2,000* +	2,000
Total	37,000†	12,000 –	25,000
* Germany £2,000.			
†Included water and gas in 1913.			
Lamps, electrical.—			
From United Kingdom ...	36,000	21,000 –	15,000
,, Germany	12,000	5,000 –	7,000
,, United States ...	14,000	7,000 –	7,000
,, Other countries ...	2,000	4,000† +	2,000
Total	64,000*	37,000 –	27,000
* Included lanterns in 1913.			
†Holland £2,000.			
Steam engines.—			
From United Kingdom ...	8,000	15,000 +	7,000
Gas and oil engines (except for motor-cars).—			
From United Kingdom ...	160,000	70,000 –	90,000
,, Australia	4,000	— –	4,000
,, United States ...	24,000	18,000 –	6,000
,, Other countries ...	2,000	1,000 –	1,000
Total	190,000	89,000 –	101,000

	1913. £	1914. £	Inc. or dec. £
Boilers.—			
From United Kingdom ...	10,000	9,000 –	1,000
Insulated cable and wire.—			
From United Kingdom ...	—	117,000	—
,, Germany	—	16,000	—
,, United States ...	—	8,000	—
,, Belgium	—	6,000	—
Total	—	147,000	—
Mining machinery.—			
From United Kingdom ...	15,000	21,000 +	6,000
,, Australia	7,000	2,000 –	5,000
,, Germany	—	1,000 +	1,000
,, United States ...	4,000	6,000* +	2,000
Total	26,000	30,000 +	4,000
* United States £4,000.			
Railway and tramway plant.—			
From United Kingdom ...	67,000	44,000 –	23,000
,, Australia	2,000	3,000 +	1,000
,, Other countries ...	2,000	3,000* +	1,000
Total	71,000	50,000 –	21,000
* United States £3,000.			

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Published expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

7,595. "Trolley heads of electric tramways." W. H. Cotter & R. H. Hollingsbee. May 29th.

7,607. "Relay switches." H. J. Herink & Relay Automatic Telephone Co. May 29th.

7,616. "Electric signalling apparatus." F. Ritchie. May 29th.

7,649. "Electric brakes, chiefly for looms." J. F. Crowley. May 30th.

7,652. "Electric motor control systems." British Thomson-Houston Co. (General Electric Co., U.S.A.). May 30th.

7,672. "Manufacture of stems for metallic-filament electric lamps, and apparatus therefor." J. A. Allison and Morris & Whitham. May 30th.

7,689. "Electrical switchgear for operation of reverse current relays, &c." I. A. D. Pedler. May 31st.

7,694. "Electrical switches." H. W. Cox & J. H. Thorne. May 31st.

7,708. "Dynamo-electric machines." Crompton & Co. and N. Pensabene. May 31st.

7,712. "Sparking plugs." A. E. White (Wolverine Spark Plug Co.). May 31st.

7,730. "Electrical signalling systems." W. C. Davey. May 31st.

7,731. "Starting internal-combustion engines." Bosch Magneto Co. May 31st. (U.S.A., June 12th, 1915.)

7,732. "Starting internal-combustion engines." Bosch Magneto Co. May 31st. (U.S.A., June 12th, 1915.)

7,733. "Electric starting ignition systems for internal-combustion engines." Bosch Magneto Co. May 31st. (U.S.A., June 12th, 1915.)

7,750. "Electric fuses." G. Inrig & L. Inrig. June 1st.

7,790. "Piston packings." British Thomson-Houston Co. (General Electric Co., U.S.A.). June 1st.

7,796. "Electric conversion." S. Cabot. June 1st.

7,844. "Metallic-filament lamps." J. R. Quain. June 2nd.

7,848. "Devices for stripping insulated wire." S. G. Wood. June 2nd. (U.S.A., June 22nd, 1915.)

7,856. "Electric light switches." N. Andrews. June 2nd.

7,859. "Transformer condenser combinations." R. Whiddington. June 2nd.

7,882. "Four-line field telephone exchange." H. P. Hamilton. June 3rd.

7,901. "Systems of ship propulsion." British Thomson-Houston Co. (General Electric Co., U.S.A.) June 3rd.

PUBLISHED SPECIFICATIONS.

1914.

13,674. Telephone Transmitting Apparatus. W. K. L. Dickson. June 5th.

1915.

5,486. Methods of and Means for Controlling Alternating Electric Currents. British Thomson-Houston Co. (General Electric Co., U.S.A.). April 12th.

6,480. Telephone Systems. H. S. Turner. April 30th. (June 30th, 1914.)

7,151. Electric Switches. L. Cadenel. May 12th.

7,213. Electric Cell, Battery, or Refill for use in connection with Portable Electric Lamps and for other purposes. May 13th.

7,304. Heaters for Electric Radiators and the like. G. Bourne. May 15th.

7,374. Electric Ignition Apparatus. J. L. Milton. May 17th. (May 15th, 1914.)

9,627. Dry Batteries. R. de Fortuny. July 1st.

10,050. Impulse Senders for Subscriber Apparatus in Automatic Exchange Systems. Aktieselskabet Elektrisk Bureau. July 9th. (July 14th, 1914.)

10,059. Vibrating Make-and-break Devices for use in Electric Signalling. A. C. Brown. July 10th.

10,668. Electric Welding Transformers. Deutsche Schweissmaschinen-Bau-und Vertriebs-Ges. July 22nd. (July 22nd, 1914.)

11,072. Identification of Electric Cables. B. J. Kat & Callender's Cable and Construction Co. July 30th.

11,144. Electric Heaters. Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.). July 31st.

12,402. Electric Motor Controllers. Electric & Ordnance Accessories Co. and N. G. Langrish. August 28th.

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THE

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ELECTRICAL REVIEW.

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THE I.M.E.A. MEETING.

YESTERDAY, in comparatively mild weather, the twenty-first annual meeting of the Incorporated Municipal Electrical Association was opened at the Institution of Electrical Engineers. Mr. A. C. Cramb, the president, in his address touched upon a variety of interesting subjects, reviewing the work of the Council during the past year; it was inevitable that war conditions should have the effect of restricting the activities of the Council and its Sub-Committees, so that the record is rather suggestive of marking time than of steady progress, but the organisation is ready for action as soon as circumstances permit of it. We share Mr. Cramb's regret that it has not been possible, even with the kind offices of the B.E.A.M.A., to arrive at an agreement with the Electrical Contractors' Association; the terms offered to the latter are so favourable that it is difficult to understand why it should continue to form an obstacle to progress, especially at a time when the only consideration that should weigh with any British citizen is the welfare of the nation as a whole. Mr. Cramb's concluding observation on this subject has an ominous appearance.

Referring to the proposal of the Board of Trade Committee on British Trade after the War to impose upon public bodies the obligation to purchase *as far as possible* only goods produced within the British Empire, the President indicated that the Council viewed the suggestion unfavourably, as constituting an injustice to the ratepayers; judging by the report of the result of the Economic Conference at Paris, there is reason to hope that, at any rate, no more orders will go to Germany.

The three technical papers which followed were all of interest and value, touching as they did upon subjects which closely concern the future prosperity of electricity supply. The development of the turbine to so remarkable a degree of efficiency and compactness has had the effect of transferring the attention of engineers to the problems of the boiler-house, and Mr. W. W. Lackie's paper on this subject comes at a most opportune time; the more efficient utilisation of our stores of coal is one of the most urgent questions of the day. We look forward to far-reaching changes in this department of engineering in the near future, for, while Mr. Lackie discusses the subject in the light of present conditions and methods, the importance of obtaining from the coal a far greater proportion of its precious contents is rapidly gaining public appreciation. It cannot be denied that the combustion of coal in furnaces is an inherently wasteful process, and we hope that drastic reforms will be effected in this connection.

In his paper on the generation of electricity on a small scale *versus* bulk supply, Mr. Harry S. Ellis draws attention again to the question which has recently been brought so prominently before the industry in the I.E.E. discussions, and indirectly by the Board of Trade circular. Mr. Ellis holds the balance fairly between the two aspects of the question, but allows it to appear that he personally favours the independent station; as he points out, his Committee refused an offer of the North-East Coast system to supply South Shields in bulk some years ago, and "the results have been entirely satisfactory." Yet he keeps the door open for the reverse conclusion by suggesting that the linking-up of large undertakings might reduce costs, and

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holds that the present chaotic state of electricity supply in this country calls for thorough investigation by a committee of members of the I.M.E.A., "with power to co-opt members of other scientific societies, such as the Institution of Electrical Engineers, the Institute of Chemistry," &c.—a remark full of significance.

Mr. W. T. Kerr's paper on the application of electricity to agricultural purposes deals with a subject which should command the attention of supply engineers in rural districts; the author points out that it has been extensively developed abroad, and proves from his own experience that it can be made a profitable enterprise. Not only the adoption of electric light and power on the farm, but also the use of electricity for intensifying agriculture, is of great promise; the latter would probably not constitute a heavy load, but it would greatly assist the demand for the former. We hope to deal with these subjects more fully in later issues.

THE FUTURE OF THE ALUMINIUM INDUSTRY.

The question of the future of the aluminium industry has just been raised in France, almost simultaneously with the annual meeting of the principal company in Switzerland that is engaged in this particular branch, although no direct connection exists between the two events. Nevertheless, it will not be without interest to hear what the Paris newspaper *L'Information* has to say on the problem as it affects the Allied nations. In the first place, it is submitted that, as in the military situation, so in the economic field should France show capability of initiative and energy, and that the country must fulfil the duty of closing to Germany the market for raw materials when France has almost a monopoly of these, as in the case of bauxite. The chief producing countries of bauxite are few. Germany only possesses the deposits in Hessen-Nassau, the quality of the mineral being declared to be more than problematical. It is true that Austria is able to furnish the former with supplies of the raw material from the deposits at Neustadt, in Styria and Carniola, and for that matter Germany has received supplies through the Dalmatian port of Almissa from the products extracted at Prechora. But the Austro-German deposits on the whole only represent a mediocre quantity for a great industry whose future is of such an encouraging character.

The allied countries, on the other hand, are particularly well favoured with deposits of raw materials. Great Britain works the advantageous bauxites at Straim, in the County of Antrim, and those at Glenravel, which afford large supplies to the works of the British Aluminium Co. The French minerals are of a clearly superior quality, and, at the same time, are abundant in comparison with the resources of their rivals in the East and their friends in the North. Thus, the minerals furnished by the Bouches du Rhone and the Var are of specially high quality, and the output is claimed to form two-thirds of the production in Europe. In addition, the Italians have discovered deposits in the Abruzzi which are not to be despised. If we now take into consideration the state of the industry in 1913, the French production of aluminium is returned at 18,000 tons, that of Great Britain (including works erected in Norway) 10,000 tons, and Italy 2,000 tons to 3,000 tons, whilst Germany turned out 7,500 tons, Austria 7,000 tons, and Switzerland 7,500 tons. The figures for the last three countries make a total of 22,000 tons, but the statistics issued by the Frankfort metal companies at the end of July, 1914, only recorded a total of 12,000 tons for these three countries combined. Leaving, however, this discrepancy on one side, and accepting the considerably higher French figures as being correct, we find the French newspaper—which states that the Neuhausen Aluminium Industry Co. is essentially a German firm whose Austrian works have been purchased by Germany—placing the Teutons in possession of 22,000 tons of aluminium per annum on the outbreak of hostilities, as compared with a combined quantity of 28,000 tons for Great Britain and France, together with 3,000 tons in the case of Italy. Such a large output on the part of Germany and Austria was only possible through its having been possible to import bauxite from France to assist in meeting their own totally inadequate resources, and in this respect the French newspaper clearly implies that the output of the Neuhausen company is controlled by Germany.

We now come to a little interesting history. The Germans, it appears, sought to monopolise the French bauxite deposits, in the same way as they endeavoured to secure possession of the iron ore resources. With this object in view, they first formed the Société de l'Aluminium Francais, which started works at Saint Louis du Rhone for the refining of alumina, and which is asserted to be merely a branch of the Neuhausen company. But the former arrived on the scene too late, as the principal deposits were already in the hands of the metallurgical companies making aluminium (Alais and Camargue, Froges, and the Métallurgique des Pyrénées), or in those of the French extracting companies (Union des Bauxites, Bauxites de France, Lecesne and Cie, &c.). Under these circumstances, the voracious appetite of the Teutons had to be content with poor nourishment. They acquired, for instance, mineral deposits at Thoronet (Var), which were so unsatisfactory that 10,000 tons had to be left at the Luc railway station, whilst the Cabasse minerals appeared to be so silicious that the motor lorries purchased for transporting them had to be put into the garages. The deposits at Vins caused the same disappointment, and although more fortunate results were obtained at Mazangues, the minerals were also greatly silicious. But these failures did not deter the Germans, who then resolved to purchase deposits which were already known and appreciated. Nine-tenths of the share capital of the Bauxites de France were secured, and the success of the scheme was celebrated in July, 1914, by the substitution of three Germans for three French directors on the Board. But the company was subsequently placed under sequestration, and although it has since been sought to replace the Teutons by Swiss representatives, the attempted deception was discovered. Now a new scheme appears to have been adopted to overcome the difficulties. This has taken the form of the announcement made by a new Norwegian company that the bauxites from the South of France would no longer be sent to Germany, but would be treated by the company in Scandinavia. Without suspecting the intentions of the company, the French newspaper pertinently asks whether the Neuhausen company is not at the back of it, apprehending a shortage of minerals for its furnaces in the event of the French Government ultimately prohibiting the export of bauxites to enemy countries after the war. The newspaper concludes by stating that it is quite obvious that the French would henceforth no longer permit the Germans to compete with them with their own (the French) products, and that the European manufacture of aluminium must be reserved for the allied countries.

It is evident from the foregoing that our French contemporary considers, as, indeed, it states, that the Neuhausen company is essentially a German firm, especially as the French Government deemed it necessary to sequestrate the company's works at Marseilles some time ago. As to the assertion that the company's Austrian works have been purchased

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by the Germans, no confirmation of this statement was contained in the annual report for 1914, nor is any reference made in the report for 1915 to any transfer having taken place. It, however, naturally follows that the production of the Austrian works would be used by the Central European Powers, together with that of the Neuhausen Co.'s works in Germany, at Goldschmied-Trotha, and the new Martinswerk, near Cologne. Indeed, Col. Naville, addressing the shareholders at the meeting held at Zurich on May 6th, stated that the company had succeeded in securing extensive bauxite mines in Hungary, and the raw materials were being transported to Goldschmieden and the new Martinswerk. Under these circumstances, the chairman's fresh denial of the assertion that the company is covertly German—the statement that the majority of the capital is held in Swiss hands, and the majority of the directors and managers have been Swiss since the formation of the company—will not dispel the fact that a large portion of the company's total production from its German and Austrian works is passing into the hands of the Central Powers for use against Great Britain and her Allies. It would be of interest in this connection to learn the exact amount represented by the shares which have been returned to Switzerland since the outbreak of the war, as the Zurich correspondent of the German *Voss. Zeitung* reported at the end of April that "large amounts" had flown back. The expression of our French contemporary that the French supplies of raw material should be wholly reserved for France and her Allies in the future, as well as at present, will consequently be reciprocated by the allied nations.

The Copper Position.

The position of the red metal continues the subject of considerable interest, despite the fact that speculation on this side has remained entirely at a standstill, in view of the prohibition in force under the Defence of the Realm Act. The sensitive state of the market may be gauged from the fact that, although dealings in warrant metal have for weeks past been virtually absent, prices have again fallen heavily, and to a much greater extent than in refined copper. The price for near delivery has now dropped to about £103, this comparing with £145, the highest touched this year, while American fine copper, which reached as high as £155 some time back, stands in the neighbourhood of £140.

That the latter shows more resistance is, of course, due to the control exercised by American producers, whose output is sold far ahead, thus encouraging them in keeping their terms at a high level as long as possible, or until they feel the necessity of competing more freely for new orders. Signs of weakness in the general outlook have, however, not been wanting, since the demand has come to a halt in all directions, even in connection with munition work. As to whether the demand in the latter respect will reassert itself again to any important extent in the near future seems very doubtful, for it is understood that war needs have been already well covered up to the end of this year. There is, therefore, a strong suspicion that no great revival of buying will be witnessed this year, while American industrial requirements, though still very heavy, have of late shown distinct evidences of falling off. Moreover, there is not much doubt that American consumers have purchased far ahead of their needs, and are now getting copper which is not actually wanted, judging from the reported resales effected lately on the part of some manufacturers. These resales, coupled with the second-hand parcels held speculatively now coming on the market, have naturally enough made themselves felt.

This factor appears to be under-rated by producers who, as a matter of fact, still profess indifference in the hope of being able to hold the market, or, at least, to protect it against any further serious fall. In the legitimate trade there is no confidence in the stability of the market, consumers generally being of opinion that it is only a matter of time when producers will be compelled to stimulate new business at considerable concessions. This view is based on the contention that the United States refinery capacity has now been very fully raised to the height of the huge mine and smelters' output. The refinery production is already estimated at about 90,000 tons a month, which should leave a very fair surplus over current requirements after making allowance for exports at the rate of 25,000 tons, which is well above the average recorded so far this year.

It may be remarked that the American exports during the first four months of this year varied between about 20,600 and 26,300 tons, and fell last month to 14,700 tons, in spite of rather easier freight conditions. Metal for early delivery is getting a little more plentiful, and producers outside the United States have, too, rather more to spare than seemed likely only a few weeks ago, and they are somewhat anxious to push business since the aspect of the market has been entirely changed. On the other hand, consumers resolutely refrain from buying beyond their early needs. Warehouse stocks on this side are still very small, but they have lately increased somewhat and the probability is that they will go on increasing.

What is an "Engine-driver"?

A remarkable decision was recently given in the Federal High Court of Australia, which may have very far-reaching effects. The importance of the case is due to the system which prevails in the Commonwealth, according to which the rates of wages for the different classes of labour are fixed by the Courts. In the present instance, an appeal was lodged against a decision of the Melbourne Court of Petty Sessions, which refused to allow a claim preferred by the Federated Engine-drivers' and Firemen's Association that the driver of an electric crane should be regarded and paid as an engine-driver. The Chief Justice said that the power of the electric motor was regulated "by pressing a button," whilst that of a steam crane was controlled by operating a valve; the difference in the simplicity, or difficulty, of the operation performed by the person in charge of the crane made no difference in its character, and therefore the decision of the lower court was reversed.

This decision appears to us to show an extraordinary lack of appreciation of the fundamental difference which exists between the vocation of an engine-driver and that of the user of an electric motor; the former is a trained man, whereas anybody can operate an electric motor without previous experience, that being one of its most valuable characteristics. What the decision means to employers in Australia may be gathered from the fact that every man who drives an electric crane, hoist, tramcar, pump, or any other appliance will in future have to be designated as an engine-driver and paid according to the wages award in force—and engine-drivers are now demanding an award of no less than 12s. 8d. per day from the Federal Arbitration Court, which, from previous decisions, appears to be disposed to grant anything that Labour asks for. If technical evidence had been produced, the Court could not possibly have arrived at so absurd a decision, and we do not know why the employers concerned failed to call such evidence; perhaps they thought the truth was obvious, even to a judge. Unfortunately, the decision cannot be revised except by appeal to the Privy Council in London.

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SILVANUS PHILLIPS THOMPSON: AN APPRECIATION.

The sudden death of Prof. Silvanus Thompson deprives the scientific and literary world of a charming personality and a man of great and diversified talents.

To many thousands of his students, and to the electrical profession, his loss will come as a shock and surprise of which they had no warning; but to his intimate friends it had become increasingly apparent during the last few months, that his health and strength were suffering severely from the long-continued strain of his work at Finsbury, and the many anxieties which the war had brought to him in an especial manner.

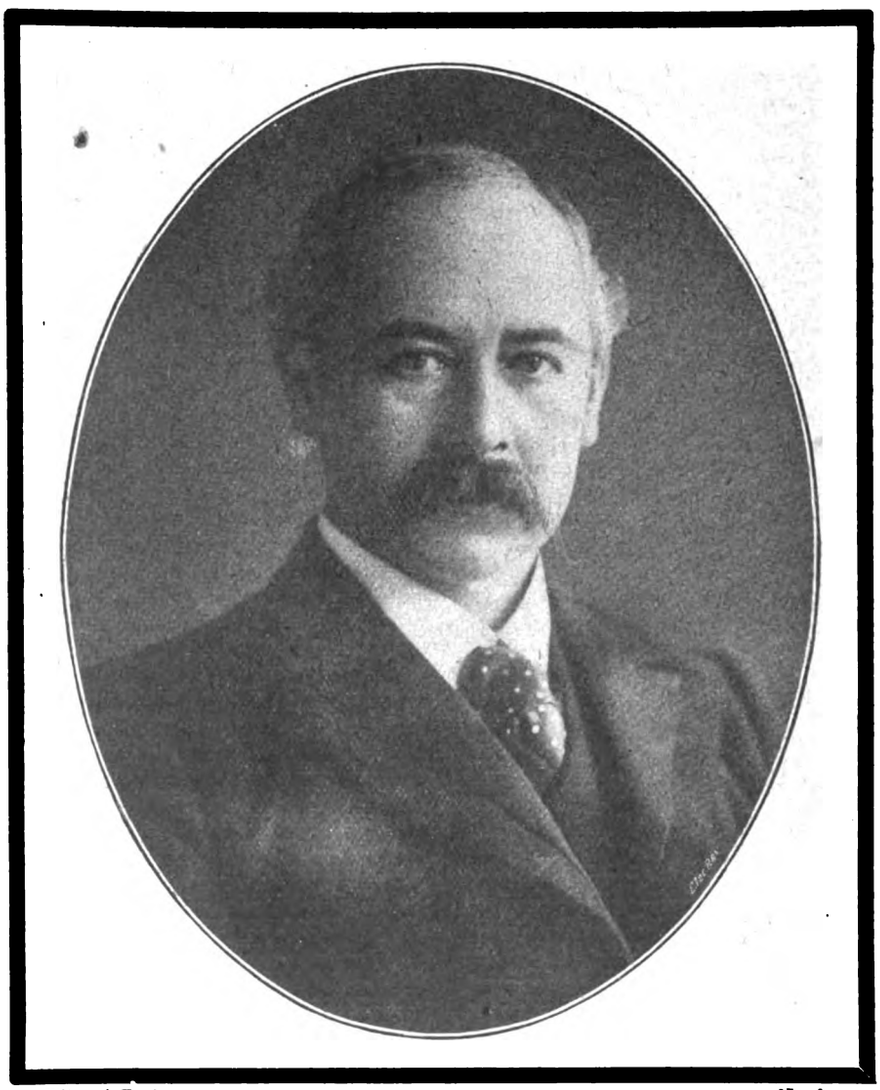
Silvanus Phillips Thompson was of Quaker descent and upbringing, and one of the best-known members of the Society of Friends, whose principles and influence have had such an enormous effect on the social and religious life of this country, although in mere numbers they have always been insignificant.

His public life commenced when he became Professor of Experimental Physics at University College, Bristol, in 1878, very soon after the conclusion of his student days which had given great promise of a distinguished scientific and literary career.

Indeed, it was this special combination of scientific ability and literary charm which gave him so prominent a place among his contemporaries, and he was almost as well known in the sphere of literature as in that of science.

In the early days of electrical engineering, Thompson, then quite a young man, achieved a foremost place as a scientific expert, and his early removal to London to become Principal and Professor of Applied Physics and Electrical Engineering at the City and Guilds College, Finsbury, gave him a large field of influence, of which he made full use. Electrical science had then scarcely emerged as a distinct branch of engineering, and Thompson was one of a very few brilliant young men who grasped a unique opportunity to establish its principles on a thoroughly scientific foundation, a work shared in by Profs. Ayrton and Perry, both of whom were connected with the foundation of the Finsbury Technical College. Thompson laboured unceasingly in this work in lectures to London audiences, and by means of books and papers which had a world-wide circulation. In those days Finsbury was almost the only place in London where instruction in electrical engineering could be obtained by evening students, and the college was crowded with young men attracted by lectures of rare lucidity and fascination, while the publication of his "Elementary Lessons in Electricity and Magnetism," and subsequently a treatise on "Dynamo-Electric Machinery," established his fame both at home and abroad as a brilliant teacher, writer, and man of science, resembling in very many ways Prof. John Tyndall, whose student he was. Prof. Thompson's numerous books, papers, and published lectures are, in fact, so well known to electrical engineers, that it is hardly necessary to deal with them in detail here, and their great value has long been recognised by the electrical engineering world. It is, therefore, rather to his work in other fields that this brief memoir is concerned, since this is, perhaps, not so widely known, although it probably forms the greater portion of his life-work.

To his artistic instinct experimental work on light appealed with especial force, and it always remained a dominant attraction. His knowledge of this branch of science, in fact, was quite as encyclopædic as in the electrical field, and one could go to him, as I often did, with some perplexing question, perhaps on polarisation phenomena, or an allied topic, and find in him a mine of information. Form and colour especially appealed to him, and he revelled in the gorgeous displays which this kind of work afforded, and to which he contributed many new and original experiments and ideas. His many contributions in this field include a brilliant course of Christmas lectures, at the Royal Institution, on "Light, Visible and Invisible," afterwards published in book form; and, more recently, a translation of Huygens's famous Treatise on Light, and the theory of double refraction, a special contribution to the Optical Society on the occasion of its highly successful Congress in London a few years ago, when Thompson was President and moving spirit.



Elliott & Fry, [*London.*

Prof. S. P. Thompson, F.R.S.

As a member of the Spectacle Makers' Co. he gave much time and thought to the diffusion of scientific knowledge among opticians, and was one of the recognised experts of this ancient City company.

In another field, that of magnetism, he was distinguished by his literary researches in connection with Gilbert's great work, "De Magnete," the writings of Petrus Peregrinus, and the history of compass cards, which latter formed the subject matter of a course of lectures delivered at University College last year. He also wrote an instructive technical work on the electromagnet, based on a special course of lectures delivered at Finsbury.

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Biography had a great fascination for him, as his admirable Life of Faraday shows, but the chief work in this field is undoubtedly his Life of Lord Kelvin. His distinguished subject took a keen interest in this work, and indeed for some time they met each week for an hour or so to talk over Lord Kelvin's earlier days. Unfortunately, Kelvin died before much progress had been made, and although this was a severe blow to his biographer, he redoubled his efforts, and in a year or so completed his great task and his most considerable literary achievement. Thompson's linguistic powers also were of a high order, and electrical engineers will remember well his Italian oration in memory of Volta, while physicists will recall his services as foreign secretary of the Physical Society of London, of which body he was also president, and his lecture, delivered in German, in Berlin on the life of Faraday.

In addition to his natural gifts, Thompson was a most strenuous worker, and a holiday for him was merely freedom from routine work, and a change of scene to begin some long-cherished project, or to complete another already outlined in his pocket-book. No one was more industrious on holidays than he, and during each summer he invariably added considerably to his collection of water-colour sketches of Alpine scenery or of some favourite haunt nearer home, which later found their way to the Alpine Club, and occasionally to the Royal Academy.

His temperament, in fact, was such that he needed few relaxations, but one of these during the winter was the monthly meeting of a small coterie of distinguished literary and scientific men, the Sette of Odd Volumes, a dining club of which he was a prominent member and past president, and to the interesting proceedings of which he was a frequent contributor. Many honours and distinctions fell to him both at home and abroad, and he filled the presidential chairs of many scientific and professional societies with distinction, tact, and skill.

He was a Fellow of the Royal Society, of long standing, and took an active part in its work, especially in connection with the catalogue of scientific papers. In recent years he was elected a member of the Athenæum, in recognition of his distinguished career.

His death removes from our midst a great teacher and man of science, with rare gifts of thought and expression, which have been freely given to his day and generation.

E. G. Coker.

Following upon the cremation, which took place at Golder's Green, a special meeting was held at the Society of Friends' Meeting House in St. Martin's Lane, W.C., on Friday afternoon. The proceedings were of a most impressive character, and will be remembered for their remarkable simplicity and true sincerity. In addition to the widow and family mourners, and many members of the Society with whom the late Professor had been a fellow worshipper, as well as a profoundly respected teacher in spiritual things, there were present men of eminence in all those departments of activity—scientific, educational, literary—upon which the deceased had left the impress of his intellect and influence. These included the following:—

Sir J. J. Thomson, Sir A. B. Kempe, Sir W. Crookes, and Prof. W. B. Hardy, representing the Royal Society.
Col. E. H. Hills (Royal Institution).
Sir Alexander Pedler (British Science Guild).
Mr. C. Hawksley (Institution of Civil Engineers).
Sir H. Trueman Wood (Royal Society of Arts).
Sir Ernest Clarke (Sette of Odd Volumes).
Prof. A. Schuster (British Association).
Mr. C. P. Sparks and Mr. P. F. Rowell (Institution of Electrical Engineers).
Mr. W. J. Tennant (Junior Institution of Engineers).
Dr. R. Mullineux Walmsley (Northampton Polytechnic Institute).
Dr. Gregory Foster, Prof. Carey Foster, and Prof. E. G. Coker (University College).
Mr. E. B. Knobel (Royal Astronomical Society).
Mr. Eccles (Physical Society).
Mr. W. T. Dunn (Institution of Gas Engineers).
Mr. F. S. Spiers (Faraday Society).
Mr. A. G. Temple (Director of the Art Gallery, Corporation of London).
Prof. G. T. Morgan and Prof. Margetson, both of Finsbury Technical College.
Mr. Howgrave Graham and Mr. C. R. Darling (the late professor's assistants), also Mr. Abell, his lecture assistant.
Prof. Dalby, Dean of the C.T.C., and formerly of Finsbury.
Sir John Gavey, Sir J. A. Ewing, Sir J. Mackenzie Davidson, Sir G. Beilby, Sir W. F. Barrett, Sir John Snell, Prof. John Perry, Col. R. E. Crompton, Dr. C. V. Drysdale, Mr. Chas. Bright, Mr. C. H. Wordingham, Mr. J. E. Kingsbury, Prof. Baily, Dr. Russell, Mr. Gerald Stoney, Mr. W. R. Cooper, Mr. W. P. Thompson (of Liverpool), and many others.

At the beginning of the meeting it was intimated that the Society of Friends had no set order of service for such occasions, and it remained for those present to lead the meeting, either in devotion or by speech, as they were moved so to do. Several Friends spoke in fitting terms and tones of reverence and solemnity of the earnestness and tenacity with which Prof. Thompson had to the last clung to the same simple religious faith with which he had commenced his career of brilliance, referring also to his spirit of humility, which made no task too mean or small which might bring honour to religion or assist those who worshipped with him or who sat under his religious teaching. The temptation of intellectual pursuits had not lured him into beliefs that religion and science were irreconcilable.

CONTROL GEAR FOR DIRECT-CURRENT MOTORS.

By E. F. BUTLER.

The subject of control gear does not always receive the amount of attention it deserves, and very little information on the subject, as the result of actual operating experience, has been published. The control gear is often the weak point in installations otherwise well laid out. This may be due to a number of reasons. In some instances quotations are given for the motor only, and when the prospective purchaser finds out that he must pay for a starter in addition, he buys the cheapest form obtainable. In other cases the seller, either for fear of losing an order, or, possibly, ignorant of the various types of control gear which are available for every conceivable purpose, cuts down the price to its lowest, and supplies one of the old-fashioned forms of starter. In many instances this has failed to give satisfaction, and created a prejudice against electric driving.

In a paper given by the writer before the Junior Institution of Engineers, on February 27th, 1914, an analysis of 100 breakdowns connected with electric motors was given. It was found that 38 per cent. were on motors, and 62 per cent. on the control gear, starters alone accounting for 28 per cent. of the whole. This is confirmed by Mr. A. P. Drake (*Proceedings* of the Association of Mining Electrical Engineers, Vol. III, page 458): "The unsatisfactory design of starting switches and controllers, together with the careless way in which they are frequently handled, accounts for about 25 per cent. of the troubles that occur in motor driving."

The neglect of suitable control gear is not confined to the commercial side, which we may charitably suppose to be ignorant of these matters. This is evident from a specification, less than three months old, before the writer at this moment. It emanates from the chief engineer of an important power station. After describing the motor in great detail—bearings to be fitted with ring lubrication, armature to be slotted-core type, brushes to be of high quality carbon, &c.—it concludes: "Protected type starter with no-volt and overload release, ventilated grids and coils, also shunt regulator in series with fields for speed regulation." And this for the most important motor in the power house! Fortunately, the importance of control gear is beginning to be recognised, and some public bodies now devote a separate specification to this item.

The following remarks are not intended to be a treatise on the subject, but are written with the idea of bringing to notice some of the types which may often be used with advantage in place of the ordinary plain type, together with some notes on both good and bad features.

The familiar type of starter will be dealt with first. As is well known, the arm moves over the contacts and cuts out the resistance in so doing. The no-volt coil is energised by being placed in series with the shunt field, and holds the

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arm in the full-on position against the pull of a spring. A few turns of thick wire in series with the armature form an overload coil which is intended to pull in a pivoted arm at a predetermined current, short-circuit the no-volt coil and return the arm to the off position.

This type of starter is useful for getting small and medium size motors up to speed, and when well made and carefully handled will give good service for such purposes as it is suited for. The greatest objection to it is that it depends too much upon the human element. If the arm is moved too quickly, there is a danger of passing an excessive current through the armature, and possibly melting a fuse or opening a breaker which may shut down a group of motors. On the other hand, keeping the resistance in circuit too long results in overheating or burnt-out coils,

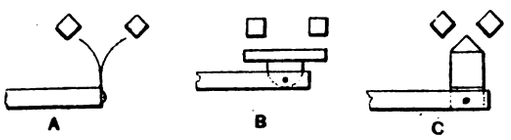

Fig. 1.

besides being wasteful of both time and energy. The writer recalls a steel works having some large rail and girder straightening presses. For some reason these were fitted with plain shunt motors, which took a large current to get under way. The starter was made up of bare iron spirals, above the starting arm. The motor was protected by a circuit-breaker nearly a quarter of a mile away, and the job was to manipulate the starter-arm at the exact moment. If it was moved too quickly the breaker opened, necessitating a walk to the switchboard, while if it was not moved quickly enough, the last spirals got red hot, and could only be kept from burning out by vigorously blowing upon them.

The trouble most commonly met with in this type of starter is the burning of the contacts, caused by moving the arm on and off the first studs. This is particularly common in the printing trade, as it is necessary to "inch" the machine, or move it round a fraction of a revolution when "making ready."

It is also very usual with machine tools when setting work, particularly with lathes having four-jaw independent chucks. When the starter arm is moved on and off the first stud, the breaking of the starting current, together with the self-induction of the shunt fields, sets up a destructive arc, which rapidly burns up the contacts, and renders the starter useless. When the motor is connected across the outers of a three-wire system, and the starter cover is earthed, as it should be, the arc often spreads to the cover, and causes a dead short-circuit, sometimes destroying the starter and burning the operator. In larger sizes trouble arises when starting up, due to the fact that as soon as the contact on the arm touches the first stud on the slate, the whole of the current passes through what is practically a line or point contact, and sticking or welding takes place. This cannot happen with a carbon contact on the arm, but a good deal of pitting and burning away is noticeable. Of course, this trouble can be got over if the attendant can be induced to get the arm full on the first step and close the double-pole switch afterwards; but this is usually asking too much. When starters of this description are met with, and it is not possible to replace them by a more suitable type, the fault can be got over by connecting the end of the resistance coil which is first cut out, to the starter arm, thus doing away with the off position altogether, and passing current through the armature as soon as the double-pole switch is closed. While this certainly gets over the trouble, it may introduce another, for if the current be interrupted and the arm flies back, the motor may run with all the resistance in when the supply is resumed. However, the author has not hitherto come across any trouble from this cause.

Whilst dealing with the ordinary type of starter, some constructional details, both good and bad, may be mentioned.

The usual internal connections are well known, and it will be noticed that as the resistance is cut out of the armature it is re-inserted in the shunt field. There is no particular objection to this, but it can be obviated in several ways, if necessary. A common method is to fit a small button contact under the last main contact, so as to short-circuit the starting resistance on the last step. Sometimes the inner end of the no-volt coil is connected to its iron core, which has the same effect. This method has the advantage that there is only one end of the coil to break off—namely, the outer end, which can be connected up again without re-winding the coil.

In good-class work it is usual to fit a brass quadrant with a small contact on the arm, so that the shunt circuit is independent of the starting resistance. It may be mentioned, in passing, that a good many no-volt coils are too weak, and the starter arm has a weak spring. If the contacts get very smooth, there is not sufficient friction to hold the arm up; if, on the other hand, the contacts get rough, the spring is not strong enough to return the arm to the off position. In fact, some makes of starters can almost be divided into two classes—those that won't stop on, and those that won't come off.

It would be an advantage if the tension of the spring were adjustable, and if a small brass set-screw and back-nut were fitted to the keeper of the no-volt coil to prevent sticking. Coming now to the overload coil, the usual source of weakness is the contacts. A very common form is shown at A, fig. 1. The trouble generally met with is the wedging of the contacts after they have pulled in. When the motor is next started, the no-volt coil is short-circuited, and the arm will not hold up. It is tied up with a piece of string, which is usually forgotten when the motor is stopped.

Next time the switch is closed, the arm still being tied up, the fuses are blown and the double-pole switch probably

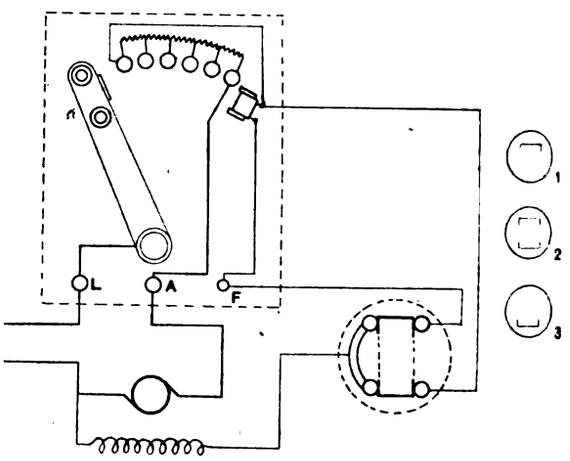

Fig. 2.

damaged. The owner remarks: "Electric driving is a great convenience; it is a pity it is so unreliable." Improved forms of contacts are shown at B and C, fig. 1, the first being a circular disk pivoted underneath, which makes contact with the lower portion of the two studs; the second consists of a short piece of round brass with a broadly-tapered end, which does not become wedged.

In order to comply with the Home Office regulations, it is sometimes necessary to arrange to shut down a motor from a distance. When a starter of the ordinary type is fitted, it is usual to run a pair of wires from the terminals of the no-volt coil to the point of control, and fix a push or switch, the closing of which short-circuits this coil, or, more correctly, more or less shunts it. The best that can be said for this arrangement is that it works—sometimes. By a simple re-arrangement of connections a much more reliable and satisfactory method is possible. Fig. 2 shows a two-way switch without an off position. When the top contact only is made, the no-volt coil is in circuit as usual. In the next position this coil is short-circuited, while in the final position, one lead to the coil is disconnected.*

Another method of connecting the no-volt coil is sometimes used when a separate regulator is used for the shunt field. In this case the coil is made independent of the

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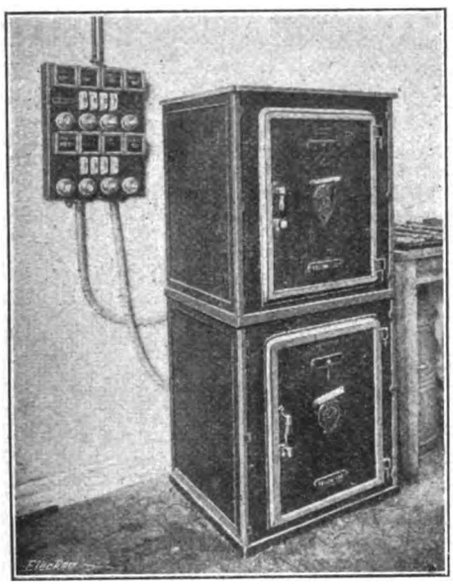
shunt field by being placed in series with a resistance directly across the mains. This obviates a common source of trouble—namely, the dropping back of the starter arm, due to the weakening of the holding-up coil.

When so connected, the overload acts by breaking the circuit of the no-volt coil, and to stop the motor from a distance the required number of switches are placed in series and normally make contact.



Baking Ovens.

The Refectory.

Arising out of these two examples, it may be noted that in dealing with problems involving the opening or interrupting of a circuit by means of magnetic switches or automatic control, it will usually be found much more satisfactory to positively open the control circuit than to shunt it more or less. With any length of wiring, and a number of dirty or oxidised contacts, it is easy to have a resistance equal to that of the coil it is intended to short-circuit.

Emergency stops may not be used for a long time, but when they are needed they are usually needed very badly, and should be reliable and positive in action.

The contacts on the slate should be renewable from the front in all excepting the smallest sizes. One make in particular should be avoided; it has segments held on by countersunk screws passing through the slate and holding the connections on the back. Countersunk screws make it easier to clean the segments, but round-headed ones enable the segments to be reversed, and both sides used. The contacts on the starter arm should also be easily renewable. For small currents a plain brass or copper strip is quite suitable, backed up by a strip of spring steel.

(*To be continued.*)

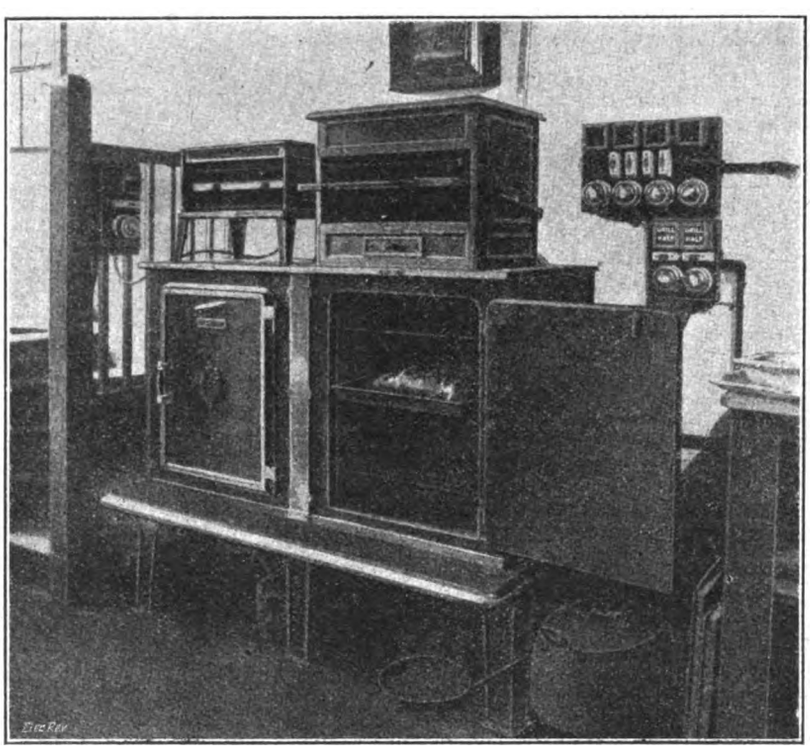
Patent Restored.—An order has been made restoring Letters Patent No. 17,026, of 1907, granted to Wm. Reavell and Reavell & Co., Ltd., for "Improvement in mechanism for converting rotary into reciprocating motion, applicable to pumps, compressors, and other machinery."

* Switch positions are indicated on right of diagram.

AN ELECTRIC RESTAURANT AT GOLDER'S GREEN, N.W.

By the courtesy of Mr. B. G. Drummond, engineer and manager of the Hendon Electric Supply Co., Ltd., we were enabled to inspect a new restaurant which has been opened at Golder's Green, and has been equipped with electric cooking apparatus. The restaurant is known as "The Refectory," and is tastefully fitted and furnished in a style in keeping with its name; and judging by the savoury odour and appearance of the dishes in course of preparation at the time of our visit, the traditions of the monastic order with regard to "living well" as an aid to leading a good life, are no less faithfully reflected in the cuisine. The enterprise is conducted by The Company of Electric Caterers, Ltd., which was formed early this year for the purpose by local residents, and the electrical equipment was installed at first on experimental lines; the establishment has now been running for about three months, and the results obtained have been so successful that the installation has been made permanent. The confidence of the promoters in their venture is indicated by the title which they have adopted, and we trust that, as a result of the experience gained in this well-known suburb, their operations will be extended to other districts.

The cooking apparatus was supplied by the Falkirk Iron Co., Ltd., its main



Roasting Ovens, Grill, and Toaster.

features including two large roasting ovens, two grilling and toasting apparatus, a hot cupboard and carving table, two pastry-baking ovens, a girdle plate, and sundry coffee and hot-water urns, milk boiler, &c., each provided with three-heat regulation. The roasting ovens, the meat grill, and the hot cupboard are loaded to 5 kw. each, the pastry ovens to 4 kw. each, and the other apparatus to 2 and 3 kw. each; they are controlled by "Diamond H" switches with indicators and pilot lights. The toaster (3 kw.) and grill (5 kw.) are fitted with convenient devices for regulating the distance of the food from the heating elements. The carving table is fitted with two vegetable trays, two carving trays, and two gravy wells, and, with the hot cupboard beneath it, has given great satisfaction to the kitchen staff.

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All the apparatus is controlled with ironclad Henley switches and double-pole fuses, and the wiring is carried out in screwed tubing, with flexible metallic tubing as a protection to the leads entering the cooking apparatus. All the appliances are operated on single-phase circuits, but the general supply is three-phase; maximum-demand indicators are installed, for observational purposes only, and Ferranti meters, on each phase.

In the pastry kitchen, besides the pastry ovens, there is a girdle plate loaded to 3 KW., which is in great demand for the baking of Scotch scones. The pastry ovens, which are loaded with 4 KW. each, are of a new and special design to meet the requirements of the purchasers, having each four heaters, disposed horizontally at the top and bottom of the oven and under the two intermediate shelves, so that in each compartment both top and bottom heat is provided; this arrangement has been found very satisfactory. There are two hot-water urns in the lounge, loaded to 3 KW. The coffee urn above mentioned is rated at 2 KW.

We gathered from the chefs, in both the kitchen and the pastry department, that the electric cooking apparatus gave them great satisfaction, with the one exception that the upward radiation from a coke fire for grilling was preferred to the downward radiation of the electric griller; but that may be a question of taste rather than an actual defect in the system.

The complete cooking installation is more than sufficient to cater for the accommodation provided, namely, 130 to 150 persons, in addition to a large output of pastry and confectionery for sale across the counters.

It is interesting to note that none of the staff had any previous experience with electrical apparatus, but they had no difficulty in familiarising themselves with it in the space of a few days; in fact, the chefs expressed surprise that they so quickly adapted themselves to the most modern system of cooking.

The general heating of the premises is provided for by means of "Falco" and luminous radiators, and ample arrangements are made both for ventilation and cooling the air by electric fans placed in suitable positions.

The lighting is effected with half-watt lamps throughout, and in the public rooms G.E.C. alabaster semi-indirect bowl fittings are used with excellent effect.

In thanking Mr. Drummond and his assistants for affording us facilities to prepare this notice, we add our congratulations to them and to the Electric Caterers on their progressive policy, to which we wish every success. We understand that the Supply Co. will be pleased to receive visitors who wish to inspect the installation.

THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION, 1916.—I.

THE annual meeting of the Association was opened yesterday at the Institution of Electrical Engineers, with the presidential address delivered by Mr. A. C. Cramb, borough electrical engineer of Croydon. The morning session was afterwards devoted to the reading and discussion of a paper on "Boiler-House Design and Operation," by Mr. W. W. Lackie, engineer and manager of the Glasgow Corporation Electricity Department. In the afternoon two papers were down for reading and discussion: "The Generation of Electricity on a Small Scale or Bulk Supply," by Mr. H. S. Ellis, borough electrical engineer, South Shields, and "The Application of Electricity to Agricultural Purposes," by Mr. W. T. Kerr, city electrical engineer, Hereford.

To-day the business meeting will take place, at which the report of the Council and that of the Electric Vehicle Committee will be presented. The following is an abstract of Mr. Cramb's presidential address:—

In attempting to look into the future of electric supply, Mr. Cramb said, one felt that in this, as in most other matters, things would never be quite the same again. When the country settled down to peaceful times people would aim at and expect greater efficiency and progress in business, and in co-operative action quicker and better results would be attained. The electrical industry needed in a greater degree the spirit of co-operation in furthering the expansion of its work for the benefit of the Empire and of its own members. When one considered the need for progress in standardisation, in publicity, in the field of domestic heating and cooking, and in the development of new lines of business, there could be little doubt that the future offered full scope for the energy of the Association.

There could be little doubt in the mind of any member of the Association of the necessity for standard conditions of contract; it was necessary, therefore, that individuals should not press their own personal prejudices to the extent of preventing the establishment of conditions acceptable by the majority. If progress was to be made, the mature opinion of the majority must be loyally accepted. Municipal engineers had in the past enjoyed the privilege of making contracts in which the contractor had little voice, and no doubt the settling of contracts in which both sides met on more equal terms might be somewhat disconcerting at first. The Council had not yet received any report from the Association of Municipal Corporations regarding the contentious clauses of the model conditions referred to them for consideration by the Association nearly two years ago. In the meantime, individual undertakings represented on the Association were accepting these conditions, and they had, he understood, been adopted by other representative bodies concerned.

The Association was indebted to the British Electrical and Allied Manufacturers' Association for their kindly offices in endeavouring to bring about a settlement of the outstanding differences between the Electrical Contractors' Association and themselves in connection with the I.M.E.A. Bill. A joint meeting took place, and it was hoped that an agreement had been reached, but the terms, as on previous occasions, were not accepted by the Electrical Contractors' Association. He wondered how long this policy of obstruction by a small section of the industry would be allowed to continue to seriously curtail the development of the business, not only of electric supply undertakings, but also of manufacturers and contractors. Even when contractors were guaranteed in the Bill that all wiring work, which would be greatly increased by the passing of the Bill, was to be placed in their hands, that supply undertakings were to be limited to prices which contractors could safely underquote, and that increased business would be brought about through hire and hire-purchase systems in which there would be no bad debts, they still hesitated to join in a course which held the promise of a considerable expansion of profitable business. Parliament had already in a number of cases granted much greater powers than those asked for in the Bill, and the present state of affairs, in which one undertaking held powers to develop its business which were denied to a neighbouring undertaking, was extremely illogical. The Association would at an opportune time again press for the Bill.

It had been the aim of the Association to effect an agreement equitable to the various interests, but it might become necessary to adopt a more active policy, to create a greater desire for settlement.

With regard to the Development Committee, the activity of which had been restricted by the war, the work of the Sub-Committee dealing with questions of electrical apparatus for cooking, heating, and other domestic requirements was urgent and important. There had been too much disjointed work in the production of cooking apparatus, and a co-operative effort by manufacturers and supply authorities was urgent. There were many matters of detail, but of great importance to success, which actual experience had demonstrated to require consideration. The production of a suitable and reliable radiant heating unit in place of the usual hot-plate was a case in which the work of the committee should yield good results. It was highly probable that valuable assistance could be rendered by the National Physical Laboratory in solving certain problems connected with electric heating and cooking.

The Publicity Sub-Committee had been instructed to prepare a complete scheme for the development of a publicity organisation in this country. Several attempts had previously been made in this direction, but in all cases had ceased after a certain period. Undoubtedly the want of funds had been the main obstacle. A first essential of success was the appointment of a thoroughly competent whole-time specialist in publicity, who should give his entire attention to the running of such an undertaking. A more liberal spirit of co-operation of the various interested parties was of equal importance. The hanging up of the I.M.E.A. Bill—which contained provision for enabling local authorities to subscribe to such an organisation—also continued to prevent progress.

The passing of the Summer-Time Act served to emphasise the courage and foresight of those undertakings which had adopted the Norwich or some other system of standing and running charges for domestic purposes before the use of metal-filament lamps became general. The advantage to the undertaking by the adoption of such a system, in maintaining financial stability against the large drop in revenue resulting from the introduction of more economical lamps and other causes, far outweighed any objections. His own experience in bringing before the householder the merits of electricity

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for domestic purposes had convinced him that there was a very large potential demand if only the electrical industry were ready with a supply of suitable apparatus which could be obtained by consumers on terms comparable with those to which they had become accustomed.

Electricity committees should realise that those members of the staff who had to deal with the development of electricity for domestic purposes should take every possible opportunity of gaining actual experience with various types of apparatus in their own homes, and that all reasonable facilities should be given to this end.

The question of sufficient supplies of coal for the maintenance of electricity undertakings had been a source of anxiety during the past year to the individual members of the Association, and promised next winter to become critical. The Council had done what was possible by appointing a sub-committee to watch the question, and by supporting representations to Parliament and the Board of Trade.

The proposal of the Board of Trade to urge consumers to make a percentage reduction in lighting with a view to economy in coal was not likely to have the desired effect. The view of many supply authorities that an increase in price was the more effective way of bringing about economy was undoubtedly correct. The saving in coal owing to reduction of lighting seemed also to have been greatly over-estimated.

The work of the British Engineering Standards Committee had been approved by the Government, from whom it received financial assistance. The Association was also subscribing to the expenses, and was well represented on the various committees of the Electrical Section. He hoped that local authorities would be prepared to help forward the work by subscribing.

Experience had proved that the control of accounts by an official independent of the engineer-manager inevitably led to unsatisfactory results. Nowadays the chief official of an electric supply department must, to an increasing extent, devote his energies to the financial and commercial side of the business, whilst guiding the work of the technical staff. It would be much more satisfactory if the municipal accountant were to act as an internal auditor.

In the report of the Board of Trade Committee on British Trade after the War, it was proposed that local authorities and other public bodies should be under legal obligation to purchase as far as possible only goods produced in the British Empire. It was felt by the Council that discrimination between local authorities and private companies in this matter was unjust to the ratepayers, and that whatever restrictions were made with a view to assisting British manufacturers, they should be equally applicable to all interests.

ELECTRICITY IN SMALL HOUSEHOLDS.

By W. B. SMITH, A.M.I.E.E.

(*Abstract of paper read before the* GREENOCK ELECTRICAL SOCIETY.)

ELECTRICITY is not a luxury, and it is economical to make full use of electric energy in any dwelling-house where a supply is available at reasonable rates of charge. Much of the information here put forward is the result of three years' personal experience of electric lighting, heating, and cooking in a house in which no gas was used, and where coal was burned at intervals for the heating of the rooms, but mainly for the heating of water for washing purposes.

The only hindrance to its universal adoption in dwellings is the initial outlay required to fit up lighting installations. The curves in fig. 1 show the approximate initial cost of installations for houses of from two to eight apartments, wired in steel tubing and wood casing respectively. The figures given are for everything necessary to complete the installation with the best of materials, and allow for inexpensive fittings in the principal rooms. They do not include the provision of wall sockets.

It will be noted from the curves that the cost of wiring in screwed tubing rises in greater proportion than that of wood-casing installations as the size of house increases, due to the general practice of adopting more expensive fittings where the wiring is carried out of sight behind plaster and below floors.

To take a typical house of the semi-detached type of, say, five rooms and kitchen, the description of lamps and fittings to adopt might be as shown below. The candle-power of the lamps should be determined experimentally, taking into account the colour of walls and furnishings in the rooms. The cost of an installation of this size might be about £17 in wood casing, and about £23 in screwed tubing, while the annual bill for lighting would vary from £2 to £3.

DWELLING-HOUSE OF FIVE ROOMS AND KITCHEN.

Position.	No.	C.P.	Switches.	Fittings.
Hall	1	50	1	1 pendant (fancy shade).
Dining-room	3	30	2	Rise and fall pendant (silk flounce).
Drawing-room	4	30	2	Brackets or ceiling fixtures (fancy shades).
Kitchen	1	50	1	Rise and fall pendant (fancy shade).
Scullery	1	16	1	Pendant (opal shade).
Stairway	1	16	2 2-way	Pendant (fancy shade).
Bathroom	1	30	1	Pendant (opal shade).
3 Bedrooms	3	30	3	Pendants (fancy shades).

The actual cost of electricity for lighting in small houses naturally depends on the habits of the occupants, but from information obtained from the accounts of the Greenock electricity department it is evident that the lighting bills of domestic consumers bear some relation to the size of the dwelling. The particulars in fig. 2 have been compiled from the average lighting bills of domestic consumers in Greenock who are charged at present on a flat rate of 3d. per unit. The cost of each lamp per annum averages about 4s. In fig. 3 the variation from month to month is shown, the amounts being calculated from actual meter readings. The cost of electric lighting per month varied from 5s. 7d. in January to 7d. for the month of July.

Having demonstrated the economy of electricity for lighting dwelling-houses, station engineers are now endeavouring to introduce electric energy for other domestic uses. Many "small-current" appliances are now in daily domestic use, the most popular in small houses being the electric iron, consuming one-third to one-half of a unit per hour, the electric kettle, with quick-boiling heating element to boil two pints in less than eight minutes, and the electric vacuum cleaner. On the lighting rate of, say, 3d. per unit, the intermittent use of these "small-current" devices does not very materially increase the electricity bill. But if more frequent use is made of them the consumer should be advised to adopt the "fixed-sum" system of charging, whereby an annual charge is made for the use of the supply and a small rate of, say, ¾d. per unit, for energy consumed.

The thick line in fig. 4 gives the average standing charges for small dwellings in Greenock, while the average total electricity bill at ¾d. per unit is shown by the dotted line above.

The recent boom in electric heating is undoubtedly due to the advent of a reliable electric "fire" giving radiant as well as convected heat. In a room of dimensions 14 ft. by 12 ft. by 10 ft., the capacity of the heater required would be 2½ KW., which could be reduced to about 1 KW. after the first few hours. In Greenock there are over 400 electric radiators in use, and more than 300 of these have been sent out during the last eighteen months.

In England, where a large amount of roasting and baking is done in the household, the electric cooker is now extensively used; but in Scotland, where boiling, stewing, frying, and grilling form the greater proportion of cooking operations, the adoption of the new method has been extremely slow. The reason for this is that although the electric oven has almost reached a state of perfection, the same cannot be said of the hotplates on most electric cookers.

In the selection of an oven, top heat should be insisted on as well as bottom heat, as it enables the food to be well browned on top, and a better variation of the heat distribution in the oven is possible. Side elements are not so serviceable in this respect. The full temperature of 300 deg. or 400 deg. F. should be attained in about 20 minutes after switching on, and the oven should be lagged so that about one-half of full loading maintains this temperature. The energy used for cooking varies from 1 to 1½ units per day for each person, and the annual cost for a family of three or four

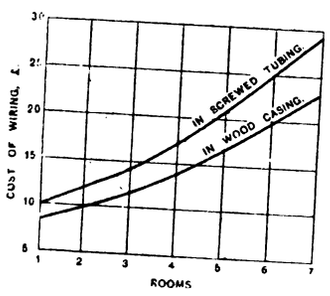

FIG. 1.

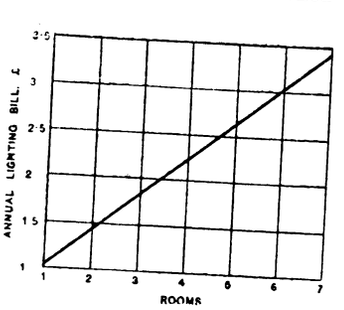

FIG. 2.

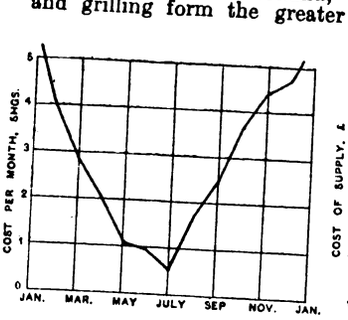

FIG. 3.

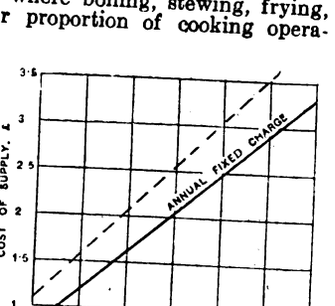

FIG. 4.

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persons should not be more than £4 10s. In a small household of three persons, where the cooking is done by electricity, and where electric heaters are used for occasional heating of rooms, the lighting costs 1½d. and the heating and cooking about 3½d., a total cost of 5½d. per day in winter. For a day in summer the cost would obviously be much less. The average price paid for the whole supply works out at a little more than 1d. per unit.

The annual cost of cooking, heating, and lighting by electricity and coal from actual results in such a house was as follows:—

	£	s.	d.
Electric lighting at 3d. per unit, 7¾d. per week	1	13	9
Electric heating and cooking at ¾d. per unit, 1s. 5½d. per week	3	15	4½
Coal at 1s. 3½d. per cwt., 1s. 11½d. per week	5	0	10
Total cost ... ... 4s. 0½d. per week	10	9	11½

In Dumbreck, Glasgow, eight small villas of four, five, and six apartments, have been fitted with electrical appliances for lighting, heating, cooking, &c., and the cost of electricity per annum for the year ending May, 1915, was found to vary from £20 to £30 for each house.

For a small dwelling, where no maidservant is kept, a total cost for electricity of £20, or even £30, per annum cannot be said to be excessive, considering the dirt and labour saved, and the usefulness of the whole arrangement. It might be argued that a large cooking and heating load would very materially raise the peak load of a power station without much advantage in increasing the general load factor of the station. Such, however, is not the case. In a town where in large tenement houses the tenants use electricity for lighting, heating, and cooking, although the total of the rated loads of 21 consumers in one block was 110 KW., the maximum load on the service cables supplying the block was only 13.5 KW. In the case of the Glasgow villas mentioned above, the maximum demand on the distributor supplying the houses was 17 KW., although the connected load totalled 80 KW., giving a diversity factor of about 5.

It has been shown in several towns that the domestic cooking and heating load comes on mainly at "off-peak" hours of the day, thereby tending to improve the load factor on the station, and assisting towards the cheaper cost of generation.

Experience has already shown that the middle-class domestic consumer has been the first to adopt electric irons, kettles, &c., and it would seem that it is in the small household where no servant, or at most one servant, is kept, that we may expect the pioneer work will be done in connection with domestic electric heating and cooking on a more comprehensive scale.

WAR ITEMS.

Exports to China.—The "London Gazette" of June 20th contains a further list of persons in China and Siam to whom exports may be consigned.

Export Prohibitions.—The "London Gazette" for June 16th contains a further list of persons or bodies in Greece, Portugal, Spain, Netherlands, &c., with whom or which trading is prohibited.

To be Wound-up.—Under the Trading with the Enemy Act the Board of Trade has ordered the following to be wound up:—

Standard Cable Manufacturing Co., Ltd., 18 and 19, Queenhithe, London, E.C. Agents for cable manufacturers. Controller: Mr. J. S. Feather, 35, Great Tower Street, London, E.C.

The Effect of the British "Black List."—The correspondent of "La Prensa" at Valparaiso says: "The trade war between the belligerent nations of Europe is assuming alarming characteristics here. In virtue of a decision of the British Government, a 'Black List' has been formulated consisting of Austrian and German business houses, with which no industrialist, trader, or private member of the 'Entente' Powers may have commercial dealings of any kind whatsoever. In this list there figure 14 firms domiciled in Chile, amongst the most important and best known in this market and whose business is connected with all Chilean products, but principally nitrate, as also with the Chilean import and export trade. The 'Black List' comprises the following firms: Dante & Co., with offices at Santiago, Valparaiso and Antofagasta; Folsch & Co.; Gildemeister & Co.; Kurtrts; Walter; Winkelhagen & Co.; Ernesto Hans; Leopoldo Reitze; Schultz, R., & Co.; Slomann & Co.; Stubernauch & Co.; Worwerk & Co.; Weber & Co. The effects of the British Government disposition above referred to are already being felt. The German nitrate company have closed down because British traders refuse to sell them sacks. Furthermore, the firm of Graham Rowe notified the Board of the Gatico Mining Co. (which is Chilean) that they would not supply them with coal or coke so long as Sr. Hutmann, manager of the German Bank, was a director. Sr. Hutmann resigned, but the prohibition of sale of coal still persists."—*Review of the River Plate.*

Exemption Applications.—At a sitting of the Bispham Tribunal last week, application was made by the Blackpool and Fleetwood Tramroad Co. for the exemption of 19 employés, including inspectors, cash clerks, a wireman, an engineer and engine tester, a feeder repairer, and motormen. Mr. J. Cameron (manager) said he was short of 50 men, and had put some conductors on as drivers, replacing them with 22 women. In the power house, where 23 men were formerly employed, there were now only 10 men, five being of military age and appealed for, and the rest being over age. In 1914, 73 men were employed, and 31 enlisted direct, and there were only 23 left. The exemptions asked for were the minimum. Exemptions were granted in every case—12 men 35 years old and over receiving conditional exemption, the remaining seven, who were under 36, being exempted until September 1st.

At Rochdale, an appeal by Mr. G. L. Adamson for an electric wireman, aged 22, was disallowed. It was stated that the man was on work directly affecting Government contracts. The firm had lost 50 per cent. of their men.

At Warrington, last Friday, an electrical contractor, aged 32, who was stated to be engaged on electrical work for firms on Government contracts, appealed on his own behalf. His appeal, together with others for certain of his employés, had been adjourned with a view to seeing whether badges which had been applied for were forthcoming. It now transpired that badges had not been received, and it was understood that badges would only be granted to people actually engaged in Government work on direct contracts. The applicant's manager had previously been granted exemption by the military authorities. Applicant now said he would not be disposed to leave anyone to look after his business in his absence, and the Tribunal deferred their decision.

The Portishead District Tribunal granted exemption to the manager and two other employés of an electrical undertaking, it being stated these were the only men left of an original staff of 26.

At the Oxford Local Tribunal, A. H. Pearson, ironmonger, Oxford, asked for absolute exemption for an electrician and fitter, the only mechanic left. Applicant was himself serving. Exemption granted so long as he remains in his present occupation.

At the St. Andrew's Tribunal, the Electric Supply Corporation applied for the exemption of one of their stokers, on the ground that the man was indispensable, as he had the repairs of machinery, &c., to do. Bailie Hall said: He left my employment at the gas works 14 months ago. He is only a fireman, and knows nothing about the repair of engines." Exempted till July 15th.

At the East Sussex Appeal Tribunal, an electrical kinema engineer applied for the renewal of an exemption given for one week by the Appeal Tribunal. Every effort had been made to dispose of the business, but without success, and if the engineer were compelled to serve the whole of the capital would be lost. He had a 21 years' lease. The appeal was dismissed. Leave to appeal was refused.

At Cookham (Berks), on June 14th, exemption until September 1st was granted to T. G. Hardy (32), electrician, of Pinkney's Green; and until August 14th to Harry Hill (36), in charge of the electrical plant for Sir R. M. Beachcroft at Cookham Dean.

At Rochdale, exemption until August 31st has been granted to Mr. T. Hartley, of Messrs. Fryer & Hartley, who is engaged on electrical contracts. Conditional exemption has been conceded to Mr. E. Rothwell (32), electrical engineer at the workhouse.

Two months' exemption has been granted, on the application of Mr. Woodman, borough electrical engineer at Dover, to a coal and ash trimmer. Leave to renew the appeal was given. A tramway body maker on the Corporation staff has been granted eight months' exemption, with leave to appeal.

At Calne, exemption until September 1st has been allowed to Mr. A. McKenzie (31), who is in sole charge of the electric power and lighting plant at the works of Messrs. Harris and Co.

Before the Devon Appeal Court, the Bradninch Electric Supply Co. appealed for Mr. L. Jeffery, engineer in charge of the generating station. It was stated that Mr. Jeffery came from Canada at the company's request to fill a gap, and if he was taken the work would have to be practically discontinued. Two months' conditional exemption was allowed.

At Aldershot, a final one month's exemption was allowed to two fitters appealed for by the Aldershot & District Traction Co. It was stated that there were now only 11 fitters on the staff, 50 per cent. having been lost during the past year.

The Tribunal at Wellington (Somerset) has granted exemption until September 1st to Thomas Antrobus, electrician, engaged at Nynehead Court, by Major Stobart.

At Salisbury, five men were appealed for by the electric light company. Mr. A. B. Randall (manager) said that all were essential to the satisfactory working of the undertaking. Nine employés had joined the Forces. Conditional exemption was given to a meter, battery, and testing assistant, two engine drivers and electricians, and an assistant engineer. The accountant and chief clerk were exempted until December.

At Walton-on-Thames, Mr. Robert James Rodd (35), electrical engineer, secured conditional exemption on the ground that he was the working manager of a firm engaged solely on Government work.

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Before the Tribunal at Woking, Mr. W. H. Exley (38), electrical engineer, designer and draughtsman, Maybury Hill, said that he was engaged on national work, and the War Office wrote to the effect that he was doing work of the utmost importance. Conditional exemption was assented to.

At Aberystwyth, the electric light company applied for exemption for Mr. E. R. Chamberlain (22), shift engineer, in charge of a Diesel engine, a steam engine, and other plant. Mr. C. P. Perkins, the manager, stated that Mr. Chamberlain also assisted in the repair and maintenance of the machinery, and it was difficult to get men capable of looking after Diesel engines. He had only two men capable of taking charge of the engine rooms, and he could not keep the works running with less men than he had now. Conditional exemption was allowed. The same Tribunal allowed exemption until September 9th to Mr. B. W. Cheetham, electrician at the local kinema theatre.

At Reigate, on June 13th, Messrs. Tamplin & Makovski, electrical engineers, appealed for exemption for seven employés. Sir Ralph Ashton (Military representative) said that in an electrical works in which he was interested five men had been replaced by women. The appeals were adjourned at the request of Mr. Makovski.

The Reigate Rural Tribunal has refused exemption to J. Penfold (40), in charge of the electric light plant at the residence of Mr. C. F. Rowsell, of Nutfield, and E. E. Cheasley (40), electrical engineer with Mr. C. L. Bower, of Nutfield.

The East Kent Appeal Court has withdrawn exemption allowed to E. J. Farewell (36), electrician at the Hippodrome, Sheerness, and granted a final month's postponement.—Mr. V. Pomfret, of Horton Manor, Chartham, appealed to the same Court for exemption for his electrician, W. J. Pay (38). A final exemption to August 25th was granted.

At Whitstable, three months' exemption has been allowed to Mr. E. C. Spray (40), electrician; and conditional exemption to Mr. A. S Tyler (32), engineer at the electricity works.

Absolute exemption was claimed, at Witney, by Mr. F. G. Curel, engineer and manager of the U.D.C. electricity works, for Victor Brice (18), on the ground that it was imperative for his daily duties to be executed for the proper maintenance of the public supply of current. Two assistants had already enlisted, and Mr. Curel said that it was impossible to obtain a competent man in Brice's place Brice had another year's apprenticeship to serve, and, including himself, the staff was now only six. There was great difficulty in finding competent electricians at the present time. One month was allowed "to look round and make other arrangements."

Before the Warwickshire Appeal Court, the Military opposed exemption until November 24th granted to Mr. A. L. Smith, electrician, of Stratford-on-Avon. The Court limited the period of exemption to two months.

At Chatham, the tramway company appealed for Mr. F. W. Bone (34), station superintendent, who has sole charge of the power station, and is indispensable. It was stated that the Board of Trade insisted upon a competent and experienced man being in charge. Three months were allowed.

Conditional exemption has been allowed to Mr. W. Robbins, wireman with Mr. W. H. Smith, of Bexley (Kent), whose former staff of 28 has been reduced to four.

The Dover Tribunal has conceded conditional exemption to Mr. E. W. Wright (39), electrical engineer.

At Stoke-on-Trent, when appeals were considered from the Potteries Electric Traction Co., it was stated that the company were prepared to liberate a considerable number of conductors now, and others later. The general manager, Mr. W. Thom, said that there were 266 eligibles left; about 46 could be gradually released as women were trained at substitutes. He offered to send the men to the military in six weeks' time This was agreed to by the Tribunal.

The Maidenhead Tribunal, on June 13th, granted exemption until October 1st to Mr. W. E. Wise (38), electrical engineer to Messrs. Wilder & Son, and until August 1st to Mr. Walter Sibley (30), electrician with Messrs. Arundell & Co.

The City of Oxford Tramways Co. appealed for absolute exemption for 29 employés. Two drivers were given one month only; the others were each exempted for three months.

Application was made to the York Tribunal in respect of three engine-room labourers, one boiler-house labourer, and one clinker wheeler, employed in the tramways department. It was stated that it had been mutually agreed that two of the claims should be refused, that two men should be exempted to August 6th, and one until September 6th.

To the Brentford Tribunal application was made for the exemption of a man engaged in the manufacture of magneto fittings for use on aeroplanes supplied to the British and French Governments. The firm had been requested to double its output, and with that object in view new machinery had been acquired. Case adjourned to enable applicant to apply for a badge.

South African Tariffs.—The Customs authorities of South Africa have recently given a decision to the effect that incandescent bulbs for pocket electric torches are to be classified under No. 114*b* of the Tariff, the general duty being at the rate of 3 per cent. *ad valorem*, with a rebate of the full duty in the case of bulbs of British manufacture.

LABOUR AND INDUSTRY.

(*Continued from page* 689.)

Many authorities are anxiously engaged with the question of how we are to employ after the war the hundreds of thousands of women-workers who have turned their hands in war-time to entirely unaccustomed pursuits. The *Engineer*, in a recent editorial, says:—"We have trained hundreds of thousands of people who had no previous knowledge of handicraft, to use these tools. What is to be done with that labour when it is no longer required for the making of munitions?" The writer replies to these questions as follows:—"A very large proportion of the labour will be glad enough to escape from the workshop and return to other duties. It is receiving now, under the impulse of necessity, wages that it is inconceivable that it should receive under peace conditions, and it is supported by zeal for its country's success in arms. Under these two influences it gives itself up to the hardship of the workshop, but when they are removed it will welcome a return to less exacting walks in life. The industrial class has broken down its boundaries, but when peace comes once again it will flow again in its old channels, widened perhaps a little, but not very greatly. The total result is that we shall have far more machines than we have workers to use."

It is, of course, impossible to forecast what the future may bring forth, but we agree with our contemporary that much of the woman labour will flow back into ordinary channels after the war—from the factory, the tramcar, the motor-omnibus, and so on. It is the stress of the times, and the desire to "do their bit" while their "boys" are away at the war, that keeps many of them working in unaccustomed ways, the strain of which they may not feel it either necessary or desirable to stand when the boys come home. In some cases they will take the place of the permanently disabled fighter and become the breadwinner, supplementing the pension; but when we read and hear prognostications of serious Labour strife after the war because the women will want to stick to their present kind of life, doing the returned men out of their positions, we are disposed to discount them as exaggerated imaginings. It is altogether too early for us to judge of the position of woman as a substitute for man in industry, however well many of them have acquitted themselves under certain abnormal conditions. Quite legitimately, the women-workers have a committee looking after their interests up and down the country, and a programme is stated to have been drawn up by which the committee hopes to ensure that a woman displaced after the war shall receive, through a Trade Union, adequate out-of-work benefit, either until she gets work or for an agreed period, and that the Government shall subsidise the Trade Unions to enable them to meet the increased cost of unemployment benefit.

At the present moment there is an urgent call being made for hundreds of thousands more women to enter the workers' ranks. As matters stand, only in this way, accompanied by the most complete dilution measures, can industrial output, which might otherwise be seriously affected by the drawing off of men for the active Forces, be maintained. Both in order to supply home needs and to assist in the upkeep of the export trade more woman labour is required. Information is being collected by a special Bureau concerning the women who are available. According to the *Daily Telegraph* there were before the war 2,180,000 women employed in industry, and by a couple of months ago 391,000 more had "enlisted."

These extra women were distributed very unevenly among the various trades. Of 49,000 who secured work between February and April, 41,000 went to the metal and chemical trades, leaving only 8,000 for all other industries, a total very much smaller than the number of men who during the same period had joined the Forces. The need for a further employment of women in these trades is therefore urgent. Some manufacturers have shown considerable enterprise, and are employing women on various new processes, the experiment often turning out quite successfully. With regard to the supply of women before the war, there were about 1¾ million who were unmarried and "unoccupied." Of these 1,000,000 were under 25, and for the most part untrained. It is pointed out that these could profitably be employed for munition work, but the needs of the other industries must not be forgotten. The textile trades, for example, employ a large number of

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women, and are most important from the national standpoint on account of the export trade. These industries are now suffering severely from a shortage of trained women.

The *Engineer* article already referred to proceeds:—"The public has been shown in a most convincing way that the restriction which Labour put upon output was a very real thing, and that employers under-stated rather than exaggerated it. Very many people who will eventually leave the workshops now know by experience what output can be attained. Hence there will be a large body of public opinion against shirking and 'ca-canny,' and it is probable that under its influence the output per machine will be increased considerably over pre-war times." Taking all the different factors into account, it is concluded that we are "in possession of enormous potential energy. We have a vast number of machine tools, and we have an increased number of workpeople—not sufficient for the tools, but still increased—who are able to turn out more per individual than heretofore. How can we make use of this potential energy? That is the question to which an answer is desired, and we must confess for our own part that we see none at present, and see no probability that prevision will be of much avail." Our contemporary apparently does not consider that there will be a great demand upon British factories for the requirements of Allied countries that before the war we were not supplying. We must make within our own borders more of our own manufactured requirements, must meet the demands of the Empire, and must strain every nerve to increase the volume of our trade.

In regard to the subject of dilution, with which we have already dealt on several occasions, detailing some of the steps which have been taken to train suitable labour and the success which has attended these efforts, the extreme importance of this question is shown by a letter written by the First Lord of the Admiralty on June 8th, in which he stated that "during the period of the war nothing short of an ample scheme of dilution would meet naval requirements and secure national safety." He expressed his appreciation of the loyal way in which the skilled men on the Clyde had assisted dilution in the engineering shops, and did not doubt that those engaged on national work in the shipyards would follow their patriotic example. An important agreement on the matter has been reached between the Commission on the Dilution of Labour and the Clyde and West of Scotland District Committee of the Boilermakers' and Iron and Steel Shipbuilders' Society. We quote from the *Times* the terms of this agreement:—

1. Co-operative efforts to increase production by the adoption of all expedients which tend to increase and maintain output.
2. Interchangeability inside the boilermakers' and iron and steel shipbuilders' trade of the various classes of persons who are members of that trade, and with that purpose in view the suspension for the period of the war of all internal lines of demarcation.
3. The utilisation to the best advantage of existing skilled men, or skilled men interchanged, and the use, as far as practicable, of pneumatic, hydraulic, and electric tools.
4. The upgrading in the boilermakers' and iron and steel shipbuilders' trade of workmen to do more skilled work wherever the nature of the work and the qualifications of the men make such procedure practicable.
5. The introduction into the boilermakers' and iron and steel shipbuilders' trade of (*a*) skilled men from allied trades; (*b*) skilled men from other trades; (*c*) unskilled men and women in all cases where the work is of such a character, or the conditions such, as to enable the labour introduced to perform the work with reasonable efficiency.
6. The relaxation of the existing demarcation restrictions, or the admission of semi-skilled or female labour not to affect adversely the rates customarily paid for the job. In cases where men who ordinarily do the work are adversely affected thereby, the necessary readjustments shall be made, so that they can maintain their previous earnings.
7. A record of the nature of the departure from the conditions prevailing when the establishment became a controlled establishment to be kept.
8. Due notice to be given to the workmen concerned, wherever practicable, of any changes in the working conditions which it is desired to introduce as the result of the establishment becoming a controlled establishment, and opportunity for local consultation with workmen or their representatives to be given, if desired.

(*To be continued.*)

Accident.—Mr. J. McClenaghan, electrical engineer, Portstewart, was rather badly injured while motor-cycling. He collided with a horse and lorry, and the animal fell on his machine.

LEGAL.

Munition Case.

The Oldham Munitions Tribunal last week refused an application for a leaving certificate made by an employé of an electrical instrument manufacturing firm, who pleaded ill-health and declared that the fumes from a soldering-pot in the works affected him. The case had been adjourned for medical examination, and the doctor reported that the applicant was suffering from slight bronchitis and slight nasal catarrh, and that there was nothing in the place where he worked that was injurious to his health. On hearing the decision of the Tribunal, applicant said his parents insisted on his leaving the place, and he took it he could do so if he "played" for six weeks. Mr. J. Hodgson (President) said that it was not for the Court to advise applicant what to do. The manager of the firm asked that the case should come under Sec. 22 of the Act in regard to the doctor's costs in examining the works, and he contended that the applicant ought to pay the doctor's costs because the proceedings, he alleged, were vexatious and frivolous. The allegations as to the working conditions had been proved unfounded. Mr. Hodgson said he did not think the proceedings were vexatious or frivolous; there was no application by the complainant for the doctor to examine the works, and he (Mr. Hodgson) did not think Sec. 22 applied here.

Injunction Against an Irish Electrical Co.

In the Irish Chancery Division, before the Master of the Rolls, a consent was received and made a rule of Court in an action by Mary E Ewing against the Irish Towns Electric Light and Power Co., Ltd., defendants agreeing to an injunction restraining them and their servants and agents and workmen from using or working on their premises at Newcastle, Co. Down, any gas engine or machinery in such a manner as, by reason of vibration or otherwise, to injure plaintiff's dwelling-house and premises at Slieve Dhu, Newcastle, or from interfering with or annoying her.

BUSINESS NOTES.

Board of Trade Inquiry.—The Board of Trade Commercial Intelligence Branch in London has the name and address of a Calcutta firm which desires to communicate with British manufacturers of electrical fittings, such as cut-glass chandeliers, &c.

Monometer Furnaces.—We have received a lengthy list of orders recently received by the Monometer Manufacturing Co., Ltd., of Aston, Birmingham, for their specialities. These include contracts for a number of well-known electrical manufacturing firms and many industrial works of other classes in this country. Monometer aluminium melting furnaces are being exported to Italy and other types by the same firm to Australia and the United States. The Monometer tilting furnace is now constructed for coke firing as well as for oil and gas.

Electricity in Collieries.—Mr. A. F. Pease, presiding at the annual meeting of Messrs. Pease & Partners, Ltd., at Darlington last week, said that the firm had been extremely fortunate in getting nearly all their electrical schemes completed before the war, and it had meant a large saving in labour in their collieries and mines in these difficult times, and left them with a larger amount of coal at the collieries to dispose of.

Patent Applications.—As announced in our advertisement pages, Mr. C. B. Kersting has applied for permission to amend Patent No. 22,549, of 1914, for "Improvements in inter-communication telephone systems."

Messrs. A. G. Hopper, J. E. Hopper Greenwood, and K. Anderson have applied for restoration of Letters Patent No. 25,363, of 1907, granted to A Greenwood and K. Anderson.

British Trade with Italy.—The British Chamber of Commerce for Italy (Inc.), whose registered London office is at Oxford Court, Cannon Street, E.C., has issued particulars of membership in the Chamber. An official notice from Italy states that the new headquarters of the Chamber at 7, Via Carlo Felice, Genoa, with exhibition show-cases, are now ready. They are centrally situated near the principal business buildings, and in the showrooms will be displayed a sample exhibition of British goods suitable for import into Italy. Communications respecting terms for space, &c., should be addressed to Mr. E. B. Weatherhead, the secretary-general, at the above address at Genoa. The Chamber has branches in Milan, Tuscany, Rome and Naples.

Catalogues and Lists.—Allies Electric Lamp Repairing Co., Ltd., Montgomery Street, Hammersmith, London.—Folder giving particulars and prices of "old lamps made into new" by their regenerating process.

The General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—A showcard measuring 17 in. by 22 in., attractively designed and executed in 11 colours, has been issued for the purpose of assisting the popularisation of "Magnet" electric fires. Afternoon tea is the subject of the picture.

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Book Notices.—"Discovery; or, the Spirit and Service of Science." By R. A. Gregory. London: Macmillan & Co. Price 5s. net.

"*Proceedings* of the Physical Society of London." Vol. XXVIII. Part IV. June 15th, 1916. London: The *Electrician* P. and P. Co., Ltd. Price 4s. net.

Manchester Steam Users' Association.—The annual report of the Committee of Management shows that in 1915 there were 2,089 members, and 10 793 boilers under inspection, and the revenue was £22,642—record figures. The year was the busiest the Association had ever experienced, 22,297 examinations being made.

Meter Approved.—The Board of Trade has approved of the Westinghouse single-phase watt-hour meter, type K, deposited in March, 1915, by the British Westinghouse Electric and Manufacturing Co., Ltd.

Dissolutions and Liquidations.—Marine Smokeless Mechanical Stoker Co., Ltd.—This company is winding up voluntarily with Mr. T. W. Gilbert, Blomfield House, London Wall, E.C., as liquidator.

Ebury Electrical Engineering Co. and Ebury Garage, automobile and electrical engineers and lighting equipment experts, 80, Ebury Mews, Victoria, S.W.—Messrs. R. Ormes, H. K. Gossip and H. Jones, have dissolved partnership, Mr. Gossip retiring. Debts, &c., will be attended to by the other gentlemen named, who will continue the business.

Stellar Signs, Ltd.—A meeting is called for July 18th, at 11, Pancras Lane, E.C., to hear an account of the winding up from the liquidators, Messrs. A. C. Hutchins and V. G. Morris.

Colston Electrical Works, Ltd., Bristol.—First meetings of creditors and contributories, June 28th, at 26, Baldwin Street, Bristol.

Bankruptcy Proceedings.—J. Boult and J. H. Bolt, electricians, Liverpool; also John Boult, separate estate.—July 5th is the last day for the receipt of proofs for dividend. Trustee: Mr. P. S. Booth, 2, Bixteth Street, Liverpool.

James Brockie, mechanical engineer, Forest Hill.—July 3rd is the last day for receipt of proofs for dividend, by the Hon. W. J. H. Boyle, 132, York Road, Westminster Bridge Road, S.E., the trustee.

Trade Announcements.—Messrs. Donnison, Sillem and Co. have decided to close the business of general and electrical engineers and contractors which they have been carrying on at 116, Great Portland Street, W, for the past 20 years. Mr. Donnison has entered into a working arrangement with Messrs. Girdlestone & Co., electrical engineers, of 23, Davies Street, Berkeley Square, W., and he will continue to give his personal attention to orders. Mr. Sillem is retiring from the business.

The style of the firm of Eckstein, Heap & Co., Ltd., Manchester, has been altered to *Erskine, Heap & Co., Ltd.*

LIGHTING AND POWER NOTES.

Aberdeen.—Plant Extension.—The Corporation Electricity Committee has considered the matter of the extension of the generating plant, together with a supplementary report from Mr. Bell, the engineer, and has instructed Mr. Bell to obtain tenders.

Aylesbury. — Price Increase. — The U.D.C. has arranged to supply electricity to the Dominion Dairy Co. at 1½d. per unit up to 20,000 per quarter, and 1¾d. per unit beyond. The existing rates of charging for lighting and power have been increased by 10 per cent.

Ballymoney.—Public Lighting.—The Council has considered the question of lighting the town by electricity, and has instructed the clerk to inquire of the L.G.B. with regard to the powers possessed by the Council for raising money by loan.

Boothstown.—Electric power, generated on the spot, is now being utilised to drive the machinery at Lord Ellesmere's Mosley Common Collieries, Boothstown, near Manchester. These collieries are amongst the largest and deepest in England, and employ 1,800 men and youths.

Bournemouth.—The Electricity Supply Co., in view of the fact that the Council has not been able, owing to lighting restrictions, to take the minimum quantity of energy specified in the contract, offered to make an allowance of ½d. per unit upon the balance of the minimum consumption; the Council has accepted the proposal.

Burton-on-Trent.—Year's Working.—The report of the year's working of the electricity department shows a total ordinary income of £20,310, and works expenditure £9,542. The profit-sharing bonus amounted to £228, leaving a gross profit of £10,540. After meeting loan and other charges, the surplus remaining was £1,938, as compared with £2 566 last year. The surplus has been allocated as follows:—£1,308 to meet capital expenditure on transformers, mains, and services, in lieu of borrowing: £520 for depreciation of Consols, and the balance of £110 was carried to the renewals fund. The total capital expended, including £2,616 during the year, was £127,389, of which £14,943 had been provided out of revenue. The total number of units sold was 3,499,388, as compared with 2,914,828 in 1915, an increase of 584,510. The principal increase was in sales for power and heating. The H.P. of motors connected increased by 357 during the year, the total being 3,360 H.P. The total costs decreased from 0·686d. per unit to 0·658d; the installation of the new turbo-generator was mainly responsible for the reduction. The maximum load of 1,751 KW. was recorded on December 9th, 1915, representing an increase of 431 KW. on last year.—*Burton Daily Mail.*

Chester.—Year's Working.—The report of the City electrical engineer, Mr. S. E. Britton, for the past year shows that the electricity department made a gross profit of £12,370 and a net profit of £2,956, as compared with £12,483 and £3,194 respectively in 1915. These figures embody the results of the steam and the hydro works.

During the 12 months 1,567,300 units were generated by water-power, of which 16,062 were used for pumping sewage, 1,600 were used for lighting the works, 42 310 for excitation and feeder booster, 128,122 in the distribution cables, and 1,379,206 were sold to consumers. The cost of operating these works and producing the above quantity of electrical energy was as follows:—

Oil and stores	£28	
Wages	242	
Repairs and maintenance	64	
Rent	100	
Rates and taxes and insurance ...	138	
Total works charges	£572	*i.e.*, ·0995d. per unit sold.

The capital charges were:—

Interest on loans	£490	
Sinking fund charges	524	
Total capital charges	£1,014	*i.e.*, ·1765d. per unit sold.

The total cost was ·276d. per unit sold—a remarkable result, which should give great satisfaction to Mr. Britton and his Committee.

The total output was 3,467,323 units, of which private consumers took 1,076 523 and bulk supply took 917,117; the tramways purchased 391,329, and public lighting (946 inc. lamps) consumed 283 089, making a total of 2,668,058 units sold, compared with 2,535,600 in the previous year. Including the whole of the plant, the average works costs came to 0·583d. per unit sold, and the total costs to 0·877d. Coal alone cost 0·285d. per unit sold, and as only half the output was generated by steam, it would seem that the cost of coal for the steam units was about twice as much as the total cost, including capital charges, of the water units.

Dover.—Year's Working.—The report of the Corporation electricity department for the year ended March 31st last shows that 1,572 604 units were sold, an increase of 53,947 on the previous year. The total expenditure on capital account to date was £192,184, including £3,814 on mains extensions for Government use and £277 on new works. The total receipts for the year were £23,586, £21,560 being for electricity supplied. Working costs amounted to £13,572, leaving a gross profit of £10,013. Interest on capital amounted to £7,593, and contributions to sinking fund to £4,174, making a total of £11,767. There was a net loss on the year's working of £1,754, which has been taken from the surplus of £3,080 brought forward from last year.—*Dover Express.*

Farnworth.—Electrical plant is to be put down in place of gas power in the Piggott Street spinning mill, Farnworth, belonging to Messrs. Hollas & Farnworth.

Gillingham (Kent).—Tar Oil.—Owing to the high price of fuel oil (£8 16s. 3d. per ton), the T.C. has referred to a Committee the question of using tar oil at the electricity works, the cost being 80s. per ton, and the efficiency 10 per cent. less than with ordinary fuel oil. About 500 tons per year are used, and with the use of tar oil there would be a yearly saving of £2,200, while the cost of the necessary apparatus for the two engines would be £515.

Great Harwood.—The B. of T. has granted the U.D.C. an extension of the Electric Lighting Order to August 7th, 1917.

Greenock.—Loan Sanction.—The Secretary for Scotland has agreed to grant borrowing powers in connection with the Corporation's electricity extension scheme for the full sum of £45,000, instead of £35,000 sanctioned previously. Repayment is to be spread over 25 years. Sanction is given subject to the condition that the whole surplus revenue of the undertaking, after meeting working expenses, depreciation, and debt charges, is transferred annually to the reserve fund, until that fund has reached its maximum. Immediate steps will be taken to proceed with the work involved in the scheme.

Heywood.—Year's Working.—The working of the electricity department for the year ended March 31st, 1916, has resulted in a loss of £1,052, including £112 for obsolete plant, disallowed by the L.G.B.

The Roeacre Dyeing and Felting Co., Ltd., has asked for a supply of electricity, and the electrical engineer is to report to the Committee on the matter.

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Kilmarnock.—In view of questions that have been raised from time to time regarding the administration of the electricity department, the T.C. has decided to ask Sir Alex. Kennedy to make a general survey and report on the position of the electricity works, and to retain him as consulting electrical engineer for the burgh.

Kingswinford.—Public Lighting.—The R.D.C. has arranged with the Midland Electric Corporation for the public lighting account from January 1st to June 10th, amounting to £550, to be reduced by £150, on account of restricted lighting, on condition that the contract is renewed for three years at the old rate, only lamps actually lighted during the war period to be paid for.

London.—Price Increase.—The Charing Cross, West End and City Electricity Supply Co., Ltd., announces that, owing to the refusal of the B. of T. to allow the company to increase the charges for electricity by 10 per cent., it has decided to fall back on the powers conferred upon it by the Act of Parliament and the City of London Electric Lighting Order, 1899. The new charges for lighting, which are to come into force at the end of June, are:—Each quarter 5d. per unit for the first three units consumed per 30 watts of connected demand; each quarter 4d. per unit for the next 8 units consumed per 30 watts of connected demand. All units in excess will be charged for at 2d. per unit.—*City Press.*

Middlesbro'.—Year's Working.—The report of the electrical engineer, Mr. R. H. Scotson, for the past year shows revenue £25,087, as compared with £25,365 the previous year, and expenditure £14,419 (·727d. per unit) as against £14,372 (·985d. per unit). The gross profit for the year was £10,668, as compared with £10,994, and the net profit £3,325, as against £3,978. The number of consumers was 2,147, as compared with 2,001, and the average price per unit sold was 1·47d., as against 1·74d. the previous year. Certain alterations he suggested a year ago had been carried out with results more satisfactory than was expected. They had sold over 550,000 more units than in the previous year, yet the combined cost was only £14 more, whereas if this extra current had been generated under the old arrangement it would have cost at least £1,150. They had saved on generation alone £1,136, in addition to the wages of six men, whom it had been possible to dispense with.

The revenue had been adversely affected amongst other things by reduction in private lighting of £2,442, public lighting of £135, and market lighting of £13. The total reduction of £3 423 was entirely due to the war, but had been met by increased revenue from power of £2,241, and a saving on wages of £529, leaving a reduction in the net profit of £653.

Newcastle-under-Lyme.—The T.C. has decided that in future a minimum charge of 5s. per quarter shall be made for electricity services.

Newfoundland.—The Imperial Trade Correspondent at St. Johns (Mr. H. W. Le Mesurier) reports the passing of an Act to incorporate the Union Electric Light and Power Co., and for other purposes. The capital of this company will be about £20,550, and it is authorised to install an electric light and power system and operate electric tramways in the towns of Trinity, Catalina, Bonavista, &c. The company is also granted the exclusive right to use the waters of several lakes and streams.—*Board of Trade Journal.*

Oxford.—Price Increase.—The Oxford Electric Co., Ltd., announces that after the reading of the meters for the June quarter there will be an increase of 20 per cent. on the present charges for electricity.

Paisley.—Switchboard Fire.—Owing to a breakdown at the electricity station, Blackhall, recently, the supply was for a time seriously impaired. It was found that the high-pressure switchboard had caught fire, and six hours elapsed before repairs could be executed.

Shropshire.—The *London Gazette* for June 16th contains a notice of the application of the Shropshire, Worcestershire and Staffordshire Electric Power Co. for Parliamentary sanction to amending their borrowing and other powers.

Swansea.—Mains are to be extended to Prince of Wales Road, at a cost of £250. The B. of T.'s letter *re* the interconnection of supply undertakings, in order to effect saving in coal, has been referred to the chairman and vice-chairman of the Electricity Committee, together with the engineer, with a view to the proposals being extended, in a similar manner to the Corporation's arrangement with the tramway company, to other large independent consumers of electricity.

Slaithwaite.—The B. of T. has extended the U.D.C.'s electric lighting order for one year.

Sweden.—A new company has lately been formed at Alfdalen, with a capital of £50,000, and the title Alfdalens Elektrizitetswerk Aktiebolag, to acquire the rights to certain waterfalls in the district, and to establish electricity generating plants to utilise the same.

Tasmania.—New Undertaking.—The inauguration of the Wynyard (Tas.) municipal electric light undertaking took place recently; the generating plant at present installed consists of an 84-H.P. Hornsby suction gas engine driving a 45-KW. D.C. 460-volt three-wire dynamo with static balancer. The storage battery of the Chloride type consists of 256 cells of 460 ampere-hours' capacity. There are 50 street lights, 42 of 100 C.P. and 8 of 500 C.P. The scheme has started under very satisfactory conditions as to load; 150 houses were wired and connected, with 40 waiting to be completed, making 190 connected to the plant in the first six weeks of operation. The motor load is also large, and is steadily increasing. The Council's engineer is Mr. A. L. Kerr, to whom is largely due the successful loading of the plant.—*Commonwealth Engineer.*

Tottington (Lancs.).—The D.C. has granted an application made by the Lancs. E.P. Co., to cross Harwood and Bradshaw Roads with their overhead mains.

Walkden.—Amongst the latest cotton mills (weaving and doubling) in Walkden to adopt additional electrical installations are Mr. W. A. Rothwell's Primrose Mill and Messrs. Faulkner's Granville Mill. Further developments in this direction are expected at Messrs. Burgess, Ledward & Co.'s Wardley Mills.

Walsall.—Year's Working.—The total expenditure on revenue account of the electricity undertaking during the twelve months ended March 31st last was £4,496 more than in the preceding year, the respective figures being £18,789 and £14,293. The increased cost of generation contributed largely to this increase, the total for the year under review being £11,699 as against £7,920, or an increase of £3,778. £22,026 was received from the sale of energy for lighting, power and bulk supply, £6,726 from sale of energy for tramways, and £553 from public lighting, making, with minor items, total receipts £29,573, or 1·84d. per unit sold, compared with £25,879 in 1915. The balance of £10,784 is carried to net revenue account. From this has to be deducted interest on loans and stock (£4,936) and contributions to sinking funds (£6,747), leaving a deficit on the year's working of £899. The Town Council is recommended to defray this loss out of the reserve fund.

The rotary converter on order for the Darwall Street sub-station is being taken over by the Minister of Munitions, on condition that it will be replaced without any cost to the Corporation. The Electricity Committee proposes to extend the mains to the works of Messrs. Craddock & Sons, at Wisemore.

Walton.—It was reported at last week's meeting of the U.D.C. that the B. of T. had considered the application of the Urban Electric Supply Co. to be allowed to discontinue the maximum demand, with the result that the Board's representative intimated that he would recommend the Board not to accede to the application for a minimum charge asked for by the company—viz., 11s. 7d. per quarter—and that he would recommend that the maximum charge should be increased to 7d per unit.

Wolverhampton.—Plant Extensions.—The Electricity Committee of the Corporation has decided to make application to the L.G.B. for permission to borrow £34,240, being £53 900 for the extensions contained in the electrical engineer's report of February 21st, 1916, less £19,660 for which borrowing powers had been already asked. The Finance Committee has been authorised to borrow the money, and, if necessary, to raise Wolverhampton Corporation stock for the purpose.

TRAMWAY and RAILWAY NOTES.

Ashton-under-Lyne.—Tramway Purchase.—The T.C. has adopted a recommendation of the Tramways Committee that a Bill be promoted in Parliament to obtain powers to enable the Corporation to acquire the tramways of the Oldham, Ashton, and Hyde Electric Tramways, Ltd, within the areas of Waterlow and Bardsley.

Australia.—The report of the Deputy Chief Commissioner on the working of the N.S.W. Government tramways for the quarter ended March 31st, 1916, shows revenue £514,661, an increase of £10,178; expenditure, £378,560, an increase of £5,773; and number of passengers carried, 75,537,540, an increase of 2,141,640.

During April two electrical tramway services were opened in Melbourne and its suburbs. The first is that from Princes Bridge, Melbourne, to Hawthorn and Burwood, the total cost of which, when completed, will be approximately £220,000; electricity is purchased in bulk from the Melbourne Electric Supply Co. The second opened was the Coburg section, about two miles of the Melbourne, Brunswick and Coburg tramways.—*Commonwealth Engineer.*

Colchester.—Year's Working.—The annual report of the Corporation tramways for the year ended March 31st last shows total revenue £15,741, an increase of £1,919 over the previous year. The gross profit on the year's working is £5,043; after payment of interest on capital £1,853, allowances to men with the Forces £187, and sinking fund charges £2,590, there is a net profit of £440, compared with a loss last year of £402. The total amount appropriated from revenue for repayment of loans since the commencement of working is now £24,619. The total revenue per car-mile was 11·41d. as compared with 9·96d. in 1915; and total working expenses per car-mile were 7·73d. as against 6·90d.

Croydon.—Tramway Strike.—The South Metropolitan Tramways Co., which has had a dispute with its employés, has concluded an agreement which is to be retrospective to the beginning of May, and to continue till 1919, the terms and conditions being similar to those obtaining under the L.C.C. The strike of the Croydon tramway employés still continues.

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Glasgow.—Wages Demand.—The motormen and conductors (male and female) in the employment of the T.C., to the number of 3,100, have applied for an increase of 6s. per week on their present scale of wages, on the ground of increased cost of living. Since the war started, all motormen and conductors have received an increase of 2s. weekly, and in addition a bonus of 2s. was paid to men whose wages were under 30s. weekly. The general manager is to report on the application, and it has been pointed out that the increase, if granted, would represent a weekly payment of £930, or an annual additional expenditure of £48,500, which would not only wipe out the surplus of £43,548 handed to the Common Good as a result of last year's working, but would leave a deficit of nearly £5 000.

Replying to a request by the Springburn Ward Committee, the Tramways Committee of the T.C. has informed the applicants that, in view of the difficulties under which the day service of cars is at present maintained, it is impossible for the department in the meantime to accede to a suggestion for establishing a half-hourly all-night service on the principal car routes in the city.

Year's Working.—The report of the tramway department shows traffic and sundry receipts for the financial year to the end of May at £1,137.336, as compared with £1,076,877. The expenditure is £773 442, including a sum of £80,437 for expenses on account of the European War. For renewal and depreciation the amount set apart is £174,407, and the surplus paid to Common Good is £43,548, as compared with £12,951 last year.

Leigh.—Owing to the rapid opening-out of new coalfields in the Astley district, local authorities are to approach the South Lancashire Tramways Co. to press for the construction of tramways from Leigh through Astley to Boothstown.

London and South-Western Electrification.—On Sunday last, trains started running on the Waterloo to Hampton Court section of the L. & S.W. Railway. This is the fifth section of the line to be electrified; only two sections, both running to Guildford, now remain to be completed. On the East Putney-Wimbledon route electric trains commenced running on October 25th last year, on the Kingston roundabout route and the Shepperton branch on June 30th, and on the Hounslow loop on March 12th. There will be trains every 20 minutes on the Waterloo-Hampton Court section.

Manchester.—The tramway department on Monday commenced an experimental half-hourly motor-bus service from West Point, Slade Lane, car terminus to the Palatine Road car terminus.

Southend-on-Sea.—War Economies.—The Committee appointed by the Corporation to consider the question of effecting economies in public expenditure has considered the possibility of saving money by reducing the tramway service in any particular way, but is of opinion that this step would be inadvisable, both from the point of view of public service and that of economy, as the capital charges in respect of the service would continue whether the cars were in use or not. Regarding the staff at present engaged for the maintenance of the service, the Committee recommends the Corporation to dispense with the services of the traffic superintendent.

Walsall.—The Corporation Tramways Committee proposes to purchase three additional single-deck motor omnibuses, at a total cost of £3,187.

TELEGRAPH and TELEPHONE NOTES.

Australia.—According to the *Melbourne Age*, the Federal Arbitration Court commenced the hearing of the claim filed by the Australian Post and Telegraph Officers' Association against the Commonwealth Public Service Commissioner and Postmaster-General on April 27th. Claims were made for increased salaries for telegraph engineers and telegraphists, reduction of hours of duty, &c.

Holland.—It is reported that several private wireless installations have been seized at The Hague and confiscated by the authorities. The owners will be prosecuted.

Italy.—The automatic telephone exchange for 2,000 subscribers, installed at Rome some two years ago, has given such satisfaction to the Technical Commission supervising its installation and working that a proposal has been introduced into the Italian Parliament to replace all the existing manual exchanges by automatic exchanges. The example of the capital will, it is believed, induce the choice of that system for all future telephone installations throughout Italy.

New Cable.—A triple convention between Russia, China, and Autonomous Outer Mongolia, regarding a telegraphic cable to Outer Mongolia, has been published in Petrograd.

Post Office.—The Postmaster-General was to open the new head office of the London District Post Office Engineering Department, near London Bridge, yesterday.

Permanent male part-time London night telephonists, who have been employed for two years or more, have been granted 3s. a week increase, retrospective to February, 1914. These men now receive 18s., with 7s. a week war bonus, for 18 hours a week.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—U.D.C. Cable. See "Official Notices" to-day.

Aberdeen.—July 7th. Corporation. One 5,000-kw. turbo-alternator with surface condenser and auxiliaries, for the Electricity Department. See "Official Notices" to-day.

Australia.—Perth.—July 19th. P.M.G. Supply of insulators (Schedule 510). See "Official Notices" June 9th.

August 16th. P.M.G. Distilling apparatus (Schedule 502), telegraph and measuring instruments (Schedule 498). See "Official Notices" June 16th.

Melbourne.—July 26th. Victorian Railway Commissioners. 400 signal lighting transformers.*

Sydney.—August 17th. Portable internal-combustion engine and dynamo (2½ kw.) for the Departmental Stores, Sydney, for P.M.G.*

August 24th. P.M.G. Automatic switchboard and apparatus for North Sydney Exchange. Schedule No. 511.*

Brisbane.—July 31st. P.M.G. Power board and accumulators. Schedule No. 381.

Exminster.—June 29th. Electrical appliances for a year, for Devon County Lunatic Asylum. Mr. C. Masters, Clerk.

Liverpool.—June 26th. Electrical supplies to Toxteth Park B. of G. for three months. Mr. R. A. James, Clerk, 15, High Park Street.

Malvern.—Urban Council. Compressor for the electricity works. The Manager.

New Zealand.—Invercargill.—September 28th. Borough Council. Steam turbo-alternator, condensing plant, and switchgear. Specifications from the Tramway Office.

Rotherham.—July 3rd. Corporation. Twelve months' supply of tramway stores and materials, coal, cable, meters, &c. See "Official Notices" June 16th.

Salford.—June 26th. Corporation. Coal conveyors and bunkers, for the Electricity Department. See "Official Notices" June 16th.

Corporation Tramways. Manganese-steel crossings and steel tramway poles. General Manager, 32, Blackfriars Street.

Spain.—July 4th. Spanish Post and Telegraph authorities in Barcelona. Erection of an interurban telephone line between Igualada, Santa Coloma and Vallfogona, in the Province of Barcelona.

Warrington.—June 27th. (1) Coal elevator; (2) vertical steam boiler feed pump. Specifications, &c. (£1 1s. each, returnable), from Mr. F. V. L. Mathias, Borough Electrical and Tramways Engineer, Howley.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Accrington.—Electric lighting of Christ Church: Contract let to Messrs. Simpson, of Hapton.

Aylesbury.—U.D.C. Extension of battery at the electricity works: Chloride Co.

Bristol.—Electricity Committee. Contracts with the East Bristol Collieries, Ltd. (value £12,561), for coal to 30th September.

Glasgow.—The Tramways Committee recommends the following for acceptance:—

Scrap trolley wire, copper and mica turnings, scrap lead, scrap lead-covered cables.—MacKinlay, Ltd.

Scrap armature coils, scrap brass, bare stranded cables, D.C.C. copper wire, turnings and borings, scrap rubber and cables, dry coils.—R. M. Easdale & Co.

Wall plug-sockets, &c.—W. C. Yuille & Co.

The Electricity Committee has accepted the offer (£250) of Messrs. Waygood, Otis & Co. for a hoist for the showrooms in Sauchiehall Street.

Electricity Committee. Recommended tender:—

Babcock & Wilcox, Ltd.—Four sets of water-tube boilers for St. Andrew's Cross, £10,632.

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Government Contracts.—List of new contracts for May, 1916 :—

WAR OFFICE.

Electric cables and wire.—B.I. & Helsby Cables, Ltd.; Connolly Bros., Ltd.; W. T. Glover & Co., Ltd.; Hooper's Telegraph & India-Rubber Works, Ltd.; St. Helens Cable & Rubber Co., Ltd.
Conduits and fittings.—Simplex Conduits, Ltd.
Ebonite rod.—I.R., G.P. & Telegraph Works Co., Ltd.; Peel-Conner Telephone Works, Ltd.
Generating sets.—Browett, Lindley & Co., Ltd.; Coventry Simplex Engines, Ltd.; W. H. Dorman & Co.; Norris, Henty & Gardners, Ltd.
Gutta-percha (sheet).—Craigpark Electric Cable Co., Ltd.
Electric lamps.—British Thomson-Houston Co., Ltd.; Cryselco, Ltd.
Works services.—Electric light installation at Crambington: Robson and Coleman. Electric light installation at Lilbourne: G. Weston & Sons. Electric light installation at London Colney: Tredegars, Ltd. Machinery and plant for power house, Milton: R. Garrett & Sons, Ltd.; British Westinghouse Electric & Mfg. Co., Ltd.; D.P. Battery Co., Ltd.

INDIA OFFICE STORE DEPARTMENT.

Cable.—Callender's Cable & Construction Co., Ltd.; W. T. Glover and Co., Ltd.
Plates.—Chloride Electrical Storage Co., Ltd.

POST OFFICE.

Telephone apparatus.—Automatic Telephone Mfg. Co., Ltd.
Telegraph arms.—Siemens Bros. & Co., Ltd.
Telephone cable.—New Gutta-Percha Co., Ltd.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.
Porous cells.—I.R., G.P. & Telegraph Works Co., Ltd.
Insulators.—J. Bourne & Son; Bullers, Ltd.; Doulton & Co., Ltd.; J. Macintyre & Co., Ltd.; Taylor, Tunnicliff & Co., Ltd.
Telegraph ironwork.—Bayliss, Jones & Bayliss, Ltd.; Bullers, Ltd.; T. W. Leach, Ltd.; Portland Bolt & Nut Co., Ltd.
Bronze wire.—B.I. & Helsby Cables, Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. & Smiths, Ltd.).
Annealed copper wire.—B.I. & Helsby Cables, Ltd.
Tinned-copper wire.—B.I. & Helsby Cables, Ltd.
Galvanised-iron wire.—Rylands Bros., Ltd.; Shropshire Iron Co.; F. Smith and Co., Wire Manufacturers, Ltd.

Wolverhampton.—Electricity Committee. Accepted tenders :—

H. Gough & Son.—Building extensions at the electricity works, Commercial Road, £3,620.
Stirling Boiler Co.—Two Stirling boilers and two superheaters, £6,406.
Underfeed Stoker Co.—Two sets of mechanical stokers, £1,907.
Crompton & Co.—Electric motor, £137.
Holly Bank Coal Co., Ltd., and W. Harrison, Ltd.—Fuel for use at the electricity works in stated quantities and at stated prices according to specification.

The Committee has confirmed the action of the chairman and the electrical engineer in placing an order with Messrs. Willans and Robinson for one turbo-alternator with condensing and auxiliary plant for £19,000.

FORTHCOMING EVENTS.

Incorporated Municipal Electrical Association.—Friday, June 23rd. At the Institution of Electrical Engineers, Victoria Embankment, London, W.C. At 10 a.m., Council meeting; at 10.30 a.m., annual general meeting.

Association of Supervising Electricians.—Tuesday, June 27th. At 7.30 p.m. At St. Bride's Institute, Bride Lane, E.C. Annual general meeting.

NOTES.

Organisation of British Engineering Industry.—Mr. F. Dudley Docker, C.B., chairman of the Metropolitan Carriage, Wagon, & Finance Co., Ltd., has joined the Committee of the Council for the Organisation of British Engineering Industry.

Educational Books for British Prisoners of War.—Arrangements have been made, with the approval of the Foreign Office, for extending to British prisoners of war interned abroad the benefits of the scheme, which has been in operation for the last year in connection with Ruhleben, for supplying selected books of an educational character to those of the interned who may be desirous of continuing their studies in any subject. Under this scheme several thousands of carefully selected volumes, mostly standard works, have been supplied to the Ruhleben Camp, which is now provided with excellent libraries (class, reference, and lending). These books, which have been sent out through the agency of officers of the Board of Education, have proved a great boon to the interned, and have enabled sustained educational work of a definite character to be carried on by the Camp Education Department formed among the prisoners. In view of the value of the work, the Board of Trade (Marine Department) have decided to take it into account, in connection with their examinations for the certificates of competency granted by them to officers of the mercantile marine and the fishing service. Accordingly, arrangements have now been completed for recording the time spent by any prisoner interned at Ruhleben or Groningen in the study of nautical or other subjects.

An appeal is, therefore, now made for a plentiful supply of new or secondhand books of an educational character (light literature and fiction is available from other sources) to meet the needs of the many thousands of British prisoners interned in enemy or neutral countries. It is to be hoped that to this appeal there may be a liberal response. A circular explanatory of the educational book scheme can be obtained by sending a postcard addressed to Mr. A. T. Davies, at the Board of Education, Whitehall, S.W., who is in charge of the arrangements.

Electricity and Rainfall.—In a recent issue (May 27th) of the *Scientific American* there is an illustrated article on the anti-hailstorm guns in general use to-day in the south of France, principally in the wine-growing districts of Bordeaux, Bourgogne, and the Champagne. The gun was orginally invented by an Austrian of the name of Stieger, in 1896. It is discharged vertically through a funnel against the storm cloud, the discharge producing a whirling vortex of air which, according to M. Vermoret, a French expert, brings about certain changes in the atmosphere. The condensation produced by the discharge—we are told—modifies the unstable electrical state of the clouds which form the seat of the hailstones so much feared by agriculturists, especially winegrowers. The American paper is evidently not satisfied with the explanation of the action of the anti-hailstorm "cannon," but states that "this odd artillery is serving its purpose very well." Another American paper, the *Amerikai Magyar Népszava*, published, a short time ago, a letter, dated April 5th, from its Budapest correspondent, containing the news that M. Vozáry, a Hungarian engineer, had been experimenting among the vineyards in the mountains round Buda with an electric apparatus, with the object of dissipating storm clouds. On two or three occasions the apparatus had failed, and rain fell copiously, but the inventor's explanation was that his apparatus was not powerful enough, and that the current was only placed at his disposal in the day time. In scientific circles the invention is treated very much in the same way as was the anti-hailstorm gun at the outset, but the correspondent understands that the Ministry of Agriculture is inclined to have M. Vozáry's electric apparatus examined and reported on by experts.

It is somewhat singular that while Mr. Balsillie, with the assistance of the Australian Government, is making experiments with a view to inducing the fall of rain by electrical means, the Hungarian scientist is trying to prevent it by the same agency. From what is known regarding the phenomena, it would appear far more probable—or less improbable—that electrical discharges would precipitate moisture than the contrary, and therefore Mr. Balsillie's chances of success seem the more favourable.

Germany's Lack of Saltpetre.—The *Münchner Neueste Nachrichten*, in discussing a project of a Munich engineer, Herr Hallinger, for the utilisation of water powers with little fall for the production of electricity, makes some valuable admissions as regards the lack of saltpetre, for the manufacture of which the new scheme is especially intended. It says that the imports of saltpetre to Germany amounted to 774,000 tons in 1913, of which no less than 700,000 were used in agriculture. During the war large Government works had been started to ensure the supply of saltpetre for military purposes, but the supply for agriculture was cut off altogether as regarded Chile, and from Norway only 60,000 tons could be imported. According to agricultural statistics, soil fertilised with saltpetre produces four times the yield that it does without it. If this is correct, the coming harvest must fall by 2 to 3 million tons below the previous annual average. The scheme of Herr Hallinger is, therefore, to be taken in hand immediately, and will be discussed shortly in the Bavarian Landtag. The Bavarian Government itself is meanwhile making preliminary investigations as to the water power that may be available in Bavaria. According to Herr Hallinger, it would take one-and-a-half to two years to carry out his plans.—*Financial Times.*

Steel Shortage in Australia.—According to a Sydney newspaper, representatives of unions whose members are engaged in the iron and steel industry waited on the Assistant Minister for Defence (Senator Gardiner) at the end of April, and pointed out that the shortage of materials in the industry was causing much unemployment. They urged that action should be taken by the Federal Ministry to provide supplies. Mr. Thompson Green (South Australia), said that the shortage of material was causing grave concern to both employers and employés. Unless something were done in the near future, there would be a general stoppage of the works. Prices had risen from 80 to 100 per cent. since the outbreak of war, and were still rising. Shipping was controlled by the Federal Ministry, and arrangements should be made so that ships coming to Australia to take wheat cargoes should bring out materials needed for manufactures. Mr. R. O'Halloran, representing the Victorian Boilermakers' Union, said that if something were not done to relieve the situation something like 2,000 men would be thrown out of employment.

A short time ago the Prime Minister of Australia (Mr. Hughes) introduced a deputation of zinc producers in Australia to the Secretary of State for the Colonies, Mr. Bonar Law, to lay definite proposals before the Government. The deputation owned and controlled all the zinc ores produced in Australia. The scheme was Imperial in its scope and objects, and at the same time rested on sound business lines. It covered a proposal for the erection of smelting works in Britain, and involved the exclusion of German spelter after the war. The scheme, as ready for adoption, provided for preferential treatment of the Empire's products, but also allotted a fair share of raw materials to France and Belgium.

Swedish Export Prohibitions.—The Swedish Chamber of Commerce for the United Kingdom, London, has received a cable from the Swedish Board of Trade, Stockholm, to the effect that the following articles have been added to the list of goods which are now prohibited for exportation from and for transit through Sweden :—Electrical safety appliances, box current regulators, with coverings or inner parts of other metal than iron; mountings for incandescent lamps, with coverings or inner parts of other metal than iron.—*Morning Post.*

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Contact Resistance of Metal Electrodes.—In a paper on this subject, read before the American Electrochemical Society, Mr. N. K. Chaney refers to the high "contact resistance" which, under certain conditions, exists between the surface of an electrode of sheet zinc and the electrolyte. This "contact resistance" between zinc and an electrolyte of zinc chloride and ammonium chloride is a secondary development occurring with measurable rapidity after the immersion of the zinc in the electrolyte. At the instant of immersion it is very small. It may rise to values of from 200 to 400 ohms per square inch of electrode surface. It forms the principal part of the internal resistance of dry cells at low current values, and as determined by measurements upon the latter it has a high temperature coefficient, decreasing to one-tenth of its value with a temperature rise of from 0° to 45° C. It is lessened or destroyed temporarily by current densities above certain low limiting values, but is practically unaffected by currents of less than 1 milliampere per 50 sq. in. of electrode surface, even if continued for a considerable time. With higher current densities it begins to decrease rapidly, and becomes negligible at current densities of about 1 ampere per 50 sq. in. On open circuit the resistance again slowly rises towards its initial value. It is destroyed or very greatly reduced by chemical treatment of the zinc surface, *e.g.*, by corrosion with dilute sulphuric acid. An explanation of the high contact resistance observed is based upon the supposed existence of a hydrogen film upon the electrode surface, discharged there by local action between the zinc and the electrolyte. This is supported by a considerable amount of experimental evidence, in which it is shown that the predicted behaviour of such a hydrogen film under selected conditions is in agreement with the observed behaviour of the contact resistance.—*Met. and Chem. Engineering.*

Testing Rubber Insulation.—In testing rubber insulation according to the Underwriters' specifications, Mr. A. A. Ladon found that samples taken from the same coil showed marked variations in strength and elongation. Samples 5 in. long were rolled between two blocks of wood to loosen the insulation; the rubber could then be slipped off the wire. The insulating material was then tested for elongation, stretch, and tensile strength. The results varied as much as 100 per cent., and in only six coils out of 52 did the samples check.

The trouble did not lie in non-uniformity or deterioration of the rubber compound, as was at first supposed. The method of separating the wire from the insulation was at fault. No matter how carefully the samples were rolled between the two blocks, the insulation could not be removed intact. In places it would stick to the wire.

A new method was therefore devised for removing the insulation. The wire was of tinned copper. Tin amalgamates with mercury very easily and forms a very slippery surface on the copper. The mercury has no effect on the rubber compound. About ½ in. of insulation was cut off each end of the samples, and the stripped wire was scraped to remove dirt and grease. The ends of the samples were then immersed in mercury. After a period of time, varying from four to 24 hours, the insulation could be slipped off the wire with almost no effort.

This method is being used by one of the largest electrical manufacturers in the country. Besides the accuracy and uniformity of results accompanying the application of this property of mercury, the cost of the testing has been reduced by over one-third.—*Met. and Chem. Engineering.*

Russian Electricity Tax.—On May 20th, with the Assistant Minister of Finance, A. I. Nikolaienko, in the chair, a sitting of the Committee of Indirect Taxes was held. The consideration of the project for taxing electricity was taken in detail. The most important decision of the Committee was the acceptance of the proposition of the representatives of the electrical industry, that the concern delivering electricity should be free of the obligation to submit to the inspection of the Excise a list of its subscribers using current. The payment of the Excise or tax will be made according to the quantity of energy delivered, and not according to the amounts paid by the clients. The Committee agreed to certain exemptions in various branches of the industry. It ruled out the projected right of the officials of the Excise to enter the premises of the subscribers at any hour of the day or night, and agreed to permit inspection by the Excise officers in private premises only during certain fixed hours of the day.

Niagara Electrochemical Works.—Unable to obtain a sufficient quantity of cheap electric power from the Niagara Falls generating companies, when millions of cubic feet of water are being wasted over the great cataract every 24 hours, the Union Carbide Co., of Niagara Falls, N.Y., has been forced to erect a $2,000,000 branch plant at Saude, Norway. Construction work has already been started. The Norwegian factory will be known as the Electric Furnace Products Co.; it will be operated as a subsidiary of the Niagara Falls plant, and the products of the foreign company will be sold exclusively in the United States. The plant is expected to be in operation in less than two years.

Practically all the large Niagara Falls electrochemical industries are constructing extensive additions to their plants, and are continually increasing their demand for power. Probably the largest construction work now in progress is the plant of the Niagara Smelting Co. This new industry will be one of the largest users of electric energy along the Niagara frontier. Upwards of $1,500,000 is being invested in the new plant.

The new plant of the Hooker Electrochemical Co., costing upwards of $1,000,000, is rapidly nearing completion, and the Aluminium Co. of America has just awarded contracts for a large addition to its Falls plant. Other electrochemical industries are also making large extensions.—*Electrical World.*

Conductors and Flexible Cord in Russia.—Since October last year a scarcity of conductors and flexible cord for electrical installations has been felt in Russia, as the stocks that were in hand have become exhausted, and it has been found impossible to renew them under the existing conditions. Inability to obtain the necessary conductors and flexible cord for factories working for the national defence often brought about a difficult situation, particularly in the provinces, and this circumstance prompted the Electrotechnical Section of the Central Military Industrial Committee to call a special council of representatives of all the cable factories, in order to take measures for the purpose of remedying the trouble. The meeting took place on Friday, 8th/21st January, on the premises of the section, under the chairmanship of Prof. A. A. Veronoff, and considered the necessity of urging the Government to grant facilities for the delivery into Russia from abroad of a certain quantity of copper, rubber, and other necessary materials for the organisation in cable factories of the production of conductors and flexible cord for stock, provided that conductors and flexible cord should be delivered from store only to such concerns as were working for defence, and under a sufficient guarantee. For the coming half-year, according to the estimates of the Electrical Section, about 750 tons of copper will be required for Government purposes, the distribution of which and corresponding quantities of other materials necessary for the production of conductors and flexible cord, and also the control of the regular delivery of all these materials, it is proposed shall be entrusted to the Electrotechnical Section of the Central Military Industrial Committee. Representatives of the cable factories explained at the same time that with an immediate delivery of the necessary materials for the preparation of conductors and flexible cord, installations might be organised only on condition that during the period of the war certain variations in the present system of making the cables and flexible cord should be permitted. The fact is that at certain cable factories at present all the braiding machines are occupied in preparing field telegraph cable, but at the same time the winding machines are empty. It was urged, therefore, as desirable that the winding instead of braiding of wire should be allowed. Another variation from existing construction consists in the application for flexible cord of thicker wires, which indeed reduces its flexibility; but it is possible, and in time of war should be permitted. Prof. A. A. Veronoff was given a copy of the minutes of the corresponding committee of cable factories which met in Moscow from December 29th to January 11th. The examination of these proposals to vary the existing types of conductors and flexible cord was entrusted to the electrotechnical section of the committee, composed of specialists in conductors, &c.—*Elektrichestvo.*

A 15,000-H.P. Motor for a Reversing Rolling Mill.—The Westinghouse Electric and Manufacturing Co., of East Pittsburgh, Pa., has sold to the National Tube Co. the electrical equipment to drive a new 40-in. reversing rolling mill, which it is about to install in its plant at Lorain, O. This rolling mill, when completed, will be one of the largest in the country. The motor will develop 15,000 H.P., and will run at a maximum speed of about 120 R.P.M. Power will be supplied by a fly-wheel motor-generator set, which will be so controlled that the load on the power plant will be limited approximately to 8,000 KW. A similar equipment has been supplied to the Indiana Steel Co., which has purchased Westinghouse electrical equipment to drive and control a new 40-in. reversing blooming mill that is to be installed in its plant at Gary, Ind. In addition to these two units, the Westinghouse Co. is at present building the electrical equipment for four other reversing mills, two of which are of approximately the same size as those mentioned above.—*Elec. Rev. and W. Electrician.*

Terrestrial Magnetism.—The report of the Astronomer Royal for the past year states that the mean values of the magnetic elements at Greenwich for the past two years were:—

	Declination, W.	Horizontal force in C.G.S. units.	Dip (inductor).
1914 ...	... 15° 6·3′	0·18518	66° 51′ 13″
1915 ...	... 14 56 5	0·18494	66 51 58

Electricity on the Panama Canal.—According to the *Electrical Review and Western Electrician*, extensive changes have been authorised for increasing the capacity of the hydro-electric plant at Gatun, Panama Canal Zone. New turbine wheels have been ordered for the three turbo-generator sets, each of 4,400 H.P., instead of 3,100 H.P. as at present. "No change will be made in the generators, as the very liberal design of these units makes it possible to operate them with an output of 3,650 K.V.A., at 80 per cent. power-factor and 55° C. temperature rise." In other words, it would seem that a miscalculation was made in the design of the generators, which were guaranteed to give only 2,500 K.V.A. continuously with 40° rise, or 3,125 K.V.A. for only two hours with 55° rise.

In order to take care of the increased output of these generators, four new 400,000-circular-mil cables have been ordered for installation between the hydro-electric station and the Gatun sub-station. The present cables between these two points are 10 in number, and of No. 0000 size.

In addition, two 4,000-K.V.A. power transformers have been ordered for the Gatun sub-station. These are the largest transformers that can be installed in the existing compartments.

One of the present 2,667-K.V.A. units will be moved to the Cristobal sub station, where it will be needed to take care of the increased load, due to the operation of the new coaling plant, the terminal piers, and the projected submarine base.

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Late Legal.—The Magneta Time Co., Ltd.—An application in a debenture-holder's action—the Magneta Fabrique d'Horloges Electriques *v.* the Magneta Time Co., Ltd.—to confirm a provisional contract for the sale of the undertaking of the defendant company to a Mr. Molden, one of the co-plaintiffs in the action, came before Mr. Justice Astbury, in the Chancery Division, on Wednesday. Mr. Vanneck said the application had been before Mr. Justice Neville, when the contract was strenuously opposed, and his Lordship then adjourned the application, with the intimation that the provisional contract would be sanctioned at the adjourned hearing unless in the meantime a better offer was brought forward. The opposition of the company was that the price the applicants were to get for certain of the assets was not sufficient, and that the company would be able to realise to better advantage and save something for themselves, whereas under the provisional contract they would get nothing. The defendants did not now appear on the application, and the applicants had had no notice of any other offer being made, and counsel understood they did not intend to oppose the contract any further. Mr. Justice Astbury thereupon sanctioned the contract.

The British Engineers' Association.—The following communication has been issued to British engineering firms, under date June 19th, from the offices of the Association, 32, Victoria Street, Westminster, S.W.:—

"As president and chairman of the Executive Committee of this Association, we appeal to you at a critical moment for your support and co-operation.

"The war is often described as an 'Engineers' War,' and there can be no question as to the vital part played by the British engineering industry.

"One result of the honourable, but heavy, responsibility which was thrust upon our engineers on the outbreak of war has been the inevitable dislocation of our pre-war trade and manufacture. As a consequence, the future contains serious problems which can only be solved by the ablest brains in the engineering trade.

"The first practical step—as in all struggles on a large scale—is mobilisation. It is notorious that neither in peace nor during the war has the British engineering industry exerted the influence to which it is legitimately entitled.

"The cause of this serious handicap has been the failure to combine. The disinclination to combine was due to British individualism and independence. But we would ask you to consider whether the dictates alike of patriotism and business do not call for combination on a large and effective scale in so far as it is vital to secure a national policy which will conserve and foster British engineering.

"If we lean on Government departments or outside helpers and advisers instead of looking after our own interests for ourselves we shall—as the past has proved—be running grave risk.

"We fully realise the strain and pre-occupation imposed upon you by the war, but the issues at stake are too urgent to be any longer side-tracked till 'after the war.'

"It is common knowledge that Germany, and, perhaps, other rivals, are preparing for a vigorous commercial campaign at our expense on the cessation of hostilities. If Germany can do this, so can we. The question is merely one of inclination. The British are the best organisers in the world, as witness the Royal Navy and our Army of 5 million men. They are also the easiest people to organise, once their consent has been won, because they are a free people.

"The time has come for the engineering industry to show the country that it believes in organised self-reliance, and that it is prepared to maintain the supremacy of British engineering against all-comers.

"The first practical step towards this end is mobilisation. We, therefore, appeal earnestly to you to join forthwith the 300 firms which already belong to the British Engineers' Association, so that we may henceforward present a united front to our common enemies whoever and whatever they may be.

"The new members whom we hope to welcome will naturally have a say in the coming campaign; and, in order to reduce the call upon the time of busy men to a minimum, we have engaged the services of special organisers to carry out the decisions of our Council and Executive Committee.

"We believe that we are justified in promising you in the near future a practical return for your support, and we shall heartily welcome your criticisms and suggestions.

"Wilfrid Stokes, *President*.
"J. E. Thornycroft,
"*Chairman of the Executive Committee*."

Institution and Lecture Notes.—Institution of Electrical Engineers.—On Thursday last week the special meeting of Corporate Members was held to confirm the resolution to alter the Articles of Association, so as to exclude alien enemies from membership. The resolution was passed with one dissentient. In proposing a vote of thanks to the President, Mr. Ll. B. Atkinson pointed out that the Council had been unable to move in the matter until it was called upon to do so by the members; but directly that step had been taken, the President and Council had acted vigorously and effectively.

Association of Teachers in Technical Institutions.—On Saturday last Dr. Wm. Garnett delivered an address on "Technical Instruction after the War" at the annual conference of the Association. He said that when the full record of the work done for Government departments by Universities and technical colleges could be made public, it would command the attention of the industrial world, and there would no longer be any need for the work of Committees on the neglect of science. He advocated the formation of associations of manufacturers in allied trades to ascertain the subjects on which research should be undertaken. We had been so keen on dealing in the cheapest markets that we forgot all national considerations; no sacrifice was too great in the way of market price to render this country industrially independent of all other nations in respect of the essentials of life and of national efficiency.

Reform of the teaching of the schools could never be effected except through the examinations, on the results of which schools gained their position in public esteem.

Amongst the special points that Dr. Garnett emphasised were the following:—

(1) That leaders of industry must place a higher value on individual scientific research, which is the greatest need of British industry. (2) That teachers in technical institutions must be more closely associated with industrial leaders. (3) That time and other necessary facilities must be given to teachers in technical institutions to enable them to carry out industrial research. (4) That consumers must be willing to make a sacrifice in order to contribute to the nursing of infant industries, so as to avoid entire dependence on foreign sources for the necessaries of life or civilisation.

The Chemical Society.—At the adjourned special general meeting of the Society, on Wednesday, a resolution was carried to remove from the list of honorary and foreign members the names of nine alien enemies, including those of Nernst and Ostwald.

The Electrical Trades Benevolent Institution.—Mr. F. B. O. Hawes, secretary of the above institution, informs us that the confirmatory general meeting was held on the 19th inst. at the Institution of Electrical Engineers, for the purpose of confirming the alterations in rules which were made at the annual general meeting. The principal alteration was to make the rule regarding the position of members who had not paid their subscriptions slightly less drastic than it formerly was. The rule formerly stated that members whose subscriptions were in arrear were entitled to no privileges whatever. The altered rule is, that a member who is thus in arrears shall not be entitled to votes. Mr. Hawes adds:—"There is no doubt that votes will in the near future be of considerable value, as the election of pensioners is by vote, and the list of members is steadily embracing more names of persons who might possibly be in need of such pensions. It is sincerely to be hoped that the list will contain many more such names in the near future."

Volunteer Notes.—1st London Engineer Volunteers.—Orders for the week by Lieut.-Col. C. B. Clay, V.D. Commanding.

Monday, June 26th.—Technical for Platoon No. 9, 46 Regency Street, S.W.; Squad and Platoon Drill, Platoon No. 10; Signalling Class and Recruits.

Tuesday, June 27th.—The School of Arms will be discontinued during the summer months; Recruits, 7.15 to 8.15.; lecture, 7.15. "Organisation and Discipline," Company Commander W. Hynam.

Wednesday, June 28th.—Platoon Drill, No. 1 Platoon.

Thursday, June 29th.—Platoon Drill, No. 5 Platoon; Shooting for No. 9 Platoon; Miniature Range; Recruits, 5.45 to 7.45; Instructional Class, 5.45.

Friday, June 30th.—Technical for No. 10 Platoon, 46, Regency Street, S.W.; Squad and Platoon Drill, No. 9 Platoon.

Saturday, July 1st.—Parade, 2.45. Uniform.

Sunday, July 2nd.—Entrenching duties: Parade, Victoria (S.E. and C. Railway Booking Office), 8.35 a.m.

Macleod Yearsley, *Adjutant*.

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, June 22nd, 1916:—

Week-End Parades.—Saturday.—The Battalion will Parade at Wembley Park at 3 p.m. for Drill under the Commandant.

Sunday.—The Battalion will Parade at Liverpool Street Station (Low-Level entrance, G.E.R.), at 9.30 a.m., and proceed by train for Entrenching duties.

Battalion Sergeant-Major's O.I.C. Class will be examined by the Commandant on Saturday, 24th inst., at 3 p.m., at Wembley Park. A new class will commence on Monday, the 26th, at Lord's Cricket Ground, at 5.30 p.m., and will continue for two months. Names should be sent in to the Adjutant as soon as possible.

Map Reading.—Mr. W. Page will commence a new class at Headquarters on Wednesday, 28th inst., at 5.30 p.m. Those who wish to attend should send in their names to the Adjutant as soon as possible.

Musketry.—Competitors for the "Holland Cup" and other members who have sent in their names to shoot at Bisley on Sunday, 25th inst., will report in uniform to Sergeant J. W. S. Burmester, at 9.45 a.m., at No. 8 Platform, Waterloo Station.

G. H. F. Duncan, *Acting Adjutant*, O.B.C.

Fatalities.—A young machineman was examining a machine with the aid of an electric lamp in the Speedwell Iron Works, Coatbridge, when he sustained a shock which proved fatal.

A verdict of "Accidental death" was returned at a Kilburn inquest, on Saturday, on Walter Percy Harris, 33, an electric fitter of Kensington, who was killed on June 15th. According to the *Daily Telegraph*, it was stated in evidence that Harris was employed by the British Westinghouse Co., Ltd., at the electric substation of the London and North-Western Railway Co., at Kilburn. He was engaged in connecting some cables, and as there was an obstruction, he went to a cubicle containing live wires with the object of finding out what the obstruction was. He had been warned of the danger. It appears that he struck a spanner against

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a live wire at the top of the cubicle, and he received a shock of 11,000 volts. The jury added a rider to their verdict to the effect that greater care should be taken in guarding live wires.

Appointments Vacant.—**Mains engineer, fitter drivers, engine drivers, and wiremen for the Military Electric Power Stations, Southern Command, Salisbury; junior assistant (30s.) for the Leek U.D.C. electricity works; station engineer, assistant engineer, charge engineer, station fitter, and linesman jointer, for the Ripon military camp. See our advertisement pages for particulars.**

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.

Central Station Official.—Mr. R. M. Wilson, late assistant superintendent at the Thornhill power station of the Yorkshire Electric Power Co., Ltd., who is leaving to take up a position with the Ebbw Vale Steel Works Co., has been presented by his colleagues with a gold albert.

General.—At a largely attended social gathering, the South Shields Corporation tramways department presented a silver cigarette case and a silver watch to Motor-man William Middleton, who was serving on one of the warships which took part in the naval battle off Jutland. Mr. W. Bunting presided, and Alderman Wylie, chairman of the Tramways Committee, made the presentation.

Mr. John Brotherton, manager of the British Insulated and Helsby Cable Works, Helsby, has been placed on the Commission of the Peace for Cheshire.

Mr. E. A. Nash, secretary of the Faraday House Testing and Training Institution, has joined the Artists' O.T.C.

Roll of Honour.—Captain Henry Newton, of the 5th Notts and Derbyshire Regiment (attached to the Royal Engineers), who is a director of Messrs. Newton Bros. (Derby), Ltd., electrical engineers and contractors, of Derby, has been awarded the D.S.O. According to the *Derby Daily Telegraph*, Captain Newton accompanied the Ilkeston Company of the 5th Battalion (T.F.) to the Front, and while there he was responsible for a number of inventions which were used to advantage by his own Battalion, and the Brigadier-General, realising their excellence and utility, gave instructions for them to be provided for the Brigade. A workshop, which now employs over 1,000 men, was established in France for his operations to be conducted on the spot, and Captain Newton was placed in command. It is stated that the King, the Prince of Wales, and the late Lord Kitchener all evinced great interest in his inventions.

Lieutenant F. Dixon, Dorset Regiment, an electrician under the Cleckheaton Urban Council, has been wounded.

Sapper Edgar Lockwood, of the 13th Divisional Company of the Royal Engineers, a member of the Institution of Electrical Engineers, aged 28 years, and formerly engaged at the Ashton-under-Lyne electricity works, has died of disease contracted on active service.

Private Ernest Barker, of the Lancashire Fusiliers, for nine years in the employ of the British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park, has been killed in action.

Private J. H. Leonard, of the King's Liverpool Regiment, who has been missing since June, 1915, is now officially presumed killed. Prior to enlistment he was employed at Messrs. Dick, Kerr & Co.'s works at Preston.

Electrical Artificer J. W. Horner, formerly on the electrical staff of the North-Eastern Railway Co. at York, was on *H.M.S. Warrior* in the North Sea battle, and was injured. He is in a Scottish hospital, and is making a good recovery.

Private Thomas Burns, Loyal North Lancashires, has died from wounds in the head received whilst fighting in France. He had worked previously as an electrician.

Lieutenant H. Duncan, of the Royal Flying Corps, formerly in the testing department at the Rugby works of the British Thomson-Houston Co., Ltd., has been decorated by the King with the Military Cross for services rendered at the Front.

Air Mechanic Ernest Whitfield, of the Royal Flying Corps, who has died of smallpox whilst on active service at Cairo, was formerly on the Doncaster municipal electricity works staff.

E. R. L. Snow, who was a wireman on board *H.M.S. Invincible*, lost his life in the North Sea battle.

Electrical Artificer Harry Woodman was lost in the North Sea fight on board *H.M.S. Queen Mary*.

Our readers will, we are sure, join us in tendering sincere sympathy to Mr. R. A. Chattock, city electrical engineer of Birmingham, on the death of his only son, Private A. A. Chattock, who was killed in action on June 4th. Private Chattock, who was 23 years of age, was educated at Hillbrow School, Rugby, and subsequently at Charterhouse School (Robinites). He studied at the Birmingham Municipal School or Art and in Paris. He was engaged on designing work when war broke out, and he joined the 2nd City of Birmingham Battalion in October, 1914, as a private. This was afterwards named the 15th Service Battalion Royal Warwickshire Regiment. The Battalion went to France in November, 1915, and he was on active service there until his death occurred.

Lance-Corporal Edward Mee, of the Loyal North Lancashires, on the Bolton tramways clerical staff, has been missing since May 21st.

Obituary.—Mr. E. March Webb.—We regret to record the death, which occurred somewhat suddenly on June 15th, at the Arundell Arms Hotel, Lifton, Devon, of Mr. E. March Webb, of the India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd. Mr. March Webb commenced his career at Silvertown in 1869, on the staff of the late Sir Charles Bright, during the manufacture of 4,000 odd miles of submarine cable for the West India & Panama Telegraph Co., which was laid in 1870. Subsequently Mr. Webb joined the Silvertown company, and took part in many cable-laying expeditions as chief electrician between 1872 and 1895. He was at one time manager of the West Coast of America Telegraph Co., Ltd., and lately he had filled the office of secretary of the Spanish National Submarine Telegraph Co., Ltd. The cable-laying expeditions in which he took part were as follows:—The Direct Spanish cable (1872); Havana-Key West (1873); New-haven-Dieppe Shore End (1874); Chile-Peru cables (1875); Marseilles-Algiers laying and Direct Spanish repairs (1879); Lizard-Bilbao (1880); Marseilles-Algiers (1880); Mexican cables and Havana-Key West repairs (1880); C. & S.A. cables (Pacific side) (1881); Spanish National cables (1883 and 1884); Havana-Key West repairs (1886); Congo cable repairs (1887); Western and Brazilian (1891); South American Co. (1892); ditto (repairs) (1893); Spanish Government and S.A. (1895). His death is regretted by his remaining Silvertown friends as the loss of one who was kind-hearted and genial to all.

Mr. William Todhunter.—We regret to record the death of Mr. William Todhunter, of the Telegraph Construction and Maintenance Co., Ltd., which occurred at Blackheath on June 19th, at the age of 59 years.

Mr. J. Tranter.—The death is announced of Mr. Joshua Tranter, of Kendal, who, under the National Telephone Co., inaugurated the service at that town 20 years ago. Later he had charge of the underground installation work at Blackpool, Lytham, and St. Annes, and he retired when the undertaking came under Government control. He was 71 years of age.

NEW COMPANIES REGISTERED.

L. Weekes, Ltd. (144,093).—This company was registered on June 14th, with a capital of £10,000 in £1 shares (1,000 founders'), to take over the businesses (1) of an electric fuse manufacturer carried on by A. L. Weekes at Langley Street, Luton, Beds., as the British Electric Calibrated Fuse Co., and (2) of electric switch manufacturers carried on as the "Safetee" Controlling Appliances Co., Ltd., at Langley Street, Luton. The subscribers (with one share each) are: A. L. Weekes, Brooklands, Harpenden, Herts., gentleman; W. J. Coom, 30, Conway Road, Luton, Beds., engineer. Private company. The number of directors is not to be more than five; the first are: A. L. Weekes (permanent chairman and sole governing director) and W. J. Coom. Qualification, £100. Registered office: Langley Street, Luton.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Bourton-on-the-Water Electric Light & Power Co., Ltd.—Particulars of £600 second debentures created August 27th, 1915, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £580. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Rural Electricity Supply Co., Ltd.—Issue on June 6th, 1916, of £100 debentures, part of a series of which particulars have already been filed.

South Metropolitan Electric Light & Power Co., Ltd.—Issue on May 24th, 1916, of a £20,000 debenture, part of a series (this debenture, with others, particulars of which have already been filed, is issued to trustees as security for an issue of debenture stock).

T. W. Broadbent, Ltd. (95,420).—Capital, £5,000 in 440 pref. and 560 ord. shares of £5 each. Return dated August 27th, 1915 (filed April 22nd, 1916). All shares taken up; £5,000 paid. Mortgages and charges: £1,000.

British Mica Co., Ltd. (72,187).—Capital, £5,000 in 2,000 pref. and 3,000 ord. shares of £1 each. Return dated March 16th, 1916. 629 pref. and 2,000 ord. shares taken up; £629 paid on the pref.; £2,000 considered as paid on the ord. Mortgages and charges: Nil.

Camborne Electricity Supply Co., Ltd. (57,950).—Capital, £10,000 in £1 shares. Return dated April 26th, 1916. 607 shares taken up; £605 paid, leaving £2 in arrears. Mortgages and charges: Nil.

CITY NOTES.

Paris Metropolitan Railway.

The report for 1915 of the Compagnie du Chemin de Fer Métropolitain, of Paris, refers at length to the tunnel and incidental works carried out by the City of Paris in connection with the extensions of the railway, and states that no routes were handed over to the company for the construction of the permanent way and

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equipment for working. Although delays had taken place in consequence of the difficulty of obtaining labour and materials, progress had been made everywhere. Similar obstacles confronted the company in the execution of its works, and the route length in operation had not varied since September 30th, 1913, the mileage slightly exceeding 48. The completion of the orders placed in 1913 for additional motor cars and trailers had been interrupted, and the rolling stock consequently remained at 700 motor cars, 270 first-class trailers, and 335 second-class trailers. The train service, which had to be reorganised and reduced in the second half of 1914, was gradually brought last year up to a time-table which substantially approached that which prevailed prior to the war, whilst the number of employés had risen from 3,658 at the end of 1914 to 4,133 at the close of last December. Concerning the bonuses granted to the staff in order to give the men a greater interest in the efficient working of the railway, the report mentions that over £36,000 was paid in this manner in 1915, and both the regular men and the temporary substitutes for those called to the Colours participated in the distribution. The total receipts amounted to £1,846,000, of which £596,000 represented the share payable to the City of Paris according to the terms of the concession, and the working expenses absorbed £806,000. After making various appropriations, the net profits are returned at £252,000, which sum has permitted of the declaration of a dividend at the rate of 5.6 per cent. on the ordinary capital of £3,000,000.

Imperial Tramways Co., Ltd.

The directors, in their report for the year ended December, 1915, state that the gross receipts of the Middlesbrough, Stockton and Thornaby electric tramways amounted to £66,529, an increase of £2,967. The passengers carried were 12,299,280, an increase of 37,656. The net profit was £15,432, as compared with £17,604. The traffic receipts continued to develop in spite of the difficult conditions in the districts served by the tramways and omnibuses. Since the beginning of the war 84 per cent. of the employés have joined the Forces or attested. The special allowances granted to dependents of employés amounted during 1915 to £1,531. This company holds £22,230 5 per cent. cumulative preference shares of £1 each and 112,451 ordinary shares of £1 each in the London & Suburban Traction Co., Ltd., and has received the full dividend for the past year on the preferences shares, but the revenue of that company for the year 1915 was not sufficient to permit the payment of any dividend on the ordinary capital. The company's net revenue account for the year shows an available balance of £25,760, and after payment of interest on the debenture stock for the whole year an interim dividend on the preference shares in respect of the half-year to June 30th last, amounting together to £17,075, 6 per cent. per annum on the preference capital (less income-tax) absorbs £5,025, and a dividend for the year at 2 per cent. on the ordinary capital (less income-tax) requires £3,467, £194 remaining to be carried forward. Annual meeting: June 26th, Bristol.

United Electric Tramways of Monte Video, Ltd.

Mr. G. A. Touche, M.P., presiding at the annual meeting on June 15th, said that the war was still a dominating factor in the River Plate. The company suffered from the abnormal conditions in the shipping world, and would do so more in the current year. Practically all materials required by them had to be shipped to Monte Video. The coal situation continued to cause anxiety. There was no coal supply in Uruguay, but there were fairly extensive peat deposits, and experiments as to their use for fuel purposes were being made. Failing British coal, it became necessary to rely on America, although it was not of the same steaming qualities as Welsh. The large railway companies and other consumers of coal in the Argentine and Uruguay had formed a committee to regulate, as far as possible, the exportation of coal to the River Plate. The Admiralty had agreed to liberate a certain amount of requisitioned shipping to carry coal from American ports to the River Plate. The cost of this coal, delivered in Monte Video, would be approximately 105s. per ton, of which 85s. represented freight. This compared with an average pre-war price of 40s. 6d. British coal might cost even more, but at the moment there was little or no chance of obtaining any. It was by no means certain that the company's requirements, even in American coal, would be fully supplied, as it was very difficult to find the ships necessary to carry it south. The fuel difficulty had not reached its acutest stage during the period covered by the accounts, but during the year now current it must represent a serious charge on the company's receipts. Weather conditions in Monte Video had also been unfavourable again. By carrying out rigid economies in every department of the hotel, the reduction in the expenses almost compensated for the decrease in the receipts. All these adverse circumstances made a rather depressing narrative, but none of them represented conditions which should be permanent. Having referred to the political and economic situation in Monte Video and given details of the results of the past year's working, the chairman expressed regret that the directors were unable to recommend the payment of any dividend on the ordinary shares. In the circumstances, there was no prudent alternative. With regard to the current year, weather conditions during the past summer season showed some improvement, with the result that the traffics had shown increases when compared with the corresponding months in the previous year. It was, however, to be regretted that practically all the increase in gross receipts had been absorbed by heavier operating expenses. Those expenses were bound to go on increasing while fuel and freight costs continued on the up-grade. He feared they could not expect any improvement in the net revenue position in the current year unless conditions made some rapid change. For some time past it had been the policy of the Government of Uruguay to municipalise businesses of public utility. With this object in view they acquired recently a controlling interest in the Norte Tramway Co., which still operated a system of trams in Monte Video by animal traction. He believed it to be the intention of the State to electrify this system and extend it in various directions—probably in competition with existing electric tramways. Experience showed that co-operation was better than competition, whether the result aimed at the public utility or financial stability. If the municipality was to enter upon the tramway business it would clearly be better that it should control the largest system in the city instead of being in competition with it. This might explain why some months ago informal inquiries were made as to whether this company would be prepared to sell to the State, and, if so, on what terms. The directors recognised that the position created by the war and the desire of the Government that British investments in North and South America should, when opportunity offered, be realised, were factors which ought to be taken into account. They therefore caused the authorities to be informed that if the Government were prepared to make a definite offer on a fair and reasonable basis of valuation, they would give it their serious consideration. Since the report was issued the Government had made a proposal, which the directors would give their full and careful consideration.

German Netherlands Telegraph Co.

The report for 1915 of the Deutsch-Niederlandische Telegraphen Gesellschaft, of Cologne, states that no changes took place in the conditions of the company's stations and cables as compared with the preceding year, the cables being still in good condition. No news had so far come to hand from the officials who remained at Yap in regard to this station, and the directors assumed that the Japanese censor had not permitted any report being made. The company had again received a dividend of 6 per cent. for 1914-15 on its investment in the German South Seas Wireless Telegraph Co. in so far as it was paid up. As a result of the alteration in the agreement with the Great Northern Telegraph Co., of Copenhagen, according to which the annual payment for repairs was reduced by £3,000 from June 1st, 1915, the German Netherlands Co. had to pay a sum lower in this year by £1,750, but a reduction in the expenses as against 1913-14 was not shown, owing to the unfavourable rate of exchange. The net profits are returned at £41,000, as contrasted with £41,600 in 1914, and the directors recommend a dividend of 6 per cent., as compared with 6¼ per cent. in 1914.

German Electrical Companies.

The Elektrizitats Gesellschaft (late W. Lahmeyer & Co.), of Frankfort-on-Main, reports net profits amounting to £103,000 for 1915, as compared with £103,500 in the previous year. It is intended to pay a dividend of 7 per cent., being the same rate as in 1914.

The accounts of the *Land und Seekabel Werke, of Cologne-Nippes,* show gross profits amounting to £61,000 for 1915, as compared with £67,000 in the preceding twelve months. After setting aside £4,000 for depreciation, as against £12,000 in 1914, and making other appropriations, the net profits are recorded at £38,000, as compared with £35,000. It is proposed to distribute 11 per cent. on the paid-up capital of £262,500, this comparing with 10 per cent. in 1914.

The shareholders in the *Bergmann Elektrizitats Werke, of Berlin,* were informed by the general manager at the recent annual meeting that over one-half of the total turnover in 1915 represented peace manufactures, the balance comprising war contracts. As a result of the Government requisitions of copper and certain other metals, the company had been compelled to equip itself for the production of metal substitutes, and this had rendered it possible to continue the output of articles for peace purposes. This fact was also of importance for the period after the war in regard to the price movement in copper. If the price of copper exceeded permissible limits the continued use of substitutes would make the works independent of other countries. On the conclusion of peace it would be possible quickly to change over to the manufacture of peace products, and competition would be keen, especially with American firms.

Marconi International Marine Communication Co., Ltd.

Mr. Godfrey Isaacs presided, on June 14th, at the annual meeting, in the absence of Mr. Marconi in Italy. After dealing with the balance sheet and the increase in the receipts, which has already been mentioned in the report, he said that they were entitled to congratulate themselves upon the result, especially considering that the business was necessarily being conducted in very difficult and abnormal circumstances, and that the whole of the losses incurred through the submarine warfare had been debited to profit and loss account. The gross receipts, which in 1911 were £64,166, had grown in successive years to £100,52[illegible] (1912), £146,325 (1913), £175,105 (1914), £208,927 (1915). The

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telegraphic receipts were very much below what they would have been in ordinary circumstances. Except in such abnormal times as these their business was not subject to any material variation in its figures in consequence of fortuitous circumstances, activity or slackness of trade. They provided what was an absolute need, the great importance of which was more marked each year. Not only was it essential that every merchant ship should be fitted with a wireless installation, but overwhelming evidence had been afforded of the importance of a world-wide organisation such as the company had built up. The number of telegraph stations owned and worked by the company as public telegraph stations on the high seas had increased since December from 1,008 to between 1,100 and 1,200, and the number was increasing daily as fast as it was possible to turn out and fit the installations. They had to-day a sound industrial business which could only progress, and which, after the war, would develop more quickly than hitherto. Their position had not been obtained without a very great struggle. Since their inception, 16 years ago, they had encountered innumerable difficulties, the country was slow to appreciate the value of their work, and the business was dangerously near to falling into foreign hands. It gave one hope that the lessons of the war would lead to national assistance—should it again fall to the lot of a British company, situated as this company was—to develop a new science and a new industry destined to become of such paramount importance to the nation. Mr. Marconi's recent developments would dispose of one more peril of the seas. He authorised him to state that in the near future he would introduce a new, independent, and very simple apparatus to be worked from the bridge of a ship, and by one of the ship's officers, which should put an end to all danger of collision in darkness or fog. Mr. Marconi had described that new work to him, and he had little doubt that every seagoing vessel would be equipped with the invention. This should prove of no small value to their company. Mr. Isaacs went on to refer to the bravery in these perilous times of their operators, of whom they had 2,000 almost continuously on the seas. Eighty-two of their operators were employed on mercantile ships which had been sunk by the enemy. Three were drowned, two had been seriously injured, and seven slightly injured. The chairman spoke very highly of the services of the manager, Mr. Bradfield, and the heads of the ship department, Messrs. Cross and Lewis, and their staff.

J. G. White & Co., Ltd.—A dividend of 6 per cent., less tax, is proposed, carrying forward £34,939. The war continues to adversely affect the business. Methods for broadening the scope of the company's work are being developed with encouraging prospects. Investments having been conservatively valued in the past, no readjustment of values is now necessary.

Marconi's Wireless Telegraph Co., Ltd.—Gross profit for 1915, £531,125; net profit, £377,818, an increase of £145,101. In view of the state of war, and having regard to the large sums of money abroad, and to the uncertainty when the moneys due from the Government will be received, the resources are to be husbanded. A final dividend of 5 per cent. will make 10 per cent. for the year. Annual meeting: June 30th.

Trowbridge Electric Supply Co., Ltd.—Mr. J. H. Blake presided at the annual meeting, on June 13th, at which a dividend of 5 per cent. on the ordinary shares was declared. The profits were only £348, as against £438 last year. That was not due to a reduction in sales, but to their not putting up the price to consumers as early as they ought to have done. It was stated that the Bradley Road residents could not have a supply, as the Council would not grant permission there for overhead wires. The cost of underground cables was prohibitive, and would be for some years to come.

Waygood-Otis, Ltd.—For the year ended March, 1916, the profit was £12,798. Depreciation absorbs £3,900, directors' remuneration and salaries of directors managing departments £6,542, grants to employés' dependents £2,396, and there is carried forward £671.

Yorkshire (West Riding) Electric Tramways Co., Ltd.—Interim dividend of 3 per cent. on account of the accrued dividend on the 6 per cent. cum. pref. shares.

Veritys, Ltd.—Dividend for the year, 6 per cent. on the ordinary shares, carrying forward £1,084.

Coventry Chain Co., Ltd.—Interim dividend of 6 per cent. per annum, less tax, on the ordinary shares.

STOCKS AND SHARES.

Tuesday Evening.

The capital news of the Russian advance contributed in no small measure to further improvements in the Stock Exchange markets, prices going ahead rapidly under the leadership of Consols. The Funds, indeed, moved much too quickly, as was apparent immediately the buying pressure became relaxed, with the result that the 4-point rise secured in less than a week was cut in half as sellers came in, tempted by the rapidity of the rush-up. Consols have once more taken the premier position as regards markets, upon them depending movements in other gilt-edged securities. The latter hardened with Consols, but in their case they managed to retain the rises considerably better than Consols did.

Home Railway stocks have dwindled a little, following upon their big rises of last week. The attention called to the market by the advances, spread to the Central London issues; though when would-be purchasers sent in their orders, they found scarcely any stock on supply, and the quotations nominal except to sellers. The 4 per cent. preferred stock is changing hands about 57½; but the 4 per cent. assented preferred stock is quoted about 72, with none on offer. The last business marked in the company's ordinary stock (non-assented) was at 35½, which is about half the present quotation for assented ordinary. Underground Electric ordinary are better at 1 15/16, though the income bonds have given way a little.

Electricity ordinary shares have a rise of 7s. 6d. to the credit of Westminsters, which has raised these to 6, at which price the return on the money comes to £5 16s. 8d. per cent. This gives Westminster ordinary the pride of place, as yielding less than any of the shares of its class in the list. Chelseas at 3 are ¼ down; up to the present they have held the position now taken by Westminsters. The highest returns are those afforded by the ordinary shares of the South London, the Brompton, and the London Electric Companies, in the order named; while from the preference shares the average yield works out to about 6¼ per cent., taking the list through. There is rather more business doing in the market than usual, and jobbers report inquiry for the shares of the leading companies. In the manufacturing group, too, Edison & Swans have picked up to half-a-guinea. British Westinghouse preference have further improved.

British Aluminium ordinary shares are a trifle easier at 26s. 6d. The report of the Aluminium Corporation, which had been awaited with considerable interest, is now out, and shows a net profit of £14,300, this being the first time for the past half decade that the company has escaped a loss. The preference shares are, therefore, to get their 7 per cent. dividend, although some criticism is directed against the payment by those who think it would have been better to fortify the financial position by refraining from making a distribution yet. Nothing has been allowed this year for depreciation, the directors stating that the question will be dealt with in the next report.

All the cable manufacturing shares are strong. India-Rubbers have risen 5s. to 11¾. Henleys and Callenders are wanted by Manchester, which also is a buyer of the other companies' shares in this group. Babcock & Wilcox gave way a trifle, but firmed up again to 2¾. Castner-Kellners have recovered the dividend recently deducted, and at 3⅝ they are 3/16 higher on the week.

With reference to dividends paid free of tax, as there seems to be a slight misapprehension amongst some readers, may we repeat that the yields per cent. which are given in our tables have been calculated without making any allowance for income-tax at all. For some time, we endeavoured to show the equivalent return where dividends were paid tax free; but, in consequence of the various alterations which took place and the different deduction made by the companies from their dividends, we reverted to the simpler practice of working out the returns "flat," leaving the necessary allowances to be made by those who are interested. To take one concrete example: The return on Eastern Telegraph ordinary stock comes to 5½ per cent.; but as the dividends are paid free of tax, deduction of 5s. in the £ would render this equal to nearly 7½ per cent. when compared with other shares the dividends on which are subject to tax before the cheques are sent out.

The strength of the telegraph market continues to stand out as one of the features of the Stock Exchange. Westerns have risen 7s. 6d., Eastern ordinary is up 2 points, "China" shares are again up ½, and Anglo-American preferred is a point to the good. In addition to these, all the rises of the previous week have been held. Considerable animation has revived in Marconis. The ordinary shares gained 7s. 6d. upon their last week's price, but at 2 13/16 shares came in, and there was a small reaction which has left the price ¼ up. Rumour is busy in the discussion of what dividend the company is likely to pay. With the parent shares, those in the subsidiaries have also rallied, Americans hardening to 16s. 3d., and Canadians to 9s. A prominent feature in this section is the strength of Marconi Marines, which rose straight from 30s. to 39s. without a break, though at the latter price something of a halt was called to the breathless advance.

Mexican news is bad. Carranza has developed unexpected truculence, and is said to have seized a station on the Southern Pacific Railroad. President Wilson has ordered mobilisation of the American Militia, and prices of Mexican securities are naturally flat. So far as the utilities are concerned, no quotable changes have been made, but the various issues are not exactly in eager demand.

Holders of the 5 per cent. convertible debenture stock of the Consolidated Gas, Electric Light, and Power Co., of Baltimore, should note that their option of conversion into common

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As will expire on July 1st. The stock is an excellent security, but the shares have fine prospects, and receive 7 per cent. dividends at present.

Brazil Tractions fell a point to 63, although other things connected with Brazil are mostly good. Prices in the railway market are making rapid strides. British Columbia deferred is harder, and a satisfactory feature is the further recovery in Anglo-Argentine Tramways first preference shares, the price putting on another ¼ to 3 11/16. The Argentine Republic has recovered very slowly from the effects imposed upon it by the war; and there can be no doubt that when it fairly turns the corner, prices will go ahead just as sharply as did those of companies trading in Brazil. The 4 per cent. debenture stock is better at 76; the 4½ per cent. has improved to 75¾, which is about a couple of points lower than the 5 per cent. debenture stock.

Bombay Electrics are good at 16¼. The British Electric Traction issues are also firm, the 5 per cent. debenture stock changing hands the other day at 80¼, and the 4½ per cent. second debenture stock at 70½. Calcutta Tramways ordinary have been done within the last few days at 6¼, which is £1 a share lower than they stood upon the outbreak of war.

The rubber share market is steady, notwithstanding a further decline in the price of the raw material to 2s. 5½d. per lb. Business is accordingly quiet, and interest has drifted away to a large extent into other and more active departments of the industrial section of the Stock Exchange. At the same time, the decline in rubber has not led to any particular selling. Copper shares have weakened, in consequence of the smart drop in the price of copper. Base metal shares of various kinds are under something of a cloud. Armament issues, on the other hand, tend to improve, in sympathy with the strength shown by iron and steel shares generally.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price June 22, 1916.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	10	6½	—	£7 13 10
Charing Cross Ordinary	5	5	8¼	—	7 2 10
do. do. do. 4½ Pref.	4½	4½	5½	—	6 18 6
Chelsea	5	4	8	- ½	6 18 4
City of London	9	8	12	—	6 13 4
do. do. 6 per cent. Pref.	6	6	10½	—	5 14 8
County of London	7	7	10½	—	6 16 7
do. 6 per cent. Pref.	6	6	11¾	—	5 15 8
Kensington Ordinary	9	7	5	—	7 0 0
London Electric	4	8	1 5/16	—	7 11 0
do. do. 6 per cent. Pref.	6	6	4½	—	7 1 2
Metropolitan	8½	8	2⅜	—	6 6 4
do. 4½ per cent. Pref.	4½	4½	8	—	7 10 0
St. James' and Pall Mall	10	8	8¼	—	6 16 4
South London	5	5	2¼	—	8 18 10
South Metropolitan Pref.	7	7	1 5/16	—	6 14 0
Westminster Ordinary	9	7	6	+ ⅛	5 16 8
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	104	+ 1	5 15 5
do. Def.	30/-	33/6	28	—	7 10 9
Chile Telephone	8	8	6⅜	—	6 5 6
Cuba Sub. Ord.	5	5	7½		6 13 4
Eastern Extension	7	8	14⅜	+ ⅛	*5 11 4
Eastern Tel. Ord.	7	8	146	+ 2	*5 9 7
Globe Tel. and T. Ord.	6	7	12⅜	—	*5 12 0
do. Pref.	6	6	10⅜	—	5 14 8
Great Northern Tel.	22	22	87	—	5 19 0
Indo-European	13	13	49	-	5 12 8
Marconi	10	—	2 1/16	+ ⅛	3 11 6
New York Tel. 4½	4½	4½	102½	—	4 7 10
Oriental Telephone Ord.	10	10	1¼	—	5 8 1
United R. Plate Tel.	8	8	6⅜ xd	—	*6 5 6
West India and Pan.	1	Nil	2½/-	—	9 6 1
Western Telegraph	7	8	15	+ ⅜	*5 6 8
HOME RAILS.					
Central London, Ord. Assented	4	4	72	+1	5 11 1
Metropolitan	1½	1	27⅛	+ ⅛	3 12 9
do. District	Nil	Nil	19¼	— ¼	Nil
Underground Electric Ordinary	Nil	Nil	1 3/16	+ ⅛	Nil
do. do. "A"	Nil	Nil	6/-		Nil
do. do. Income	6	6	87	— ½	*6 18 0
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4⅜	—	6 6 4
Anglo-Arg. Trams, First Pref.	5½	5½	3 1/16	+ ⅛	7 9 2
do. 2nd Pref.	5½	5½	3¼	—	8 9 2
do. 5 Deb.	5	5	77½	—	6 8 7
Brazil Tractions	4	4	63	- 1	6 7 0
Bombay Electric Pref.	6	6	10⅜	—	5 15 8
British Columbia Elec. Rly. Pfce.	5	5	59	—	9 9 8
do. do. Preferred	—	Nil	40	—	Nil
do. do. Deferred	—	Nil	39	+1	Nil
do. do. Deb.	4½	4½	62	-	6 17 1
Mexico Trams 5 per cent. Bonds	—	Nil	42	—	Nil
do. 6 per cent. Bonds	—	Nil	85	—	Nil
Mexican Light Common	Nil	Nil	20	—	Nil
do. Pref.	Nil	Nil	32	—	Nil
do. 1st Bonds	Nil	Nil	42	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	14	15	2⅜	—	5 9 1
British Aluminium Ord.	5	7	2 5/8	- 6d.	5 5 8
British Insulated Ord.	15	17½	10¾	—	7 2 10
British Westinghouse Pref.	7½	7½	46/6	+ 6d.	6 9 0
Callenders	15	20	12½	—	8 0 0
do. 5 Pref.	5	5	4¼	-	5 17 8
Castner-Kellner	20	—	3⅛	+ 1/16	6 10 3
Edison & Swan, £3 paid	Nil	—	10/6	+ 6d.	Nil
do. do. fully paid	Nil	—	1½	—	Nil
do. do. 5 per cent. Deb.	5	5	57	—	8 15 8
Electric Construction	6	7½	14/6	—	10 6 10
Gen. Elec. Pref.	6	6	9⅜	—	6 4 8
Henley	20	25	15	—	8 6 8
do. ½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11⅛	—	*8 18 10
Telegraph Con.	20	20	89	—	*6 4 0

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, June 21st.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/8	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	,,	£54	..
a Bisulphide of Carbon	,,	£28	..
a Borax	,,	£30	..
a Copper Sulphate	,,	£63	..
a Potash, Chlorate	per lb.	2/6	..
a ,, Perchlorate	,,	2/-	..
a Shellac	per cwt.	9/-	..
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	,,	£4	..
a ,, Lump	,,	£10	..
a Soda, Chlorate	per lb.	1/4½	..
a ,, Crystals	per ton	12/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	1/4½ to 1/4¾	¼d. dec.
c ,, Tubes (solid drawn)	,,	1/5½ to 1/6¼	¼d. to ½d dec
c ,, Wire, basis	,,	1/4½ to 1/5	¼d. to ½d dec.
c Copper Tubes (solid drawn)	,,	1/7 to 1/7½	¼d. dec.
g ,, Bars (best selected)	per ton	£160	£4 dec.
g ,, Sheet	,,	£160	£4 dec.
g ,, Rod	,,	£160	£4 dec.
d ,, (Electrolytic) Bars	,,	£159	£1 dec.
d ,, ,, Sheets	,,	£157	£1 dec.
d ,, ,, Rods	,,	£146	£1 dec.
d ,, ,, H.C. Wire	per lb.	1/5½	¼d. dec.
f Ebonite Rod	,,	3/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/3	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	9/5	2d. dec.
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
l ,, Wire, galv. No. 8, P.O. qual.	,,	£36	..
g Lead, English Pig	,,	£32	2s. dec.
g Mercury	per bot.	£16 12 6 to £16 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e ,, ,, ,, medium	,,	3/6 to 6/-	..
e ,, ,, ,, large	,,	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/8½	..
r Steel, Magnet, in bars	per ton	£85	..
g Tin, Block (English)	,,	£178 to £179	£11 £12 dec.
n ,, Wire, Nos. 1 to 16	per lb.	3/-	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Aluminium Corporation, Ltd.—The report for 1915 shows continued improvement, and a further improvement in the profits, which, after providing for debenture interest and other charges, amount to £14,257, plus £3,286 brought forward. The directors recommend a dividend of 7 per cent. less tax, upon the preference stock, leaving to carry forward £4,559 to the next account, when the questions relating to depreciation will be dealt with. The driving of the Dolgarrog Tunnel was completed early in the present year, and has already fully justified its construction. Arrangements have been made to increase considerably the water power, and the consent of the Treasury has been obtained to the issue of another £100,000 of first mortgage debentures. It is therefore proposed to obtain the approval of the existing debenture holders to the creation and issue of this amount, increasing the total authorised issue to £250,000.

French Thomson-Houston Co.—The report of the Cie Française pour l'Exploitation des Procedes Thomson-Houston for 1915 states that the net profits amounted to 4,821,775 francs, an increase of 272,000 francs. In order to strengthen the financial position, 40,000 6 per cent. bonds of 500 francs each were issued. A dividend of 7 per cent. is proposed, leaving 197,614 francs to be carried forward.—*Financial Times.*

Eastern Telegraph Co., Ltd.—Preference dividend at the rate of 3½ per cent. per annum, less income-tax, for the quarter ended June; also a first quarterly interim dividend of 1¼ per cent. on the ordinary stock, free of tax.

Ruston, Proctor & Co., Ltd.—Final dividend on the ordinary shares making 8 per cent. for the year, plus a bonus of 2 per cent., both less income-tax. £45,000 has been placed to reserve and £16,300 carried forward.

Anglo-Argentine Tramways Co., Ltd.—We understand that the directors have decided not to pay an interim dividend on the second preference shares.

Bullers, Ltd.—An interim dividend at the rate of 5 per cent. per annum (5s. per share), free of tax, is announced

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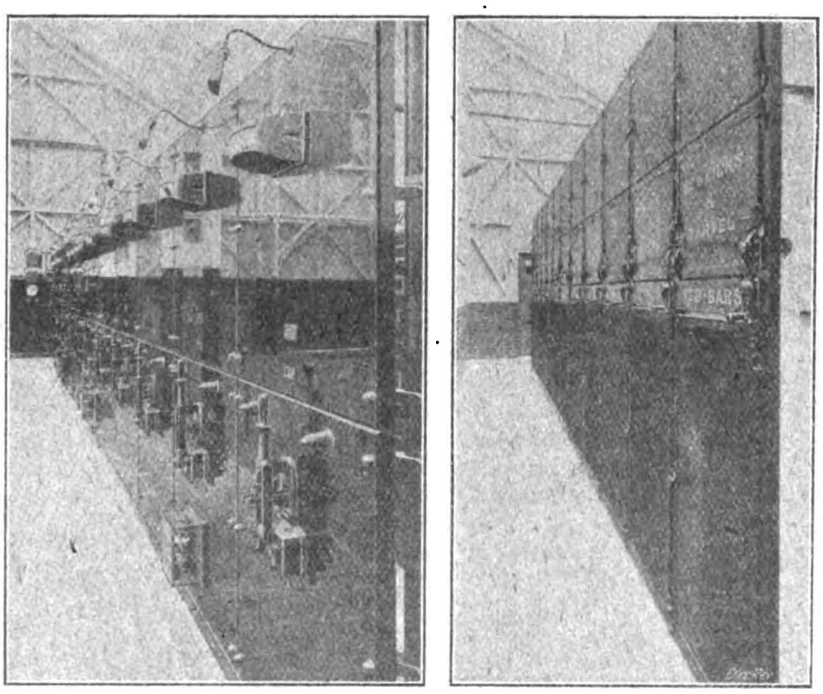
MUNICIPAL ELECTRICAL EXTENSIONS AT KILMARNOCK.

(*Concluded from page* 669.)

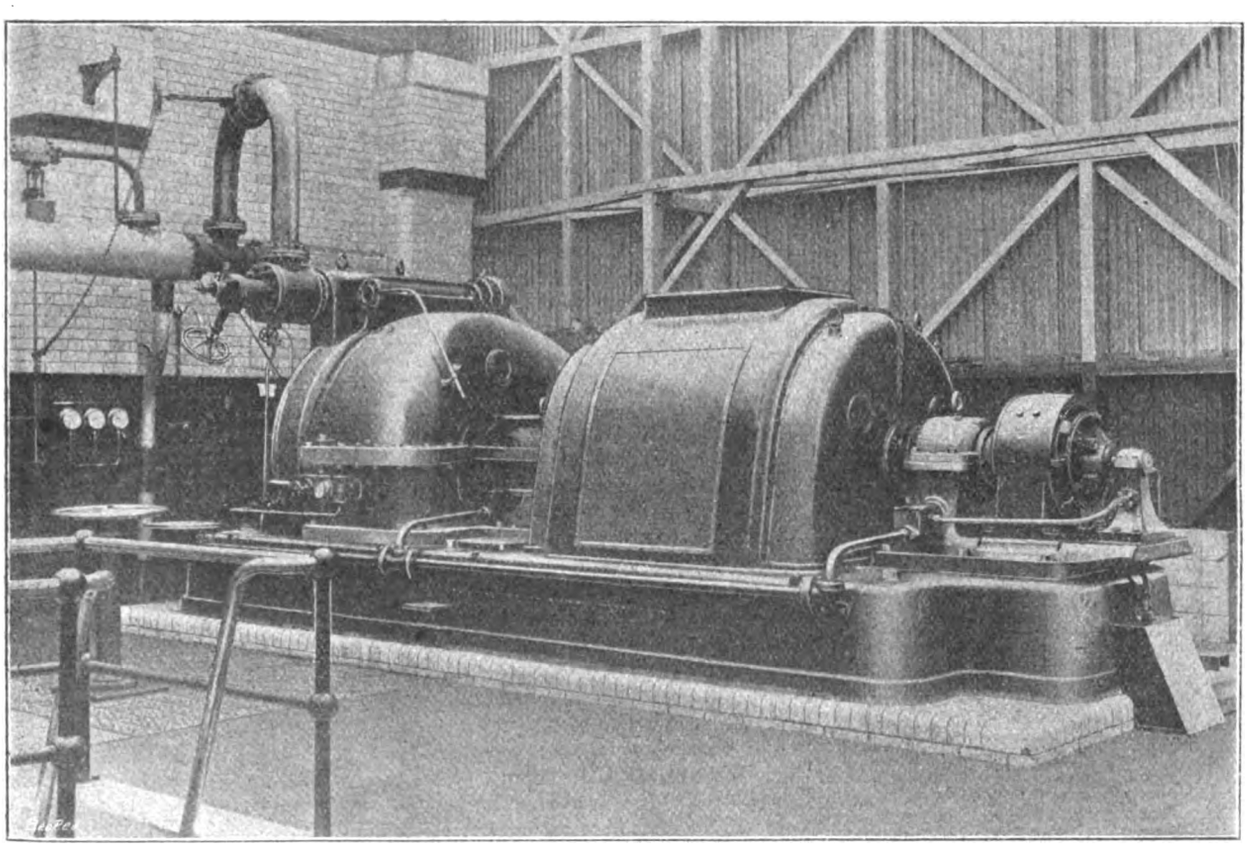
The transmission line to supply the eastern area was not completed until the end of the summer; thus this line is *not* so revenue-producing as the western route. However, a number of the mills are considering offers for completely electrifying their plants. This transmission line is similar in design and capacity to the western section. The sub-stations at Galston, Newmilns, and Darvel are erected in close proximity to the power line, and in each case the line loops in and out of these sub-stations, so that the circuit can be divided up. At a point between Kilmarnock and Galston a tapping is taken into the sub-station of Messrs. A. Strang & Co., Ltd., where a 50-K.V.A. transformer is installed, and arrangements are made whereby a supply can be given to the village of Hurlford.



HIGH-PRESSURE SWITCHGEAR, AND CUBICLES.

At Galston the sub-station is similar to those at Troon and Irvine, but the transformer ratio is 11,000/415 volts. Low-pressure mains are laid from this sub-station into the town. The supply here was available in the middle of January, 1916; the Wholesale Co-operative Blanket Works have some 150 H.P. installed, and a number of smaller consumers have been connected. Ducts are laid with the low-pressure mains for installing H.P. mains immediately the demand for energy warrants the extension. As mentioned, the transmission line is looped into this sub-station, and continues on to the Burgh of Newmilns. Between Galston and Newmilns the supply is teed off to the Loudoun Pit, and an 11,000/3,300-volt transformer is installed. Here one 100-H.P. and one 50-H.P. motors are running day and night, driving turbine pumps placed at the bottom of the pit shaft; the adoption of electric winding is also under consideration.

The sub-station at Newmilns is erected under a railway arch, and L.T. mains run to the various mills. New mills are in course of erection, and the manufacturers are driving throughout by electricity, utilising a motor on each loom. It is essential that the loom drive shall be steady and not jerky when starting up; with a modern spring adjustment on the motor, the starting-up trouble has been overcome, and the three-phase A.C. motor is recognised to be a complete success in every respect. There is no doubt, therefore, that many of the manufacturers, now that the electric drive on lace looms is proved to be satisfactory, will eventually discard their steam engines and adopt the electric drive.



B.T.H. 2,500-KW. TURBO-GENERATOR.

Owing to the mills not being in close proximity to one

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another at Darvel, as is the case at Newmilns, 3,300-volt mains are laid in the burgh to the various mills. The sub-station is similar to those already described, the transformer ratio being 11,000/3,300 volts.

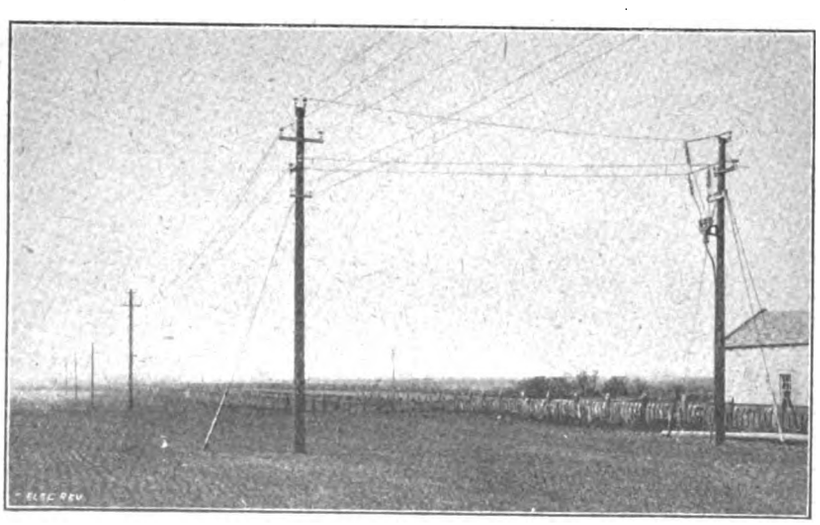
The supply at Darvel has only been available for a few weeks, and only one mill is as yet electrified, but applications from others have already been received. Messrs. Stirling & Auld, prior to taking the Corporation supply,

HIGH-PRESSURE SWITCH PILLAR AND TRANSFORMER KIOSK.

generated their own electricity by means of an 80-H.P. suction gas engine and belt-driven alternator.

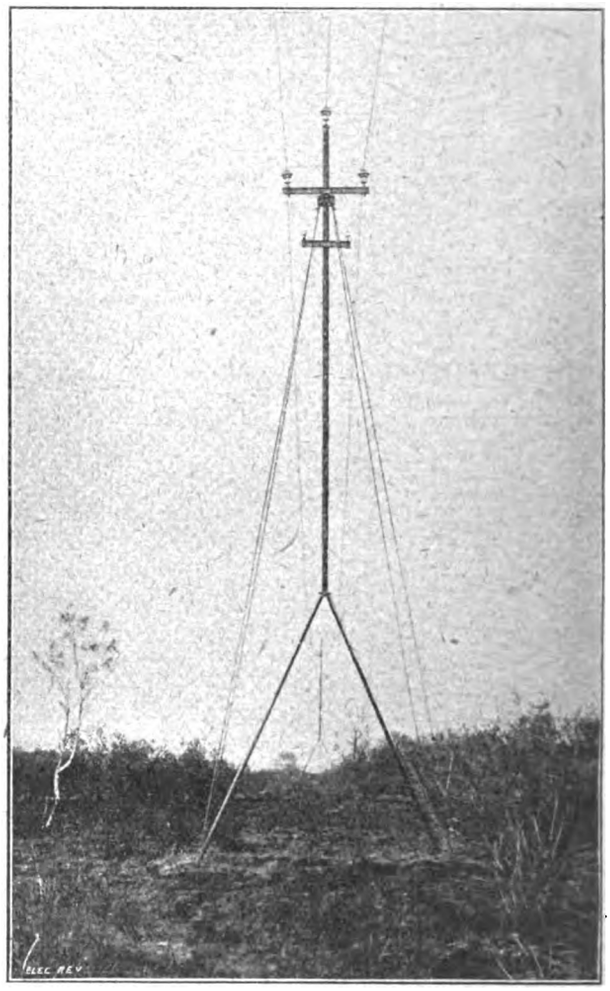
To cope with the demands from the Burgh of Kilmarnock, and its recently-extended area of supply, extensive alterations have taken place at the power station, and extensions to the engine room and boiler house, and a switch annexe, have been built. A turbo-alternator set of 1,500 KW. was installed in January, 1915, and a further similar 2,500-KW. set was put on load in April, 1916, bringing the total plant capacity to 5,550 KW., there being nine sets in all, three of which are turbo-alternators. Both the 1,500 and 2,500-KW. turbines are of the B.T.H. horizontal Curtis type, running at 3,000 R.P.M., and driving 3,300-volt, 50-cycle alternators, with the exciters on the ends of the shafts. The 1,500-KW. set is designed for 25 per cent. overload and 50 per cent. momentary overload, but the 2,500-KW. set is designed for 50 per cent. overload for a long period. On both alternators a Heenan & Froude air filter is provided.

The condenser on the 1,500-KW. set is of the surface type, with the air, circulation, and extraction pumps driven by an auxiliary turbine manufactured by Messrs. Mirrlees Watson.



TEE OFF E.H.P. TRANSMISSION LINE TO SUPPLY IRVINE.

The condenser on the 2,500-KW. set is of the Worthington surface type, the air, circulating, and extraction pumps being driven by a B.T.H. steam turbine. The exhaust steam from the two auxiliary turbines can be passed into a direct-contact feed-water heater situated on the top of a hot-well tank, or put into the main turbine condenser. With the 2,500-KW. turbine a Lea recorder is installed.



CALLENDER K TOWERS CROSSING BOG LAND (see p. 668).

The high-pressure switchgear supplied by the British Thomson-Houston Co. consists of one Tirrill regulator panel, three machine panels, two converter panels, and six feeder panels. Immediately behind the control board and in the switch annexe are built concrete cubicles containing bus-bars, switches, &c. The whole of the bus-bars and isolating switches are duplicated, and the doors of the cubicles are interlocked with the switches.

In order to make full use of the efficient turbo-alternators, one 500-KW. and one 300-KW. Bruce Peebles motor-converters are installed in the power station to supply the direct current for lighting and tramways, and these also run in parallel with the converters at the Langland Street sub-station. These machines have the same voltage regulation as the D.C. generators, and can be run in parallel with them.

In the boiler house one 20,000-lb. Babcock & Wilcox boiler has been added, and a similar one is in course of erection at the works, making a total of eight boilers, three of which are of the Lancashire type. Owing to the cheap grade of fuel which can be had around Kilmarnock, this new boiler is fitted with "undergate" forced draught. This was the first of Messrs. Babcock and Wilcox's manufacture, and it has been found that a very small and cheap class of smudge can be burned economically and well. B.T.H. steam-flow meters are installed in connection with the chain-grate stokers. An induced-draught plant is at present being erected, and much better evaporation is expected from the boilers when

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this plant is working. A railway siding runs direct over the coal-bunkers in front of the boilers, and the usual bunker elevators are in use for taking the coal into the stoker hoppers.

The pumping plant consists of three Weir double-acting feed pumps, and a rotary feed pump will be installed shortly. Although the works are situated on a bank of the river Irvine, a shortage of water was experienced during the summer, the river being dammed at a number of places. To overcome this difficulty, 36-in. ferro-concrete pipes have been laid from the nearest dam to the works, and an ample supply of water is now available. The condenser and pumps are now always flooded.

The maximum load during the winter of the year ending May 15th, 1915, was 1,340 KW., and the average day load for the last four months has been 2,000-2,200 KW. This load would have been some 500 KW. better had sufficient plant been available, but owing to the delay in getting the 2,500-KW. turbo-alternator into commission, it has been necessary to restrict a number of the large consumers from taking the whole of their requirements.

The majority of the large consumers are under agreements for 10 to 15 years, the Corporation covering itself against increased cost of coal by inserting a coal clause in these agreements.

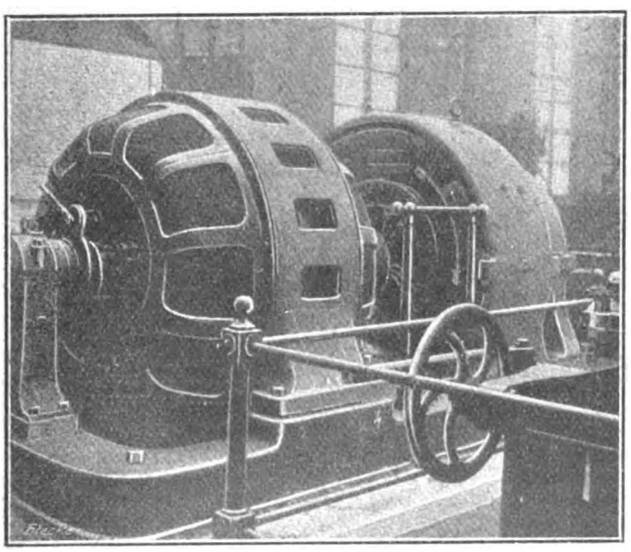
The transmission lines were erected by Messrs. Callender's Cable and Construction Co., Ltd.; the total length of overhead mains is 19·78 miles, and the total number of poles 581, spaced, as a rule, 55 to 60 yards apart.

The A.C. supply-pressure is kept constant by means of a Tirrill regulator; the alternators are star-wound, and the neutral point is connected to earth through a limiting resistance.

The Town Council of Kilmarnock is doing everything possible to further the interests of the electricity department, and a showroom has recently been opened. The tariff charges for lighting and power are reasonably low in Kilmarnock, and even in the outer areas the lighting is at the same rate, but the power charges are 10 per cent. above the Kilmarnock rates. However, at this figure the power consumers are finding the electric drive more economical than their old steam or gas engines.

The construction of the outside extension was not commenced until June, 1914, and was greatly delayed owing to the difficulty in getting material consequent on the war, but practically the whole scheme will be completed in three months' time, except for local extensions. Up to May 15th, 1916, some 2,050 H.P. in motors had been connected.

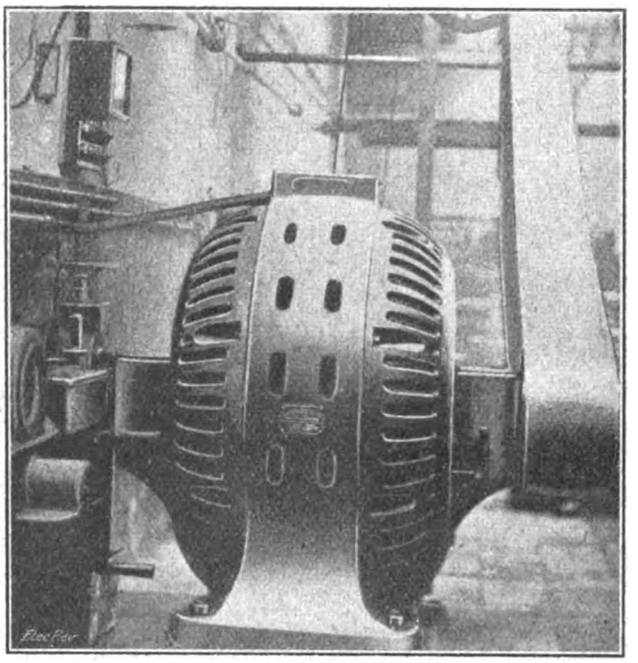
The 11,000-volt transformers were supplied by Messrs. Ferranti, Ltd., and are of the oil-cooled type; the end



Peebles 500-KW. Motor Converter at Glenfield and Kennedy's Works.

turns are specially insulated to withstand increased pressure, and each transformer has approximately 5 per cent. reactance. A number of the transformers have their coils clamped by means of the above makers' patented spring clamp, and all the transformers have their coils clamped in order to withstand, as far as possible, short circuits and overloads. Tappings of 11,000, 10,800, 10,600, 10,400, 10,200, and 10,000 volts are taken out of the transformers, in order that the correct voltage may be obtained. The kiosk transformers are air-cooled, and are of the well-known "Berry" make.

The underground cables were supplied by Messrs. Callender's Cable and Construction Co., Ltd., and were laid by the Kilmarnock Corporation Electricity Department.



Siemens 100-H.P. Motor Drive at Spinning Mill.

In conclusion, we must express our indebtedness to Mr. William Bexon, the burgh electrical engineer, for providing us with particulars and views of the extensive supply scheme under his control, towards the success of which his efforts have so greatly contributed.

GERMAN SUBSTITUTES AND ECONOMIES IN ELECTRICAL CONDUCTORS.

The oft-repeated boast that Germany has within her own borders many years' supply of copper, and has secured inexhaustible supplies in allied or occupied territory in the Near East, has been accompanied by an ever more extensive commandeering of domestic copperware, and, in the electrical field, by the most vigorous efforts to find a substitute for copper conductors. At first iron wire and cables were employed, but these soon proved very inconvenient, apart from the fact that the conductivity of iron is only about one-eighth that of copper. Aluminium is, of course, quite a useful substitute for copper in practically every electrical application, and the fact that the enemy has gone the length of formulating rules concerning the use of zinc and iron in wiring and in machine windings merely indicates that the shortage of aluminium is as serious as that of copper. The conductivity of zinc is more than twice as great as that of iron, and the metal is non-magnetic, and more flexible and convenient in its mechanical properties. In this respect the latest zinc wiring on the German market is claimed to be almost equal to copper. Under favourable circumstances, this is probably the case, but it is never possible to rely on a single zinc conductor being sound throughout its length, and the mechanical properties of zinc are inferior and treacherous at temperatures much above or below normal atmospheric temperature. Zinc cables may not be laid during frost, and, once laid, they must not be moved except with very great care, and only between narrow limits of temperature. Electrolytic corrosion, at the expense of the zinc, is very apt to occur at all junctions with dissimilar metals, and mechanical contact clamps are preferable to soldered joints, owing to the low

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melting point of zinc and the risk of coarsening the crystalline structure and rendering the metal brittle by heat. For this reason, zinc wiring or windings may not be used in hot situations, and joint-boxes must be as small as possible, and filled with a compound melting at somewhere below the boiling point of water. Zinc may not be used for overhead lines, and zinc windings are not safe in motors to be used out of doors, neither are they safe in totally-enclosed machines; indeed, they are not reliable enough under any circumstances to be considered safe for use in electrical apparatus for military service. As an approximate rule, zinc conductors may be worked at half the current density, giving the same temperature rise as in copper conductors.

Only a few weeks ago fresh rules were published by the V.D.E. concerning the use of aluminium and zinc lighting wires, pendant and workshop flexibles, as well as rubber-insulated and armoured aluminium cables. A further economy, prescribed "for the duration of the war and a suitable time thereafter," relates to the thickness of lead on lead-sheathed cables. This is to be reduced to values indicated by the following summary, in which the approximate equivalents of the I.E.E. values are added for comparison. Double-lead sheathing is prohibited for the present.

Effective copper section.	Thickness of lead sheathing. New V.D.E. Rules.	I.E.E. Rules (approx.).
1 to 10 sq. mm.	1·0 mm.	1·5 mm.
35 to 50 "	1·2 "	1·8 "
95 "	1·3 "	2·0 "
150 "	1·5 "	2·3 "
240 "	1·7 "	2·5 "
500 "	2·0 "	3·0 "
1,000 "	2·5 "	—

Concentric and multicore cables may have a single lead sheathing, the thickness specified advancing by steps of 0·1 mm. from 1·1 mm. for cables 10 mm. or less in diameter (under the sheathing) up to 3 mm. for cables 70 mm. in diameter.

By agreement with the Association of Central Stations and with cable manufacturers, it is arranged that all conductors insulated with "regenerated rubber" shall have a bright green identification thread.

The war-time fittings wire, for use only in or on low-pressure lighting fittings, consists of a solid aluminium or a 7-strand aluminium or zinc wire of 0·75 sq. mm. cross-section, covered with 0·8 mm. of vulcanised rubber, which may be "regenerated" material. Over this there is the usual impregnated cotton or silk braiding, and the test for the finished material is ability to withstand 1,000 v., A.C., for half an hour between the cores of 5 metres of twin conductor or between two single wires twisted together.

Pendant wires are insulated similarly, and subjected to the same electrical test, but the conductor section is increased to 1 sq. mm., and consists of 19 aluminium or zinc strands. One, or, if preferred, two tension flexibles are stranded with the current-carrying cores, and the whole, after braiding, must be flexible enough to pass without injury over a 25-mm. roller in the case of single cords, and over a 35-mm. roller in the case of double cords.

Flexible for domestic service, subjected to small mechanical stress and lower pressure, is to consist of aluminium or zinc wires of at most 0·3 mm. diameter, suitably twisted together. The smallest permissible section is 1 sq. mm. in aluminium and 1·5 sq. mm. in zinc; the largest permissible sections are 2·5 mm. and 4 sq. mm. respectively. Each core must have at least 1 mm. (radial) of rubber sheathing (which may be "regenerated"), and over that a braiding. The test for this class of wiring is ability to withstand 2,000 volts A.C. for half-an-hour on 5-metre test lengths after immersion in water for 24 hours. Workshop flex is of similar construction, but sections up to 16 sq. mm. are permissible, and wires 0·4 mm. in diameter may be used in sections exceeding 6 sq. mm. Vulcanised rubber insulation is specified, and this must be covered with impregnated tape or paper. Two or more cores are placed together under a strong outer braiding; earthing conductors must have strands not exceeding 0·3 mm. diameter.

The following extract from the wiring table for aluminium and zinc wires may be compared with the I.E.E. limits for copper:—

Conductor section.	Maximum permissible current. Aluminium (V.D.E.)	Zinc (V.D.E.)	Copper (I.E.E. approx.)
1 sq. mm.	8 amps.	—	6 amps.
4 " "	20 "	13 amps.	24 "
10 " "	34 "	23 "	38-57* "
25 " "	80 "	52 "	64-103 "
50 " "	125 "	83 "	98-158 "
95 " "	190 "	125 "	150-245 "
150 " "	255 "	170 "	204-327 "

* Rubber and paper insulation respectively.

In addition to last year's rules sanctioning rubber-insulated zinc cables for use in low-pressure permanent installations, rules have been issued for rubber-insulated aluminium wires of the same general construction, but permitted in sections down to 1 sq. mm., this conductor having 7 strands and at least 1 mm. thickness of rubber. In armoured aluminium cables the minimum conductor section is 1 sq. mm. The following figures show the maximum permissible sustained current flow in a few sizes of aluminium cables laid in earth, and give a good idea of the rating permitted:—

Aluminium conductor section, sq. mm.	Single-core cables to 750 v.	Maximum sustained current, cables laid in earth. 3,000-volt cables. 2-core.	3-core.	4-core.	Con-c'ntric	Triple con.	10,000-volt cables. 2-core.	3-core.	4-core.
4	42	32	28	26	—	—	—	—	—
10	75	55	50	44	55	42	50	46	42
50	200	145	125	115	140	115	135	120	105
150	390	275	240	220	275	220	255	230	210
240	515	360	320	295	360	295	—	—	—
400	695	485	435	—	490	405	—	—	—
1,000	1,200	—	—	—	—	—	—	—	—

The specific resistance of the aluminium and zinc conductors covered by the above tables may not exceed 0·030 ohm and 0·0067 ohm respectively, per sq. mm. per metre at 20° C.

Bus-bars and other interconnectors can be made of zinc without difficulty, except that precautions must be taken against corrosion at contacts where iron screws are necessarily employed. Rules have been framed also for the use of zinc wires and iron slip-rings in electrical machinery and transformers, but in these applications the defects of the substitutes are very pronounced. Zinc windings with anything like reasonable losses cannot be easily accommodated, particularly on rotors, and iron is one of the worst metals from the sparking point of view. From the provisions of the V.D.E. rules it appears that zinc windings are scarcely practicable in machines or transformers exceeding 250 KW., and that serious difficulties are often encountered in apparatus of 50 to 100 KW. In all cases the first cost of the zinc-wound apparatus seems to be at least as high as that of standard construction, and the cost of running losses is, of course, much greater. There is no reason to believe that zinc conductors will ever be used otherwise than under the compulsion of necessity.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Bennis Automatic Elevators.

An automatic mechanism has recently been added to the design of the Bennis independent elevators. The Bennis bucket elevator consists of a strong steel chain to which buckets are attached at regular intervals; the coal is fed into the elevator boot by means of the Bennis rotary safety feeder at a suitable speed, rendering choking of the bucket by over-supply impossible. The shoot which feeds the fuel from the elevator head to the hopper is swung on a balanced lever supported by the elevator head; the tail end of the shoot is supported by means of a chain, rod, or wire rope. The elevator feeds the coal into a small hopper forming the upper end of the shoot. When the shoot is empty, the weight on the balance lever draws the belt on to the driving pulley through a parallel link motion, so that the elevator starts up. When the shoot fills, it overbalances the balance lever and pushes the strap fork on to the loose pulley, and the elevator is brought to a stop.

When the shoots are about half empty, the balance lever comes into operation again, and the elevator starts up. By this means there is always a sufficient supply of coal to keep the hoppers full, but the elevator is never allowed to overflow. The rate of revolu-

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tion of the rotary feed can be altered by the raising or lowering of a handle. The device, views of which are given in figs. 1 and 2, can be applied to any existing elevator, and diminishes the cost of attendance, an important matter in these times.

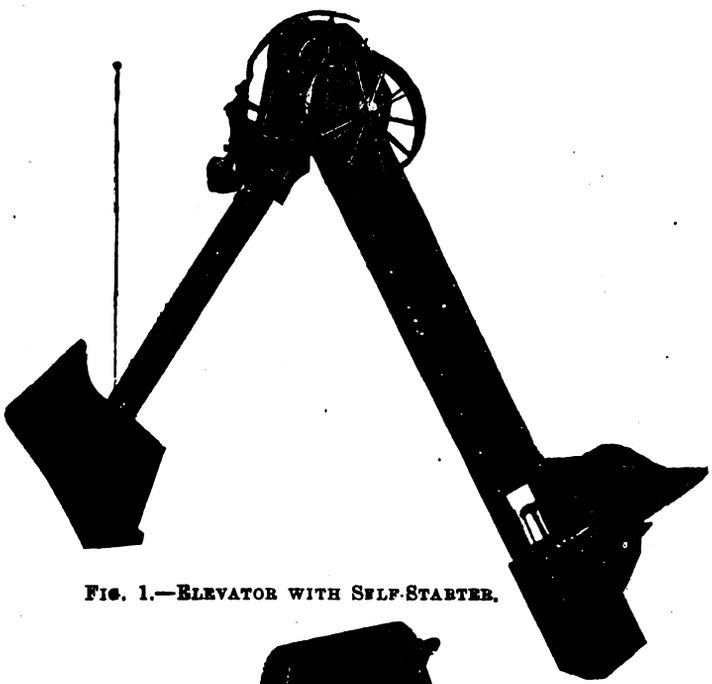

Fig. 1.—Elevator with Self-Starter.

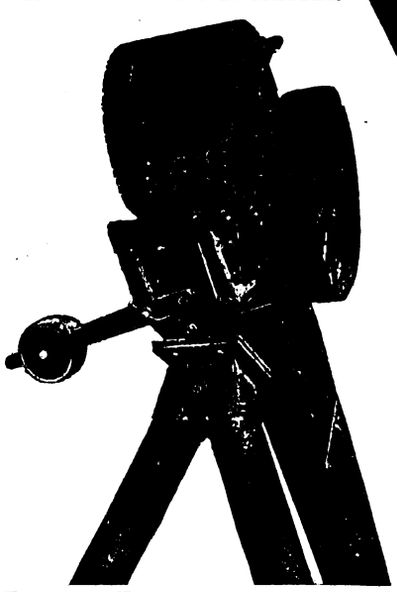

Fig. 2.—Elevator Head, showing Balance Lever and Belt Fork.

The apparatus is manufactured by Messrs. Ed. Bennis & Co., Ltd., Little Hulton, Bolton, and 28, Victoria Street, S.W.

Isolating Switches.

A line of substantial isolating switches for use on high-pressure systems has been designed by the British Thomson-Houston Co., Ltd., of Rugby, for pressures up to 11,000 volts, and currents to 1,200 amperes. The switches are made in several patterns, of which Type I is illustrated in fig. 3. The switches are, with few

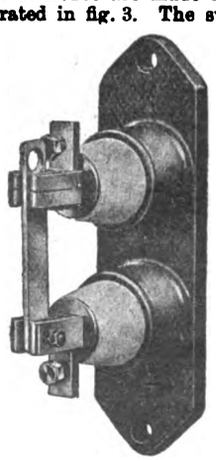

Fig. 3.—200-amp. Isolating Switch on Cast-iron Base.

exceptions, of wrought copper, carried on white porcelain insulators, and are designed to be operated by means of insulated hooks on wooden handles. Interlocking mechanism and safety catches can be provided if required. For three-phase circuits rotary switches are made.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

"O Ye of Little Faith."

Why is it that the electrical men of this country have such little faith in advertising and modern methods of selling? The seventh instalment of your contributor's article on the "Selling Side of Electricity Supply," has evoked this outburst from an otherwise peaceful citizen. One would think that the product, and the accessories to that product, which we are so interested in, are unworthy of expenditure in the matter of advertising and sales promotion.

Your contributor shows a lack of knowledge of true advertising by stating that artistic *embellishment* is necessary to the success of a piece of advertising matter! A calendar or diary is not the best form of advertising, neither is it the first form of advertising to adopt! What is the matter with a piece of blotting paper printed on one side? It is cheaper than the calendar, and is needed in most households; but how poor must be the claims of the product if, in order to secure attention, we must give away something that is "useful."

To suggest that any form of advertising should be prohibitive on account of expense, is at once to label it as unsound in principle, and therefore not in any sense good business.

Again, what value does he place upon the claims of electrical domestic appliances, when he says that the meter-reader should not *waste* his time canvassing. Why talk of increasing sales by giving the meter-reader an increase in wages of 6d. per week?

Do not the merits of the electric iron, toaster or vacuum cleaner warrant the adoption of ordinary commercial methods; and is it impossible for a good traveller, receiving a salary of about £5 a week and commission, to earn this sum by selling electricity and domestic appliances? If such is the case, why discuss the question?

In a recent advertisement a manufacturer was appealing to central-station engineers and contractors to acquaint themselves with electric cooking and heating by using the appliances themselves. Can we hope to increase the demand for articles which do not merit a place in our own homes?

Until we have confidence in our wares, and look upon advertising (by which I mean the employment of men as well as printed matter) as an investment instead of an expense, we can only grow in spite of ourselves and through the sheer merits of our products.

I believe I am one of the few who have little faith in the co-operative idea of advertising—except as an adjunct of individual effort. The business of the world has been built by sane competition, and so long as we adopt methods which tend to stifle this, progress will be slow.

Advertising to be successful need not involve a vast expenditure, but it should be suited to local conditions and give the fullest possible information to prospective clients.

Co-operative literature cannot be made direct enough in its appeal to ensure an adequate return—it is necessarily too general.

Let each central-station engineer, contractor, and manufacturer who believes in advertising secure the assistance of a capable advertising man, and collaborate with him in spending the appropriation in the most direct way possible. If he feels inclined to put 10 per cent. of this money into a pool for a broader campaign, then he will be doing the right thing; his motto should be 90 per cent. direct, 10 per cent. indirect, until such time as he feels that the whole of the money can be best spent in his own way and in his own locality.

After 14 years' experience in advertising and selling in the electrical industry, I have found the fac-simile typewritten letter (with name and address filled in so well as to render it equal in all respects to an individual type-written original) to be one of the most productive forms of advertising. Added to this, should be an occasional business-like leaflet, which relies on photographic illustrations and the interest of its message rather than "artistic embellishment" to secure a reading.

Both will eventually find a resting-place in the waste-paper basket, but what matters if an adequate percentage has actually created a sale? We can afford to send these inexpensive forms of advertisements out again and again to those who have not purchased, and then secure the advantages of cumulative effect.

The central-station engineer is in a most favourable position in that he has a complete list of consumers, and by using the post he can eliminate all waste in advertising.

In the case of the London companies, conditions may be so different as to render it more profitable to take a London newspaper, in order to reach their consumers at a minimum expense. At least one supplier of domestic electrical appliances has found the London daily Press a paying medium, but then he is interested in all districts.

All these considerations are simple of solution when one has facts and figures to work upon; and the more one thinks of advertising in connection with electricity generally, the more one realises the vast possibilities in the field.

During the last few years manufacturers have shown a greater appreciation of the claims of the trade paper in the matter of advertising. It is a hopeful sign, and I doubt not but that other sections of the industry will fall into line eventually.

A. J. G.

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Salaries for Engineers.

At this period one hardly likes to criticise an important Government department, which we all believe is doing good work, but a word of protest seems not out of place against the suggestion contained in an advertisement—in your issue of June 10th—of the Admiralty, that a fair salary for the services of a M.I.E.E. is £250 per annum.

I understand that men competent to supervise power and lighting plants are required, and for such it is only right that an adequate salary should be offered—especially as the appointments are not permanent. If the salary named is a fair return for the services required, then there can be no need for engineers who are sufficiently qualified to be full members of the Institution. The successful candidates will, I believe, be ranked as second assistants—not a particularly high degree. As it stands, the advertisement is distinctly open to the interpretation that the electrical department of the Admiralty has not much respect for the Institution and its standards of professional competency.

A.M.I.E.E.

60-cycle Transformers on 25-cycle Systems.

Could any reader explain why some transformers, designed to operate on a supply having a frequency of 60 cycles, work satisfactorily on a 25-cycle system, disregarding regulation and temperature, whilst others, although of the same type and output, cannot be used?

We are running certain transformers under this condition, and have several others that we cannot use.

Is there any way whereby these transformers could be used up, to save having them re-designed?

William Lovell.

London, N., *June 15th*, 1916.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

COLOMBIA.—A Resolution, dated December 29th, 1915, of the Minister of Hacienda notifies that goods dispatched to Colombia must be declared in the Consular invoices in the terms of the nomenclature of the Colombian Customs Tariff. Firms exporting goods to Colombia should therefore obtain from the importers or their agents the information necessary to enable them to do this.

VENEZUELA.—According to a recent Presidential Decree, electric batteries when imported into Venezuela must be declared in the Consular invoice as "pilas electricas," and will be dutiable under Class III of the Tariff at the rate (including surtaxes) of 0.391 bolivar per kilog. gross. (Bolivar = 9.6d.; kilog. = 2.2046 lb.)

Note.—It is important to preserve the exact (Spanish) wording mentioned above in the declaration for Consular invoice.

CHILE.—In virtue of a Law, dated February 29th, the fees to be charged from April 1st to December 31st next by Chilean Consular Officers are to be levied at the rates hitherto in force (viz., those fixed by the Law of September 21st, 1909), with an increase of 50 per cent. Particulars of the fees chargeable under the Law of 1909 are obtainable from the Commercial Intelligence Branch of the Board of Trade.

NEWFOUNDLAND.—The free entry of material for installing wireless telegraphy on board ships engaged in the trade and fisheries of Newfoundland was among the proposals made by the Minister of Finance and Customs in his Budget speech of April 18th. The Act embodying this proposal was passed on May 4th.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Published expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

7,934. "Electrical transmission and control of motion." L. G. W. Guest and H. O. Merriman. June 5th.

7,936. "Portable electric battery." A. Sandrini. June 5th. (Italy, June 5th, 1915.)

7,942. "Systems of ship propulsion." British Thomson-Houston Co. (General Electric Co., U.S.A.). June 5th.

7,963. "Electric switches." F. J. Decker. June 5th.

7,995. "Telegraphy." E. S. Heurtley. June 6th.

8,003. "Underground circuit making and breaking device." E. Brodsky. June 6th.

8,011. "Wireless signalling systems." British Thomson-Houston Co. (General Electric Co., U.S.A.). June 6th.

8,042. "Ear protector for telephone and wireless telegraphy head receivers." I. J. Trim. June 7th.

8,056. "Electrical water heaters." J. F. Barr. June 7th.

8,091. "Combined electric iron and heating apparatus." J. Kluijtmans. June 8th.

8,103. "Field telephones." E. Thompson. June 8th.

8,111. "Electrolytic apparatus." Siemens & Halske Akt. Ges. June 8th. (Germany, June 24th, 1915.)

8,128. "Electric motor control systems." British Thomson-Houston Co (General Electric Co., U.S.A.). June 8th.

8,150. "Continuous-current dynamos." F. Kesselring. June 8th.

8,165. "Systems of ship propulsion." British Thomson-Houston Co. (General Electric Co., U.S.A.). June 9th.

8,166. "Electric traction devices." Soc. Anon. dite Ateliers de Constructions Electriques du Nord et de l'Est. June 9th. (France, December 21st, 1915.)

8,178. "Telephony." H. J. Herink & Relay Automatic Telephone Co. June 9th.

8,179. "Telephone systems." H. J. Herink & Relay Automatic Telephone Co. June 9th.

8,191. "Electromagnetic switches or contact makers." Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.). June 9th.

8,199. "Electric trucks." F. J. Decker. June 9th. (U.S.A., June 9th. 1915.)

8,211. "Printing telegraph systems." A. D. Chardwell. June 9th.

8,216. "Sparking plugs for internal-combustion engines." F. A. L. Johnson. June 10th.

8,232. "Electric generators for road vehicles." A. F. Evans. June 10th.

8,238. "Manufacture of galvanic batteries." J. J. Linzell. June 10th.

8,239. "Manufacture of galvanic batteries." J. J. Linzell. June 10th.

8,240. "Device for passing through the human body currents derived from ordinary town main electrical supply." E. E. Greville. June 10th.

8,245. "Electric ignition or sparking arrangements." H. W. F. Ireland and Siemens Bros. & Co. June 10th.

PUBLISHED SPECIFICATIONS.

1914.

22,807. Wireless Control Systems. M. Compare. November 20th.

23,505. Transformer Connection for Three-phase Metal Vapour Rectifiers. Allgemeine Elektricitäts Ges. December 3rd. (December 3rd, 1913.)

1915.

717. Protection of Electric Cables. J. H. Bowden & H. F. J. Thompson. January 16th. (July 16th, 1915.)

2,897. Electric Railway Systems. F. G. Brettell (C. W. Leffler, U.S.A.). February 23rd.

4,378. Telegraphic Printing Apparatus. M. B. Rodriguez. March 20th.

7,467. Electric Current Limiting Devices. W. Hamilton, G. Wall and Ferranti, Ltd. May 18th.

7,546. Electric Accumulators or Storage Batteries for use in Electric Battery Lamps. S. D. Smith. May 19th.

7,579. Telegraphy. E. S. Heurtley. May 20th.

7,829. Process for Manufacturing Metallic Filaments for Incandescent Electric Lamps and for other purposes. K. Nishimoto. May 26th.

8,485. Centrifugal Compressors. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 8th.

9,582. Telephone Systems. Automatic Telephone Manufacturing Co. and P. T. Bates. June 30th.

12,434. Loaded Telephone Line System. Western Electric Co. August 30th.

13,769. Loading Coils for Telephone Lines. Western Electric Co. (Western Electric Co., U.S.A.) September 28th. (Addition to 12,434/15.)

13,869. Electric Current Duration Meters. A. Aubert. September 29th. (October 1st, 1914.)

15,128. Electric Measuring Instruments of the Thermal Type. P. M. Lincoln. October 26th. (November 12th, 1914.)

15,792. Electric Motors. F. J. Osius. November 9th.

16,044. Electric Killing Apparatus for Flies or other Insects. J. Satinover. November 13th. (November 27th, 1914.)

16,393. Loaded Telephone Line System. Western Electric Co. (Western Electric Co., U.S.A.). November 20th. (Addition to 12,434/15.)

16,479. Loaded Telephone Line System. Western Electric Co. (Western Electric Co., U.S.A.). November 22nd. (Addition to 12,434/15.)

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1916.

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999. January 14th, 1902. E. de Pass. Railway points.

1,061. January 14th, 1902. F. G. Creed & W. A. Coulson. Electric telegraphs.

2,736. February 3rd, 1902. Gas engines. G. Honold.

3,227. February 8th, 1902. T. F. Walker & T. S. Walker. Legs.

3,737. February 13th, 1902. R. A. Hadfield. Alloys.

4,754. February 25th, 1902. R. Lundell. Dynamo-electric machines.

5,104.* February 28th, 1902. Soc. G. et P. de Mestral. Electric lamps.

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7,995. April 5th, 1902. P. Jensen. Electrolysis.

8,558. April 12th, 1902. British Thomson-Houston Co. Controlling electric motors.

(To be continued.)

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THE I.M.E.A. MEETING.

IN our last issue we referred briefly to the annual meeting of this Association, which took place in London on Thursday and Friday last week, at the Institution of Electrical Engineers.

As was the case in the previous year, the proceedings were severely curtailed, though, judging by the numbers attending the meeting and the nature of the business transacted there, it is certainly open to question whether such drastic treatment of the annual gathering is not a mistake. If "public interest" is to be taken as a criterion, then the three papers considered on Thursday last week—which, so far as the authors' abstracts at the meeting are concerned, might equally well have been "taken as read"—deserved a better fate than to be crowded into one day, as they were devoted to pressing questions of the hour, of the first importance not only to the electricity supply industry, but also to the State, and might well have been discussed at greater length.

Mr. Lackie's paper dealt mainly with the arrangement and operation of the steam-raising plant in a modern coal-fired boiler house, though the discussion embraced several other topics and led to interesting disclosures on the subject of gas-firing. We confess that we were rather surprised that the paper contained no reference to the higher steam pressures and superheats, towards which developments in central-station practice have been tending for some time; fortunately, in the discussion, Mr. J. P. Gregory's intimation that a boiler-turbo unit of 1,500 KW. had been operating satisfactorily for over a year with steam at up to 400 lb. pressure and 700 deg. F. temperature, showing an overall thermal efficiency of over 19 per cent., afforded an indication that progress is being made by our engineers in this direction. The whole question of boiler pressures requires careful consideration now.

There appears to be no obvious reason why a factory for the commercial production of electricity should be rectangular in outline, any more than any other factory, and the care often displayed in fitting the boiler-house or houses to the modern turbine room is remarkable; we appreciate Mr. Selvey's remarks on this matter, though we cannot quite understand his apparent repugnance to gas-firing.

To us it seems that the suggestion of Mr. Christie, to separate the fuel plant from the modern boiler-house and treat it as a specialised department, has many points to recommend it.

It was unfortunate that Mr. W. Yorath Lewis, whose diagrams of Niclausse boiler plants were dis-

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played upon the wall, was not called upon to speak until the sitting was about to close.

The paper by Mr. H. S. Ellis on independent stations *v.* bulk supply was criticised in some quarters because it was based on published statistics relating to works costs, &c., which are, of course, admittedly unreliable for certain purposes, such as, for instance, individual comparisons, but are, nevertheless, useful where average results of groups of stations are concerned. The future of the individual station is closely bound up with the question of interlinking supply areas, to which we have referred at some length in recent issues, and it is evident that if the highly efficient high-superheat plant referred to by Mr. Gregory is adopted to any extent, the life of the smaller generating stations as independent plants may be prolonged.

It is not at all unlikely, however, that linking-up may come about solely on the score of reliability, and, to turn to the third paper, by Mr. Kerr, on agricultural electricity supply, such linking-up in agricultural districts would probably be the means of developing a profitable load *en route*, from supply to farms, country houses, and villages in the vicinity of the line.

Mr. Kerr's paper is, we believe, the first one read in this country dealing specifically with the electrical aspects of agriculture from the central-station man's point of view, and draws timely attention to a matter in which we lag seriously behind many Continental nations, as well as the Canadians and Americans.

The paper recapitulates many matters which have, of course, appeared in the various articles on the subject appearing in our pages from time to time, and it is not now a question of whether electricity supply is valuable to the farmer and welcomed by him, or of whether it will pay the central station to supply the farmer, but solely a question of how to render such a supply available at an early date, in all reasonably accessible districts.

We have on previous occasions urged the pressing necessity of taking immediate action in this matter, the urgency of which is dictated alike by the favourable opportunity created by the present labour shortage, and by the need for checkmating the energetic campaign in favour of oil and petrol engines for farm work, which has already made considerable headway.

The discussion, though wholly favourable to Mr. Kerr so far as it went, rather tended to show that there are still many engineers and committee-men who are disposed to adopt a "Wait and See" policy. The achievement of practical results in the direction of agricultural electricity supply would obviously be facilitated were supply engineers—municipal and company alike, for the matter cannot be confined to municipal circles—to arrive at some common understanding as to the methods to be employed in installation work on farms, in running farm services, in formulating scales of charges, and generally in conducting this class of business; experience already gained should be within the reach of all, and no effort should be spared to secure both organised and standardised methods of dealing with the agricultural business. The matter is one on which it would be interesting to have the views of station engineers already engaged in this class of work, and an attempt should be made to secure the co-operation of the electrical and agricultural machinery makers. Possibly a society—or at any rate a committee—of representatives of all the interests involved might be formed to deal with these matters, and we should be happy to afford any assistance in our power towards attaining this end.

The Economic Pact.

The Prime Minister has announced in the House of Commons this week that if there is any general desire for discussion of the findings of the Allied Economic Conference he will find an opportunity therefor. While we must not attach too much importance to remarks that may fall in the course of a Parliamentary debate on this great subject, it would be of some value to see whether House of Commons opinion is as substantially sound on the matter as is opinion generally, and particularly in commercial circles, throughout the country. We heartily agree with those who say that there is no time to be lost in making such preparations as are necessary for carrying the Allied policy into effect. The French Cabinet has already signified the adhesion of the French Government to all the resolutions adopted, and Mr. Asquith has intimated that the result of the Conference is binding on the House of Commons. Each of the nations in the Entente will take steps suited to its own position and circumstances, but all are determined that both now and after the war they will not allow either their resources, their trade, or their people's interests to be exploited to the advantage of enemy countries or to the detriment of themselves. Of course, it is quite true, as some people have been saying, that the precise manner of dealing with the matter will be affected by the kind of peace that is secured. An inconclusive peace might leave much power in the hands of the Central Empires, limiting the ability of the Entente to carry the Conference's intentions into effect. But there is to be no inconclusive peace, and if Prussian militarism is to be stamped out the Prussian military party must be disposed of, or chained for generations. If the Allies' military and naval victory be so complete, as we believe it will, that there will be a break-up of Prussianism and a removal of its leaders from the head of German affairs, there will still be the commercial magnates and organisations to deal with. The break-up of the idol of World Domination may, as time passes, pave the way for new and better ideals among the millions of Germany, but the need will remain for those who, against their will, were plunged into this unparalleled war, to secure their position for the future, until the chastening of Germany has smashed the idol of commercial and industrial "penetration" and "domination." Therefore, it has been necessary to make these very definite recommendations for meeting the measures which the Central Empires are understood to be developing to defeat us all economically after the war. But the recommendations are to become more than mere recommendations. We observe that an attempt has been made to secure opinions in favour of a great gathering of industrial and commercial authorities to discuss how they should be carried into effect, but we doubt whether such a conference is either possible or desirable just now. The Government and the Board of Trade must know the mind of the country by this time on most of the points in the recommendations, and Mr. Asquith has promised to make "at an early date" a general statement as to the steps that are to be taken to give effect to the convictions so strongly expressed by the Conference. We await that statement with interest. There is no room for half-measures or for any half-hearted way of dealing with the matter. Step by step the Government has been assisted along a progressive way by the opinion of the majority of the nation, but we trust that Mr. Asquith's statement will show that the Cabinet needs no further pressure from the people, is of one mind, and ready for prompt, thorough, and energetic action in regard to these vital questions.

Mr. Asquith's promised statement is described as a "general" one. It will doubtless be sympa-

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thetic and will deal chiefly with the main principles by which we are to be influenced in the carrying out of our policy; the manner of dealing with particular industries will be dependent upon the findings of the After-the-War Trade Committees which are now sitting. Mr. Runciman in his best moments said that Germany must be prevented from ever again raising her commercial "head." In later expressions of his views the "head" became only a Hunnish military "helmet." The Conference, at which he was unfortunately prevented from being present, seems to suggest the need for an economic straight-jacket to be fitted on to the enemy, only to be removed at the good pleasure of the Allies.

Lead.

There has been another considerable fall in the price of pig lead within the last few weeks which must be largely ascribed to the attitude of the authorities under whose control the market remains entirely as heretofore. The supply of spot or prompt metal has been throughout quite liberal, and offers of Government metal having at times been rather pressed, this has accelerated the downward tendency, which, moreover, has been lately assisted by the general depression in metals. The tendency, at the same time, has been very irregular, quite according to the extent of the demand from consumers for early delivery. The value of the latter has dropped to well below £30 a ton, and the fact is worth noting that forward positions have been obtainable at a steadily widening discount. Statistical data are now complete since supplies under Government control are no longer included in the official returns, so that these are of no use whatever in making attempts to gauge statistical merits. The authorities alone would be able to throw light on that point, or to what extent supplies are coming in or have been absorbed for munition purposes. Very big tonnages, no doubt, have been required in that direction, but there is good reason for believing that the authorities have already made full provision for all their requirements for some months to come. They are thus well able to accommodate consumers for current needs, and for this reason the sagging of prices is not unlikely to continue.

The efforts of the Government in getting prices down from an unduly inflated level have proved successful in the long run. There has been a severe fall from the highest seen this year, namely £36 10s., but prices still stand pretty high, making allowance that present indications as regards the course of the war lend themselves to a gradual return to more normal conditions. Unless a change of attitude becomes manifest on the part of the authorities, or arrivals unexpectedly fall far short of requirements, those dealers who are suggesting a recovery in values seem rather premature in their views. It is true that prices across the Atlantic are still at a high parity level as compared with our market, but there are now already vague signs of some American interests contemplating the placing of forward contracts for shipment to this side which may be regarded as the forerunner of a further letting down of prices in America. So long as America is still able to divert considerable quantities of metal to the Far East and elsewhere against old contracts entered into at high prices, no important development may be experienced in that quarter; but there is no doubt that with decreasing domestic requirements, American producers will soon feel the need of stimulating export business once more. Attempts in that direction would now probably be facilitated by the fact that exports from this country are still virtually prohibited, attempts made for some time past to obtain permits having proved abortive.

THE ECONOMIC PACT OF THE ALLIES.

The representatives of the Allied Governments who met in June in Paris at the Economic Conference declare that the Empires of Central Europe are today preparing in concert with their Allies for an economic contest to continue after the re-establishment of peace. Agreements now under preparation between our enemies have the obvious object of establishing domination over the production and the markets of the whole world, and of imposing on other countries an intolerable yoke.

In face of this grave peril, the representatives of the Allied Governments state that they consider it their duty, on grounds of necessary and legitimate defence, to adopt and realise from now onwards all the measures requisite on the one hand to secure for themselves and for the whole of the markets of neutral countries full economic independence and respect for sound commercial practice, and on the other hand to facilitate the organisation on a permanent basis of their economic alliance. The following resolutions are therefore submitted for the approval of ourselves and our Allies, and in view of the unanimity of the conference, the definite nature of its propositions, and their importance as a basis for the preparation of a Government policy which shall be equal to the emergency, we print them in full. It behoves our own and the Allied Governments to proceed at once to embody the recommendations in Acts. The Conference, by its closing sentences, has declared that there must be no delay, and, though there will be tender-speaking voices and critical minds that will be all too solicitous for the interests of the enemy, we believe that the great bulk of the nation will be behind legislators if they take strong action immediately to ensure that the work of the Conference shall not be thrown away.

The recommendations relate to three periods:—(1) During the remainder of the war; (2) during the period of reconstruction, commercial and otherwise, in Allied Countries; (3) for after period (2) when permanent measures will be needed for mutual assistance and collaboration among the Allies.

Measures for the War Period.

I.—The laws and regulations prohibiting trading with the enemy shall be brought into accord. For this purpose:—

(*a*) The Allies will prohibit their own subjects and citizens and all persons residing in their territories from carrying on any trade with (1) the inhabitants of enemy countries whatever their nationality, (2) Enemy subjects wherever resident, (3) persons, firms and companies whose business is controlled wholly or partially by enemy subjects or is subject to enemy influence and whose names are included in a special list.

(*b*) They will prohibit the importation into their territories of all goods originating in or coming from enemy countries.

(*c*) They will devise means of establishing a system enabling contracts entered into with enemy subjects and injurious to national interests to be cancelled unconditionally.

II.—Business undertakings owned or operated by enemy subjects in the territories of the Allies will all be sequestrated or placed under control; measures will be taken for the purpose of winding-up some of these undertakings and of realising their assets, the proceeds of such realisation remaining sequestrated or under control.

III.—In addition to the export prohibitions which are necessitated by the internal situation of each of the Allied countries, the Allies will complete the measures already taken for the restriction of enemy supplies, both in the mother countries and in the Dominions, Colonies and Protectorates:—

(1) By unifying the lists of contraband and of export prohibition, and particularly by prohibiting the export of all commodities declared absolute or conditional contraband;

(2) By making the grant of licences for export to neutral countries from which export to enemy territories might take place conditional upon the existence in such countries of control organisations approved by the Allies; or, in the absence of such organisations, upon special guarantees such as the limitation of the quantities exported, supervision by Allied consular officers, &c.

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Transitory Measures for the Period of Commercial, Industrial, Agricultural, and Maritime Reconstruction of the Allied Countries.

I.—The Allies declare their common determination to ensure the re-establishment of the countries suffering from acts of destruction, spoliation and unjust requisition, and decide to join in devising means to secure the restoration to those countries, as a prior claim, of their raw materials, industrial and agricultural plant, stock and mercantile fleet, or to assist them to re-equip themselves in these respects.

II.—Whereas the war has put an end to all the treaties of commerce between the Allies and the Enemy Powers, and whereas it is of essential importance that, during the period of economic reconstruction which will follow the cessation of hostilities, the liberty of none of the Allies should be hampered by any claim put forward by the Enemy Powers to most-favoured-nation treatment, the Allies agree that the benefit of this treatment shall not be granted to those Powers during a number of years to be fixed by mutual agreement among themselves.

During this number of years the Allies undertake to assure to each other so far as possible compensatory outlets for trade in case consequences detrimental to their commerce result from the application of the undertaking referred to in the preceding paragraph.

III.—The Allies declare themselves agreed to conserve for the Allied countries, before all others, their natural resources during the whole period of commercial, industrial, agricultural and maritime reconstruction, and for this purpose they undertake to establish special arrangements to facilitate the interchange of these resources.

IV.—In order to defend their commerce, their industry, their agriculture and their navigation against economic aggression resulting from dumping or any other mode of unfair competition, the Allies decide to fix by agreement a period of time during which the commerce of the Enemy Powers shall be submitted to special treatment and the goods originating in their countries shall be subjected either to prohibitions or to a special régime of an effective character.

The Allies will determine by agreement through diplomatic channels the special conditions to be imposed during the above-mentioned period on the ships of the Enemy Powers.

V.—The Allies will devise the measures to be taken jointly or severally for preventing enemy subjects from exercising, in their territories, certain industries or professions which concern national defence or economic independence.

Permanent Measures of Mutual Assistance and Collaboration among the Allies.

I.—The Allies decided to take the necessary steps without delay to render themselves independent of the enemy countries in so far as regards the raw materials and manufactured articles essential to the normal development of their economic activities.

These measures should be directed to assuring the independence of the Allies not only so far as concerns their sources of supply, but also as regards their financial, commercial and maritime organisation.

The Allies will adopt such measures as may seem to them most suitable for the carrying out of this resolution, according to the nature of the commodities and having regard to the principles which govern their economic policy.

They may, for example, have recourse either to enterprises subsidised, directed or controlled by the Governments themselves, or to the grant of financial assistance for the encouragement of scientific and technical research and the development of national industries and resources; to customs duties or prohibitions of a temporary or permanent character; or to a combination of these different methods.

Whatever may be the methods adopted, the object aimed at by the Allies is to increase production within their territories as a whole to a sufficient extent to enable them to maintain and develop their economic position and independence in relation to enemy countries.

II.—In order to permit the interchange of their products, the Allies undertake to adopt measures for facilitating their mutual trade relations both by the establishment of direct and rapid land and sea transport service at low rates, and by the extension and improvement of postal, telegraphic and other communications.

III.—The Allies undertake to convene a meeting of technical delegates to draw up measures for the assimilation, so far as may be possible, of their laws governing patents, indications of origin and trade marks.

In regard to patents, trade marks and literary and artistic copyright which have come into existence during the war in enemy countries, the Allies will adopt, so far as possible, an identical procedure, to be applied as soon as hostilities cease.

This procedure will be elaborated by the technical delegates of the Allies.

Whereas for the purposes of their common defence against the enemy the Allied Powers have agreed to adopt a common economic policy, on the lines laid down in the resolutions which have been passed, and whereas it is recognised that the effectiveness of this policy depends absolutely upon these resolutions being put into operation forthwith, the representatives of the Allied Governments undertake to recommend their respective Governments to take without delay all the measures, whether temporary or permanent, requisite for giving full and complete effect to this policy forthwith, and to communicate to each other the decisions arrived at to attain that object.

THE BENJAMIN ELECTRIC WORKS.

RECENTLY, by the courtesy of the Managing Director, Mr. Guy Campbell, we were enabled to make tour of inspection through the works of The Benjamin Electric, Ltd., in Rosebery Avenue, E.C. The workshops, which were established seven years ago, have been continually extended until they now occupy the whole of the space available at this site, and are packed as full of machinery and workers as they can be—indeed, they are overflowing on to the roof, where a copper-depositing outfit is being installed. While the building is not ideally adapted for the purpose, the business has grown up in it and developed to its full capacity, and like the hermit crab, it is in need of a change of shell to provide more roomy accommodation—but that must wait until after the war; at the moment the works are so busy that the temporary disorganisation that would be incurred by making a change is out of the question.

The principal line of manufacture is, of course, the well-known Benjamin reflectors, but special types of lighting

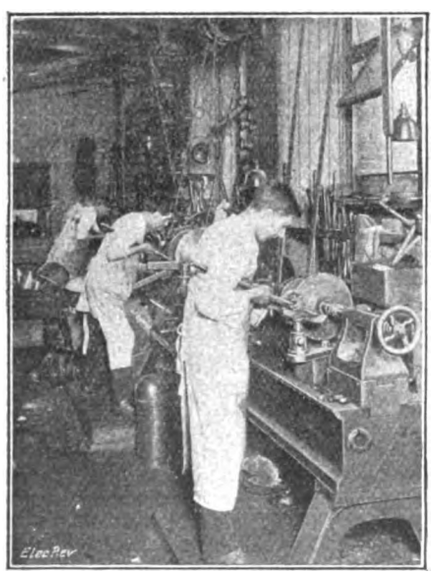

FIG. 1.

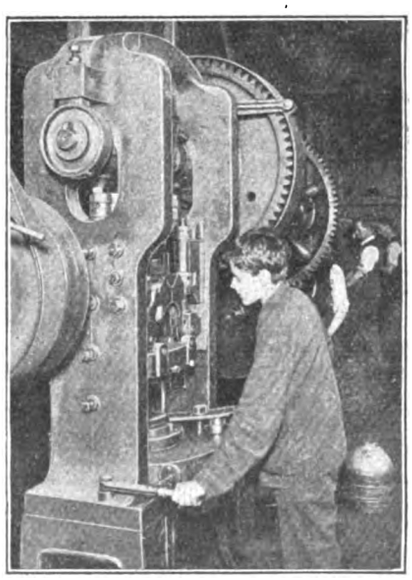

FIG. 2.

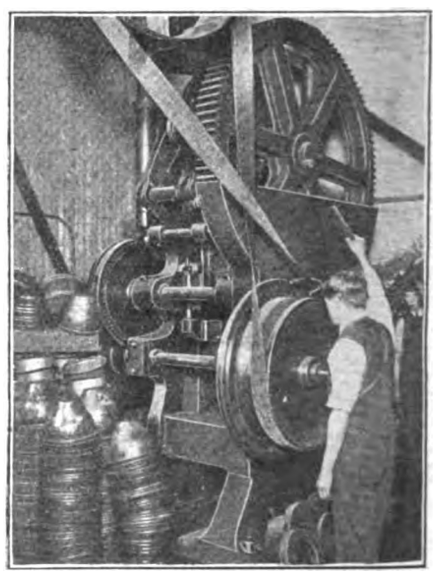

FIG. 3.

VIEWS IN THE BENJAMIN ELECTRIC WORKS.

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fittings, Goliath lampholders, large spinnings, &c., are important features of the company's products. The spinning of extraordinarily large vessels from sheet aluminium—sometimes as much as $\frac{1}{8}$ in. in thickness and 7 ft. in diameter at the commencement—is, indeed, a speciality of these works, and is rarely seen in course of execution in other factories.

These vessels, or tanks, are being made in considerable numbers for use in certain processes connected with the manufacture of munitions in which absolutely perfect

Fig. 4.—Experimental Laboratory.

freedom from leaking joints is necessary, so that spinning is the best method of production. At the time of our visit tanks about 2 ft. in diameter and 2 ft. deep were being made; they were beautifully finished, the surface of the metal being smooth, and the cylindrical shape of the vessel perfect. Spinning is an operation which demands not only a high degree of skill, but also very severe muscular effort on the part of the workman, who, in fact, when dealing with these large jobs, has to be assisted by a labourer; the spinner, moreover, is scarce, and, naturally, a good one can command high wages. Spinning is employed in the manufacture of certain types of Benjamin reflectors, especially those which are made of copper—though steel also is spun

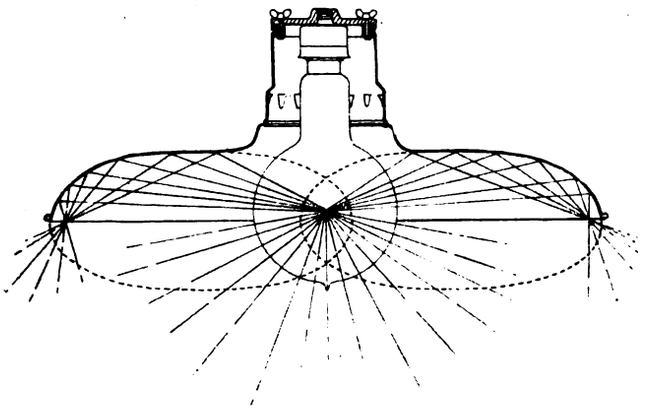

Fig. 5.—Diagram showing Optical Design of Distributing Reflector.

when required; other patterns are pressed out of the sheet, and, consequently, the spinning lathes, heavy presses, and annealing ovens form prominent features of the equipment. We give herewith a view in the spinning department (fig. 1), showing such work in progress, whilst fig. 2 shows one of the heavy power presses, fitted with safety control. A still larger press, which is used for drawing large and deep bowl reflectors, is illustrated in fig. 3 (back view). These presses were made by Messrs. Taylor & Challen, Ltd., and Messrs. J. Hands & Sons, of Birmingham, and are driven by electric motors. The heavy machines are all installed on the ground floor, together with the annealing stoves and enamelling ovens; enamel is applied by a pneumatic process, which results in an admirably smooth and uniform finish to the coating. A special aluminium enamel has been developed by the company, which when applied to the interior of a reflector gives high reflecting power, and at the same time prevents the steel from rusting, and is easily cleaned; as a rule, however, the reflecting surface is coated with white vitreous enamel, combining high reflecting efficiency with a sufficient amount of diffusion to produce a soft illumination.

An inherent feature of the Benjamin reflectors is that they are not simply "made," but are *designed*, on scientific

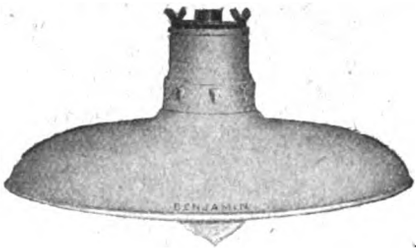

Fig. 6.—Benjamin Half-watt Reflector Fitting, Distributing Type.

principles, to produce particular results; and the achievement of the desired end is not merely presumed, but is definitely ascertained by actual trial. For these purposes a room has been set apart as an experimental laboratory, in which the designs of the reflectors are prepared and the result is afterwards tested photometrically. We illustrate in fig. 4 the interior of the laboratory, and in fig. 5 the method of arriving at the correct shape for a "half-watt reflector fitting," the final form of which is shown in fig. 6. This reflector is of the distributing type, and its radial

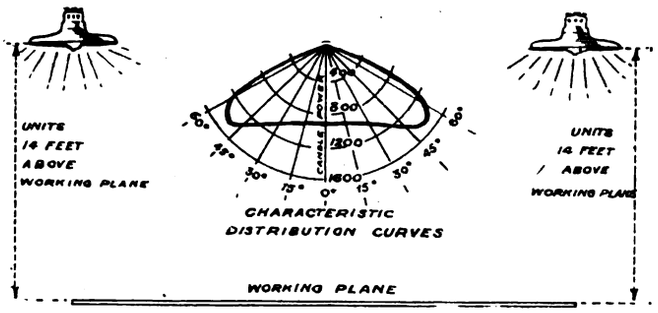

Fig. 7.—Characteristic Curve of Fitting, with Half-watt Lamp of 400 m.h.c.p.

section is part of a true ellipse, of which one focus coincides with the source of light; assuming the reflecting surface to be perfectly regular, all the rays emanating from one focus that are reflected from the surface must pass through the other focus, and the result is practically to produce a secondary light source in the form of a ring near the edge of the reflector.

The characteristic curve of distribution of light resulting from this design is shown in fig. 7, from which it will be

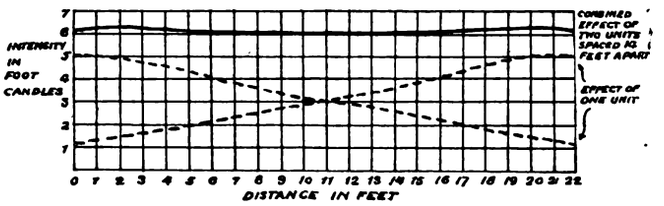
INTENSITY IN FOOT CANDLES
7
6
5
4
3
2
1
COMBINED EFFECT OF TWO UNITS SPACED 20 FEET APART
EFFECT OF ONE UNIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
DISTANCE IN FEET

Fig. 8.—Illumination Curves.

seen that the intensity of illumination is greatly increased, especially at an angle of about 50° with the vertical. It is not sufficient, in lighting an area, to consider only the effect of a single lamp; the combined effect of all the lamps on each unit of area ought to be taken into account,

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and this can be done by means of the curve. As a first approximation to the result, the illumination due to two adjacent lamps can be taken, and this useful information is given by the Benjamin Electric in connection with many of their reflectors, for stated conditions. For example, in fig. 7 two lamps are shown spaced 30 ft. apart and 20 ft. above the working plane; in fig. 8 are given the illumination curves for the space between the lamps, showing a remarkable uniformity of illumination, which will be preserved, but with different intensity, in all positions provided that the lamps are spaced apart (in this case) one-and-a-half times their height above the working plane. In addition to such information, the company include in their lists a variety of useful data, and a rapid method of calculating the wattage required to produce a given intensity of illumination.

Besides the distributing type of reflector above illustrated, a concentrating type is made, as well as a wide range of angle, intensive and extensive, cluster and other patterns, and a variety of lampholders and accessories. In particular, the porcelain Goliath screw lampholder, designed to take the place of the German lampholders with which the market was flooded before the war, has had an enormous sale; these holders are provided with a patent gripping device which effectually prevents the lamps from unscrewing, a great trouble in windy weather. The special machinery for making these and other accessories is installed on an upper floor, of which fig. 9 shows a section; and another floor is devoted to assembling the parts, as shown in fig. 10. In the tinman's shop special facia reflectors for shop windows were being made at the time of our visit, as well as a number of "daylight" fittings, provided with special glass light filters which, with half-watt lamps, give a light practically identical with daylight; we understand that this is a speciality of the Benjamin Electric. Special fittings for powder works, with deep spun copper reflectors, have been made in great numbers, the company having supplied them to many of the Government factories.

While the company does no installation work, it has on many occasions designed schemes for lighting important areas, such as railway goods yards, &c., having acquired exceptional experience in such work, and is always willing to advise either purchaser or contractor; thanks to the system of scientific design combined with experimental verification, it is able to produce the desired results with certainty, and we were much impressed with the scientific methods of investigation that are practised in the laboratory. Moreover, although in the first instance the company marketed American products, almost the whole of its output is now produced in the shops in Rosebery Avenue, only a few items, for which there is a small demand, being imported. That the electric lighting industry has benefited greatly by the introduction of the types of reflector identified with the name of Benjamin cannot be gainsaid, and we congratulate the management of the company upon its success, which we hope will be maintained in the future also.

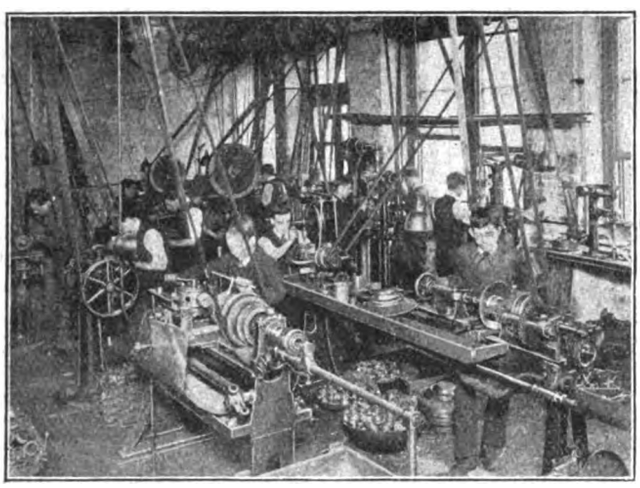

Fig. 9.—Part of Machine Shop.

Fig. 10. Assembling Department.

THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION, 1916.—II.

On Friday morning last the concluding session of the meeting was held, to receive and discuss the Report of the Council and the Balance Sheet, and the Report of the Electric Vehicle Committee. Several passages in the Report gave rise to animated discussions, especially a proposal to end the impasse with regard to the Model General Conditions, some of which have been "receiving the consideration" of the Association of Municipal Corporations for nearly two years, by adopting the Model General Conditions of the I.E.E. Strong feeling was shown adverse to this proposal, and the matter was left *in statu quo ante*. The composition of the Council was another rather controversial matter, the discussion on which occupied a great part of the sitting; it was admitted that the engineers in charge of the big undertakings were men of ability and experience, but it was urged that those responsible for the smaller ones were not without merit, and as the small undertakings constitute the bulk of the membership, they should be directly represented in greater proportion than at present, a point which, to some extent, was ultimately conceded. The subject of British trade after the war called forth some excellent speeches in favour of the utter exclusion of enemy manufactures, a view which was heartily endorsed by the applause of the members. Little time was left for other questions, which were rapidly dealt with—including the report of the Electric Vehicle Committee, which was not discussed—and the meeting closed "in perfect harmony."

During the morning the result of the ballot for new members of Council was announced, as follows:—

President, Mr. F. M. Long. Senior Vice-President, Mr. S. J. Watson. Junior Vice-President, Mr. F. Ayton. Engineer Members: Messrs. J. Christie, S. T. Allen, and J. H. Bowden. Committee Members: Coun. Sinclair (Swansea) and Ald. Walker (Manchester).

The following is an abstract of the report of the Council:—The membership of the Association now stands at 377, made up as follows:—

Committees (Members)	168
Chief Electrical Engineers (Members)	172
Honorary Members	6
Chief Assistants (Associate Members)	4
Assistants (Associates)	27

Model General Conditions of Contract.—The British Electrical and Allied Manufacturers' Association expressed the hope that the I.M.E.A. would now recognise the Institution of Electrical Engineers' conditions as standard. The Council have, however, been unable to take any further steps in the matter, pending the receipt of the report of the Association of Municipal Corporations.

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I.M.E.A. Bill.—At the suggestion of the B.E.A.M.A., joint meetings of representatives of the I.M.E.A., the B.E.A.M.A., and the Electrical Contractors' Association were held, at which it was believed that a complete settlement agreeable to all parties had been arrived at. After reference to the full Councils of the respective Associations, however, the E.C.A. finally declined to continue negotiations and decided to oppose the Bill so long as powers to sell are retained therein.

Eastbourne Accident and the Board of Trade.—The Council had had under consideration the report of the Electrical Adviser to the Board of Trade on the subject of the fatal accident which occurred on December 26th last, arising out of the collision of a motor car with a switch pillar. The Eastbourne Electricity Committee expressed a desire that the Council should approach the Board of Trade with a view to getting the recommendations contained in the above-mentioned report modified. The question is still engaging the attention of the Council.

Coal Supplies.—On the invitation of the Institution of Electrical Engineers, the Association appointed a representative (Mr. Chattock) to attend a national conference of representatives of the gas and electrical industries for the purpose of considering the question of coal supplies on May 6th, 1915. As a result of the deliberations a deputation of 34 representatives was appointed to present the case to members of Parliament, asking for their assistance in urging the Government to give effect to the recommendations passed at the meeting, calling for increased output, railway transit facilities, and proper regard to the requirements of public utility undertakings dependent upon their supplies on sea-borne coal, when requisitioning coal steamers.

Bailie Smith, a member of the I.M.E.A. Council, took a prominent part in the negotiations with the Coal Export Committee, and subsequently he was successful in getting an amendment made to the Price of Coal (Limitation) Bill, giving power to public utility undertakings to have the Bill made retrospective to include already placed contracts. Bailie Smith received the thanks of the Council for his valuable service. The whole question of coal supply as affecting members of the Association was referred to a sub-committee, with instructions to make recommendations and to assist members in any difficulty, with advice as to proper procedure.

In March, 1916, a summary of the report and recommendations of the sub-committee, which had been adopted by the Council, was communicated to the members. This was to the effect that while there had been, in many cases, serious difficulty in getting the necessary supply, there was a serious shortage in connection with a few undertakings only; the Board of Trade had, on February 7th, 1916, instituted Committees on Coal and Coke Supplies in 11 districts throughout the country, and the business of there Committees was to see that the resources of their respective districts were used to the best advantage, and that the requirements of important industries were fully met. The Association had approached the Board of Trade, urging them to restrict the exportation of small coal and to limit exportation to large bunker coal.

Since the District Committees had got to work it had become evident that they had very little power to obtain coal for public utility undertakings. Steps had therefore been taken to urge upon the Government the desirability of giving the Board of Trade powers to distribute coal where it was required, and to organise local coal for local use as far as possible, and so relieve congestion on the railways. It was also urged that more steamers should be provided to bring coal down from the North to the South of England.

The Council.—The Council elected Ald. Miller, of Croydon, a member of their body for the current year, and appointed Coun. S. Evans, of Sheffield, to fill a vacancy caused by the death of the late Coun. Crowther, of Sheffield.

The Council had had under consideration a communication from Mr. Purse, of Carlisle, making observations on the constitution of the Council, and some suggestions having for their object more particularly a definite representation of the smaller undertakings on the Council, and the substitution of a postal ballot for the present procedure whereby the ballot is restricted to those members attending the annual meeting.

The Council were of opinion that it would be unfortunate to draw any distinctions between members as representing the large or small undertakings or otherwise, and believed that satisfactory representation was gained under the existing Articles of Association.

British Trade after the War.—The Council had had before it the report of the Sub-Committee of the Advisory Committee of the Board of Trade on Commercial Intelligence, with respect to measures for securing the position, after the war, of certain branches of British industry, and after having given the report careful consideration unanimously passed the following resolution:—

"That this Council, while being anxious in every way to encourage British trade and the purchase of home manufactures, and being prepared heartily to support measures taken to this end by legislation or otherwise, view with deep concern recommendation 6 (*b*) of the Sub-Committee of the Advisory Committee on the Board of Trade to the effect that:

"'All Government Departments, local authorities and statutory bodies entrusted with the control of moneys raised by taxes or rates, should be under legal obligation to purchase, so far as possible, only goods produced within the British Empire.'

"The Council is strongly of the opinion that in the event of this recommendation being adopted, the interests of municipal electrical undertakings and their consumers—which latter embrace some of the largest manufacturing concerns in the country—will be seriously jeopardised, and that municipalities should in no way be subjected to any restrictions with regard to the purchase of plant and materials other than those imposed on private concerns."

Honorary Treasurer's Report.—The chief features of the accounts are a reduction in the cost of postages, printing and stationery, and in general expenses. The income from subscriptions remains stationary, and there is a decrease in the income from sales and advertisements derived from the proceedings. The net result is a surplus for the year of £77, as against £62 last year. The balance sheet shows a slight decrease in the liabilities and a surplus of assets over liabilities of £926.

Financial Organisation.—As a result of the Council having received a number of communications from engineer members intimating that difficulties were being experienced by them in efficiently managing the undertaking for which they were responsible, by reason of the systems of financial control adopted by the local authorities owning such undertakings, it was decided that the matter was of such importance as to warrant the appointment of a special sub-committee to consider the whole question and to report thereon. Mr. W. Wyld was requested to assume the duties of hon. secretary.

The Sub-Committee came to the conclusion that the difficulties experienced were not peculiar to electricity supply undertakings, but were common to all municipally-owned trading departments, and that the matter could better be dealt with by a joint committee composed of members of various interests concerned. To this end the co-operation of the Municipal Tramways Association (Incorporated), the Municipal Waterworks Association, and the Institution of Gas Engineers was invited, with the result that these bodies have appointed representatives to serve on a Joint Committee, and meetings of the Committee so formed are being held.

A request has been forwarded to all engineer members of the I.M.E.A. to submit to the hon. secretary of the Sub-Committee particulars of troubles which are being experienced by them in connection with the financial control of the undertakings with which they are connected.

REPORT OF THE ELECTRIC VEHICLE COMMITTEE.

The report states that *The Electric Vehicle* has been regularly brought out quarterly, and the Committee feels satisfied that it is proving a valuable means of educating the public as to the advantages of the electric vehicle for the different purposes for which it is specially recommended.

The Committee, jointly with representatives of the Tungsten Lamp Association, has considered the question of the sizes of bulbs, and the voltage, of incandescent lamps for use on electric vehicles. The result of the joint deliberation was the issuing of a recommendation that the standard voltage should be 12 volts, the lamps to be coupled across a section of six cells in a lead-plate battery or the equivalent number in a nickel-iron-alkali battery. It was recommended that the sizes of bulbs should be those fixed by the British Engineering Standards Committee in their Report, No. 69.

Standards have also been fixed for the overall sizes of cells, the rating for lead-acid electric vehicle cells, lead battery plates, inspection plugs, charging voltage, charging plug and receptacle.

The Committee has been in communication with representative electrical engineers in our Colonies with a view to the British Electric Vehicle Standards being adopted throughout the British Empire.

The Committee is again indebted to municipalities, electric supply companies, manufacturing firms, and others for financial assistance amounting to £142.

During the past year the following additional bodies have become represented on the Committee:—Garage Proprietors, Institution of Municipal and County Engineers, Municipal Tramways Association, Light Railways and Tramways Association, British Electrical Federation, Ltd.

Many new vehicles have been put into commission during the year, so that, at the present time, the estimate of vehicles in use in the United Kingdom is in the neighbourhood of about 680. This number includes 48 electric warehouse or works trucks, the use of which is likely to extend considerably in the near future; 33 municipalities operate between them, or have on order, 78 vehicles. The total number shows an increase during the twelve months of 197 vehicles.

The Committee thanks the hon. secretary, Mr. F. Ayton, for the very able and efficient manner in which he has handled the work of the Committee.

The accounts show a surplus of income over expenditure of £46, and a surplus of assets over liabilities of £141.

In the discussion on the Report of the Council, Mr. R. A. CHATTOCK suggested that the question of the Model General Conditions should be settled out of hand; it had been hung up by an instruction to the Committee, but he moved that the instruction be rescinded, and that the Model General Conditions of the Institution of Electrical Engineers be adopted provisionally for a year or two; they could be altered to suit individual cases. Mr. H. FARADAY PROCTOR seconded

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the motion, but it was vigorously opposed by so many speakers that eventually it was withdrawn. In closing the discussion on this point, Mr. A. C. CRAMB pointed out that the I.E.E. Conditions were designed to be fair to all parties, and not merely to aid the purchaser.

On the subject of coal supplies, Bailie SMITH expressed gratitude to the Council for its action, which had resulted in a great saving.

The constitution of the Council was attacked by Mr. F. W. PURSE, who called for the inclusion of members representing the smaller stations; various suggestions were made with a view to attaining this end, and finally a proposal of Mr. E. E. HOADLEY, that at least one seat should be reserved for the representative of a town of less than 50,000 inhabitants, was adopted as a recommendation to the Council.

It was agreed that arrangements should be made for the adoption of a postal ballot for the election of the Council.

On the subject of British trade after the war, Mr. C. C. ATCHISON expressed regret at the attitude taken up by the Council, but said that luckily the Paris Conference had cut the ground from under their feet. He deplored the proposal that local authorities should not adhere to British machinery.

Ald. WALKER moved a resolution urging the Government to take immediate steps to deal with the situation that would arise directly peace was declared; chaos would reign in the industrial world, the output capacity of manufacturing plant had been increased by 30 to 50 per cent., and local authorities' supply undertakings were dependent upon the maintenance of industrial prosperity.

Mr. CHATTOCK seconded the motion, and Bailie SMITH energetically called upon engineers to act for themselves instead of waiting for the Government to move; he hoped that no municipality would accept anything from enemy countries in the future. Another speaker agreed, holding that the Government should reverse its customary attitude and encourage trade, instead of neglecting it. Enormous assistance could be given in this way, and if it were done quickly there would be a trade boom after the war. The Chairman of the Kilmarnock Electricity Committee, in an able speech foreshadowing a victorious peace, said that it was the duty of the Association to support the Government in getting its house in order ready for that event. The country had been duped for years into assisting Germany to organise for war; they should urge the Government to put an embargo on all goods from enemy countries. A resolution on the foregoing lines was passed, and the Report and Balance Sheet were adopted.

The place of meeting next year was left to be settled by the President and Council.

On the motion of Mr. H. FARADAY PROCTOR, a resolution pledging the Association to assist, with evidence and financially, the Hackney Borough Council in an action with reference to preferential charges was adopted.

Mr. A. B. MOUNTAIN, of Huddersfield, was elected an hon. member, and the proceedings closed with votes of thanks to the president and other honorary officers.

Boiler House Design and Operation.

By W. W. IACKIE.

(Abstract.)

IN the design of a modern boiler-house the main object has come to be to have the maximum of steaming capacity in the minimum of space. Twenty years ago, in the design of a generating station, it was a simple matter to install an additional boiler for each addition to the engine-room plant; economisers were seldom installed, and the stations were run non-condensing.

The growth in the demand for electric energy, the much improved load factor, and the introduction of the use of the steam turbine for the driving of electric generators about the year 1904, brought about a change in the relative space required for engine-room plant and boiler-house plant. Instead of having 1 H.P. per sq. ft. of engine-room floor space, we have to-day turbine rooms with 5 H.P. per sq. ft., and in designs for new power stations, using 15,000 to 30,000-KW. sets, this figure may go up to 20 H.P. per sq. ft. of engine or turbine-room floor space.

It is now recognised that even with improvements in boiler-house design, where very large turbo-generators are in use, every pair of such sets requires a separate boiler-house. Several present-day power houses have an evaporation of 50 lb. of water from and at 212 deg. F. per sq. ft. of ground space occupied by the boilers, but it is possible with improved design of the boiler-house plant to approach an evaporation of 100 lb. from and at 212 deg. F. per sq. ft. While the engine-room and boiler-house floor space were 20 years ago about equal, and remained so even for 10 years thereafter, to-day in a large modern generating station the ground space occupied by the boiler-house is from 1½ to 2½ times the space occupied by the turbine-room.

It is now recognised that a modern boiler-house should consist of three storeys at least: the basement or ground floor containing ash-handling plant; the second floor containing the boilers proper, and the third or upper floor containing economisers and coal-conveying machinery, and probably coal storage.

In stations where boilers of 50,000-lb. capacity are installed, it is necessary to erect a separate chimney for each boiler or each pair of boilers. One is practically compelled to adopt steel in preference to brick for chimneys in a modern boiler-house, as with steel the chimney can be erected from the third floor, on which the economisers are placed, whereas if brick is used the foundations and superstructure up to the second floor simply mean a waste of valuable space and a mass of brickwork which serves no useful purpose.

The space actually occupied by boilers at present, with the necessary passages between them, does not as a rule exceed 33 per cent. of the total boiler-house floor space, and of this 33 per cent. the grate area only accounts for one-half.

Let us consider the case of a boiler-house which has to supply steam to two 15,000-KW. sets. The steam required for each set will amount to between 180,000 and 200,000 lb. per hour. This steam under modern conditions would be supplied by four boilers, each capable of generating 50,000 lb. of steam. Each boiler will require to burn at least 7,000 lb. of coal per hour, depending upon the calorific value of the coal. Grates of 250 to 270 sq. ft. will be necessary, which means that each boiler will actually occupy, with passages between, about 500 sq. ft., eight boilers will require 4,000 sq. ft., and the boiler-house will have a floor area of 12,000 sq. ft. Fig. 1 shows a plan and cross-section of such a boiler-house.

Twenty years ago water-tube boilers of 4,000 to 6,000 sq. ft. heating surface were considered large; to-day boilers are made with a heating surface from 10,000 to 20,000 sq. ft. In Detroit five boilers each with over 20,000 sq. ft. heating surface are in use.

The boiler-house should be designed to admit of an ample supply of natural daylight. This is managed by placing the boilers back to back, with a firing floor down each side instead of down the middle between the two rows of boilers. Light can then be had from windows in the side walls as well as from the roof. This, however, means a larger floor area and a space between parallel boiler-houses, and further increases the area occupied by the power station. Adequate daylight can be got from roof lights with proper design of the roof, and fig. 1 shows such an arrangement.

There is still a tendency to-day to construct the combustion chamber of boilers much too small. A combustion chamber should be of such dimensions as to allow ample space for complete combustion to take place and the products of combustion thoroughly to mix before coming on to the heating surface. The older boilers had 2 to 2½ cu. ft. of combustion chamber per sq ft. of grate area; to-day similar

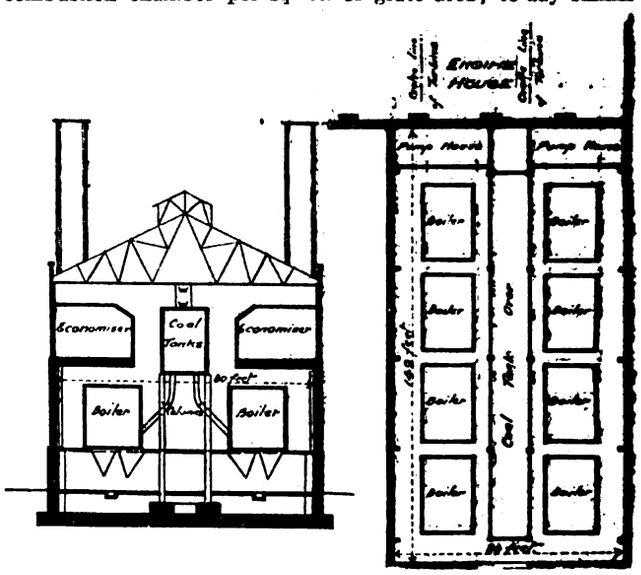

FIG. 1.—SECTIONAL ELEVATION AND PLAN OF BOILER-HOUSE.

boilers have 5 cu. ft. The Detroit boilers before referred to have 9 cu. ft. per sq. ft. of grate area, and this fact is very largely responsible for the high efficiency of these boilers at widely varying loads.

Steam flow meters are as necessary on boilers as an ammeter is on a generator, as they indicate what each boiler is doing, and whether all the boilers are doing their fair proportion of the work.

CO_2 recorders are an index of the working efficiency of the boiler-house; a word of warning, however, is required against assuming that high CO_2 always means high efficiency. There may be a large quantity of CO present. There should be thermometers or pyrometers with dial faces on every boiler, giving the temperature of the superheated steam leaving the boiler, also the temperature of the gases at the damper.

We may at an early date see an increase in the boiler pressure from 160 and 200 lb. to 250 lb. The Commonwealth Edison Co., of Chicago, in 1910 adopted 250 lb. at their North-West station.

A station of 50,000 KW. capacity and burning 200,000 tons of coal per annum requires coal-handling facilities for a supply of 1,000 tons of coal per day, together with facilities for handling 100 tons of ashes per day. This means a railway siding capable of holding from 100 to 200 full trucks, and probably another siding of equal dimensions to hold the

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empty trucks. The length of railway sidings for a 50,000-kw. station would not be less than half a mile, or an addition to the site equivalent to 4,400 sq. yd. The wagons have to be tipped, and coal-conveying plant has to be provided capable of handling 200 tons per hour. Coal-breaking machinery should be installed, for while we have been in the habit of using small coal, circumstances may in the near future render it economical to buy and break larger coal.

Large coal storage accommodation is advisable and will prove economical; not less than from two to four months' fuel supply should be retained. This margin enables coal to be delivered in fairly regular quantities throughout the year, and may result in lowering coal prices.

The cost of energy for lifting coal from canal barges or from trucks, and placing it overhead in coal hoppers or in the coal store, is a small item. In one Glasgow station we have a coal transporter fitted with a one-ton grab. This transporter cost £2,600, and handles coal at the rate of 40 tons per hour; the cost of energy, labour, and repairs brings the cost of handling coal in this way just under 1d. per ton. In another station truck-loads of coal are elevated 30 ft. at one end of the coal store to an overhead platform, whence the coal is tipped into an overhead hopper or to the coal store, and the empty trucks are lowered by a second elevator at the other end of the coal store. These two elevators, complete with electrically-operated capstans, cost £2,000. The inclusive cost of handling coal in this way is 3¼d. per ton, the higher cost being due to the amount of labour necessary for handling the trucks. These figures are conclusively in favour of the grab and transporter. Where coal has to be carried a short distance from coal store to boiler-house, bucket or tray conveyors appear to be the right thing. On the other hand, for longer distances, the telpherage system works out slightly cheaper.

For the removal of ashes, bucket conveyors have proved to be costly in upkeep on account of the wear of the axles and pulleys, caused by the fine hard grit of ash dust, but even with this drawback, bucket or tray conveyors seem to be the cheapest method of removing ashes. Suction ash plant is finding much favour on account of the absence of moving parts in its design, but the capital cost is about three times that of bucket conveyors. The cost of energy for operating suction ash plant works out at about 5d. per ton handled, at 1d. per unit. Suction plant is now made to do other work. It can be constructed for the purpose of elevating riddlings and small unburned fuel to a hopper or tank over the coal-conveying plant. It can also be made suitable for the removal of soot from economiser soot chambers, and flue dust from the base of the chimneys.

A modern boiler-house calls for comparatively large overhead ash storage, from which ashes can be dropped into wagons or other vehicles for removal. The removal and disposal of ashes is becoming a serious matter. A few years ago ashes had a market value, and we could get as much as 4d. or 5d. a ton for them; to-day we have difficulty in getting the ashes from our stations carted away at 2s. a ton. It has been suggested that it would pay the large electrical undertakings to purchase 3-ton or 5-ton electrically-propelled wagons for the removal of ashes, especially where convenient railway facilities are not available.

Coal-weighing machinery for each boiler or group of boilers is absolutely necessary if proper records are to be made of the boiler-house efficiency. It should always be possible to ascertain the amount of coal used in each eight-hour shift and at the end of each week or month, so that the coal used per kw.-hr. generated may be ascertainable. These weighing machines should preferably be fixed between the overhead coal hopper and the boiler stoker, but some stations in America have a travelling gantry, fitted with a weighing machine at each end, the gantry travelling along the whole length of the boiler-house between two rows of boilers. The duty of the operator on this gantry is to move up and down the boiler-house and to weigh out regularly to each boiler a predetermined amount of fuel.

The total condensate from the turbine-room condensers should be measured by a Lea or other water recorder, and this should have an integrating attachment. Having ascertained the amount of coal used and having measured the condensate, we can get the amount of water evaporated per lb. of coal used.

No very great increase in the efficiency of steam boilers can be looked for. The heat balance of many of the steam plants in operation at the present day is as follows:—

Heat absorbed by boilers	78 per cent.
Heat lost in flue gases	15.5 per cent.
Heat lost in radiation and unaccounted for	6.5 per cent.

That is to say, the total loss on which any reduction can take place is 22 per cent., but it is only a small proportion of this figure which can be attacked with a view to lowering it. It would be doing negative work to discharge the gases from a boiler at a temperature lower than that of the water in the boiler.

An evaporation of 4 lb. of water per sq. ft. of heating surface in the boiler was, until recently, considered standard practice, but to-day water-tube boilers are designed, in conjunction with special economisers, to evaporate at the rate of 6 lb. normal load, and at overload 8 and even 10 lb. per sq ft. of heating surface of the boiler. The heating area in most water-tube land boilers is of the order of 50 times the grate area. With such proportions the general practice is to emit the gases from the boilers at a temperature of 500 deg. to 550 deg. F., *i.e.*, from 100 to 150 deg. F. above the temperature of the steam at the boiler working pressure. The proportion of heating surface in economiser to heating surface in boiler varies, but 35 per cent. may be taken as a fair average. With such a proportion, allowing for heat drop in flues, the gases at the outlet to the chimney will have a temperature of from 325 deg. to 350 deg. F., and the economiser will have utilised about 7 per cent. of the heat of the gases emitted from the boiler. The inlet water to the economiser from the hot-well will, with present-day practice, be raised to a temperature of 200 or 220 deg. F. Until recently the evaporation per sq. ft. of heating surface of boiler and economiser combined was therefore roughly 3 lb. per sq. ft. of heating surface. Modern practice tends to diminish the heating surface in the boiler from 50 times the grate area to 35 times the grate area and to increase the area of the economiser to 80 per cent. of that of the boiler heating surface. The result is to put up the evaporation of the boiler at overloads to 8 lb. per sq. ft. of heating surface and the temperature of the gases now emitted from the boiler is considerably raised, being about 650 deg. F. The heat, however, is taken up in the economiser and the temperature of the feed water to the boiler is considerably increased. The net result is that we get an evaporation of 4½ lb. per sq. ft. of heating surface of boiler and economiser combined. The overhead economiser is suitably proportioned to give the very highest combined efficiency. Boiler plants arranged in this way probably give a higher efficiency than was the case with previous designs, inasmuch as the radiation losses are less and the loss between the boiler and the economiser is reduced to an absolute minimum.

(*To be concluded.*)

WAR ITEMS.

Lighting Prosecution.—For allowing light from unscreened lamps to shine through four windows and the door of the boiler-house at the electricity works at Middleton (Lancs.), James Faulkner, of Oldham Road, Middleton, was last week fined 7s. A police officer said that when he saw defendant about the matter, he said the windows and door were opened for about an hour on Thursday nights to allow of ventilation while the boilers were swept out.

To be Wound-up.—The Board of Trade has ordered the following to be wound-up:—

Eiermann & Tabor, Lauderdale Buildings, Aldersgate Street, London, E.C., bronze powder and metal leaf manufacturers. Controller: P. W. Straus, 7, Great Winchester Street, E.C.

The Bakelite Co., Ltd., Orb Works, Cowley, Middlesex, makers of insulating material. Controller, Sir W. B. Peat, 11, Ironmonger Lane, E.C.

Griesheim-Elektron, Ltd., 3, Thames House, Queen Street Place, London, E.C., and Salford, merchants in dyestuffs and chemicals. Controller: W. Eaves, 15, Fountain Street, Manchester.

Exemption Applications.—An application for exemption made by Mr. E. Inkpen (36), electrician, of Camberley, has been refused.

At Exeter, Mr. F. T. Baker, electrical engineer, who has lost five of his staff and an apprentice, was given exemption until November 30th.

Hastings Tribunal has given conditional exemption for three months to Mr. A. Tester, electrical contractor, and Mr. R. Merrifield, repairer of electrical plant, with Mr. Wordley.

By arrangement with the military, the Reading Corporation Tramways Committee has decided to release for military service all motor-men under the age of 27, and to retain the rest. Sixty per cent. of the staff have enlisted, and the pre-war staff of 200 has been reduced to 84, 47 of whom are being taken for the Army.

On the appeal of Mr. J. T. Spencer, conditional exemption has been granted by the Reading Tribunal to G. P. Wilkins (29), electrician.

At Northampton, on Monday, the Electric Light & Power Co., Ltd., appealed for eight of 15 employés recently unbadged by a Government Inspector. It was stated that the pre-war staff consisted of 77 men and 10 boys; now there were 71 and 16 respectively, but the heavy demand for power for factories had increased the output by 55 per cent. Temporary exemption was allowed in each case.

Exemption has been allowed to Mr. J. W. Gibson (30), manager of the Holsworthy Gas & Electric Supply Co.

The Leigh (Lancs.) Tribunal has granted one month's temporary exemption to the electrician at a local picture house.

At Oldham, exemption was granted to the attendant and electrician at the Castleshaw filtration works on the application of the Corporation waterworks engineer.

At Salford, an electrical contractor appealed for a wireman—his brother—aged 19, and said he had only three men left, including himself. He was indispensable to the business, and applicant had written to the Ministry of Munitions, but had not yet received any reply. The appeal was adjourned for a fortnight so that the decision of the Ministry of Munitions might be obtained.

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At Reigate, Messrs. Tamplin & Makovski, electrical engineers, appealed for a foreman, fitter, and turner, an electrical engineer, a maintenance engineer, an engineer, a foreman and skilled hand, and a skilled wireman. It was stated that the firm had lost 18 of their permanent staff. The foreman fitter and turner, the foreman and skilled hand, and the maintenance engineer were conditionally exempted; the engineer was directed to be medically examined, and the other cases were dismissed.

The Maidenhead Tribunal has granted exemption until October 1st to A. R. Mills (21), engine driver and stoker, and Geo. Arthur Cox (22), shift engineer, engaged at the Corporation electricity works.

Leyton Tribunal has granted conditional exemption to nine employés at the destructor works of the U.D.C. The staff has been reduced from 25 to 17.

Six months' exemption has been granted at Hemel Hempstead to Mr. F. Bishop, electrician, of Cotterells. Mr. Bishop was invalided from the Naval Service, and is now certified fit for home garrison duty.

At Rochdale, exemption was claimed by Mr. G. L. Adamson for W. Bentley (22), electrical wireman, engaged on work directly affecting Government contracts. Mr. Adamson said that 50 per cent. of the employés had been lost. Twenty-one days were granted.

As the result of appeals at Epsom, Mr. F. Fairs, estate electrical engineer, of Stoke d'Abernon, has received exemption until June 30th; Mr. H. J. Proctor, electrician, of Cobham, until September 30th; and Mr. E. E. Newbald, electrical engineer and contractor, of Epsom, for three months.

On the appeal of the Woking Electric Supply Co., Samuel Chas. Bicknell (37), wireman and repairer, has been exempted for three months, and Philip S. White (39), cable jointer's labourer, for one month.

Mr. J. S. Mander (32), assistant engineer with the Ascot and District Electrical Co., has been granted a month's exemption, until July 15th. It was stated that it had been found impossible to fill Mr. Mander's place, and that, alternately with another employé, he had charge of the generating machinery.

Hertford Tribunal has granted exemption until September 30th to Mr. A. H. Sharrat, electrical engineer.

Mr. Lambert applied to the Maidstone Tribunal on behalf of the Corporation for the exemption of Mr. J. P. Macrow (29), electrician, regarded as indispensable to the tramways system, and conditional exemption was conceded.

The Blackpool Tramways Committee has given instructions to the manager to apply to the Tribunal for exemption till the end of the season for a dozen motor-men. It has been found impossible, Mr. Furness informed the Committee, to secure suitable men of non-military age, and therefore, for the first time, he was compelled to apply for the temporary exemption of drivers.

The County Appeal Tribunal at Preston, last Friday, heard an appeal by an electrician, but disallowed it, recommending that the appellant should undergo a trade test with a view to his skilled services being used to the full in the Army.

The branch manager of an electrical firm at Lewes (Sussex) has been conditionally exempted on undertaking to join the Volunteer Training Corps.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

60-cycle Transformers on 25-cycle Systems.

In reply to your correspondent Mr. William Lovell, *re* "60-cycle Transformers on 25-cycle Systems," it is very difficult, in the absence of further information, to answer his first query; but assuming the supply voltage is the same in each case, then the flux generated when working on a 25-cycle system will be 2·4 times that on a 60-cycle system, which will mean a magnetising current, probably, considerably in excess of the full-load value, depending upon the degree of saturation. For instance, if ordinary Lohys iron be used in the magnetic circuit, and worked at a maximum density of about 6,000 C.G.S. lines per cm.^{2} for 60-cycle supply, then the maximum density on 25-cycle supply would be 2·4 times; *i.e.*, 14,400 C.G.S. lines per cm.^{2}, which would enable the transformer to supply the load, disregarding regulation. Considering another transformer with the same outward appearance, but whose magnetic circuit is built up of Stalloy iron, worked at a maximum density of, say, 11,000 C.G.S. lines per cm.^{2} for 60-cycle supply, then the maximum density on a 25-cycle circuit will be 26,400 C.G.S. lines per cm.^{2}; the iron being very highly saturated a large magnetising current would be drawn from the mains.

In order to avoid any alteration to the transformers, I would suggest that they be coupled in banks of two in series; the maximum density would then be only 20 per cent. greater than normal, and should allow them to supply a reasonable load.

If the transformers are three-phase, with delta-connected primaries (though hardly likely), they might be coupled star and put across the mains singly; in this case the maximum density would be about 40 per cent. greater than normal.

D. D. Rayner.

Wolverhampton, *June 24th*, 1916.

Throwing-Off Motor-Starting Rheostat from a Distance.

In the interesting first instalment of his articles on "Control Gear for D.C. Motors," in your issue of 23rd inst., Mr. Butler does not mention (in connection with the last diagram) that the short-circuiting tumbler switch should spring back to its normal position when released. This action is very necessary, as otherwise the switch would often be left in the "shorting" position, and the starter would not hold on.

We have no difficulty in modifying our own standard construction to do what is required, and the same can be fitted for either lever or push-button actuation. As regards the bridging of the "way" contacts in passing over, this principle was adopted some time ago in our inductive-circuit switch.

The special motor-stop switch arrangement is all the more necessary when two or more are to be fitted, as the lengths and resistances of the leads tend to increase in such cases. At first sight it may seem impossible to connect more than one of the special stop-switches in circuit, but the problem resolves itself into connecting the top or normal contacts in series, and the "shorting" contacts in parallel. We shall be happy to send a diagram of connections to anyone who is interested.

A. P. Lundberg & Sons.

London, N., *June 26th*, 1916.

The late Prof. Silvanus Thompson.

May I be allowed to add a word to your tribute to Dr. Silvanus Thompson, from the point of view of an old student?

I was at Finsbury 10 years ago, and though I only spoke to him directly perhaps half a dozen times, and have never seen him since, he has always filled a unique place in my mind. "The Doctor" inspired the greatest affection and confidence in all his men, and was at all times ready to give help and advice to those who went to him.

I remember one of his last lectures in my second year, in which he dropped technical matters, as he sometimes did, and was talking of our future lives and prospects; and he told us then that if ever in our future lives we were in any moral or personal difficulty and felt the need of a "father confessor" he was always at our service; and I should never have had the slightest hesitation in going to him with the full assurance of a patient hearing and wise counsel.

Kipling's lines—

> "He scarce had need to doff his pride or slough the dross of Earth—
> E'en as he trod that day to God so walked he from his birth,
> In simpleness and gentleness and honour and clean mirth.
> * * * *
> Who had done his work and held his peace and had no fear to die."

—might have been written of him, and all those who came under his influence will feel that they have lost a very dear friend, and the world a very perfect gentleman.

S.

Discounts.

Some little time ago you inserted an article on discounts, which showed the waste of time arising from the unnecessary complication of multiple discounts commonly used in the electrical trade. The T.L.A. secretary then pointed out that the T.L.A. issued sheets giving equivalent discounts. To this the writer of the article naturally replied, "Why not use the equivalent right away?"

One notes with delight that this suggestion has been adopted in the new circular sent out, and that one discount is now used to do the trick. What about other branches? The I.R. cable makers might take the hint and do likewise with great advantage.

Hope.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

New Telegraphic Apparatus.

An interesting application of resonance has been made by Mr. Alban Roberts, a New Zealand inventor, to telephony and telegraphy, and should prove of great utility. In both cases the principle involved is the tuning of a column of air enclosed in a tube after the style of the old "pitch-pipe," in one case to produce any desired pitch at the source of vibrations, and in the other to intensify by cumulative resonance vibrations of a particular frequency, and thus to exercise a selective function.

Taking the familiar reaction between a telephone receiver and transmitter as a basis, Mr. Roberts has devised a buzzer which possesses no make-and-break contacts, and which emits a perfectly clear and sustained musical note for any length of time; as shown

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in fig. 1, the watch-type receiver R and transmitter M are coupled in circuit through an induction coil C with a battery B, and are fixed facing each other at a distance apart of a few centimetres, in a cylindrical case which confines the column of air between them, and thus strengthens the reaction. Directly the circuit is closed, a clear, musical note is emitted, in the usual way. The back of the receiver is partly removed to allow of the attachment of a tube T, in which moves a piston P; by varying the distance between the diaphragm of the receiver and the piston, the natural pitch of the enclosed air-column is varied over a range limited only by the length of the tube and the dimensions of the receiver, the natural frequency of the diaphragm of the receiver

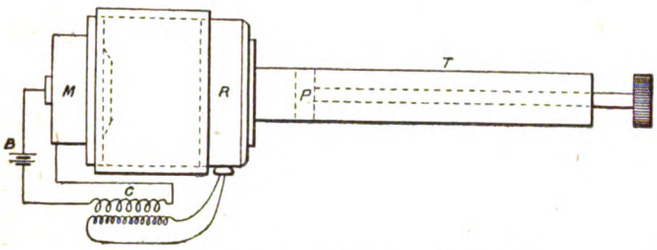

FIG. 1.—DIAGRAM OF THE ROBERTS BUZZER.

being completely suppressed or overcome by that of the pitch-pipe. This arrangement, which Mr. Roberts has demonstrated to us, forms an excellent buzzer with variable note, consuming very little current, and of very simple construction; the signalling circuit can be taken off the secondary terminals of the coil in shunt to the receiver, and the timbre and pitch of the note are admirably adapted for the purpose to which buzzers are applied.

The sound intensifier or amplifier depends upon the same principle, and is purely acoustic in its action. It consists, in one form, of a tube T fitted with a movable piston P, and one or two side tubes *t*, ending in sockets in which telephone receivers R connected with the source of electrical oscillations (such as a wireless antenna) fit closely; to a pocket in the upper end of the tube T is connected a pneumatic head-set such as is used by medical men in connection with the stethoscope, consisting of rubber tubes *r r* which end in ear-pieces *e e*, attached to the steel spring S.

The operator, with the head-set in place, varies the position of the piston in the tube until resonance is obtained with the incoming signals—which is indicated by the manifold increase in the strength of the sounds, as we can testify from experience. Reception can then proceed without further adjustment, but, if desired, a shunt can be applied to the telephone receivers to damp down *all* the oscillations to which they are subjected; obviously those which are not reinforced can be made practically inaudible, while the note which has been selected for intensification remains clear and distinct. The device thus forms a means of tuning out irregular and undesirable oscillations, and retaining only those which are useful; it has the advantage that it can be added

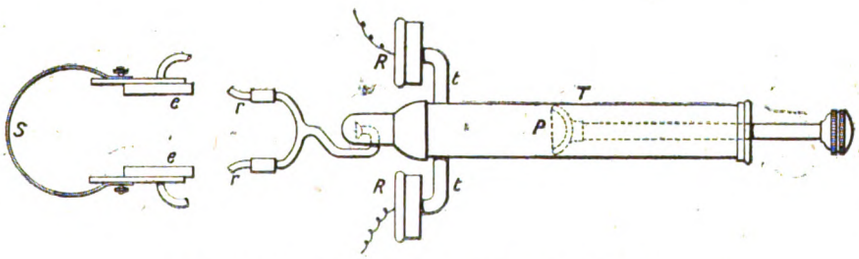

FIG. 2.—DIAGRAM OF THE ROBERTS AMPLIFIER.

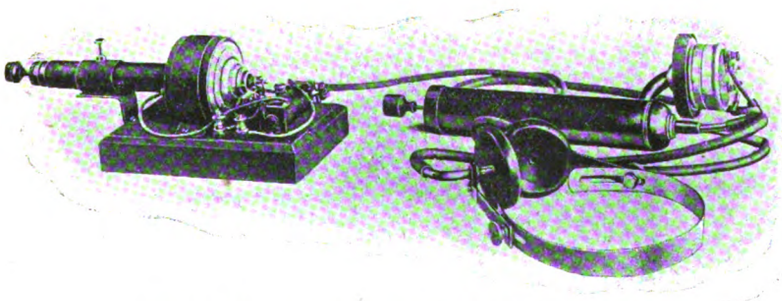

FIG. 3.—BUZZER AND AMPLIFIER IN MODEL FORM.

to any wireless installation without alteration to the latter—instead of listening to the receivers directly, the operator places them in the sockets on the Roberts intensifier, and puts on the head-set of the latter. It is a simple and cheap device, and should find many applications in connections with military signalling, wireless telegraphy, &c. Fig. 3 shows the buzzer connected up to the intensifier—both apparatus in their experimental form, but quite efficient.

We have described the devices in their simplest form; the inventor has devised other forms for applying resonance to both sides of the diaphragm of the receiver, damping down the signals with mechanical means (such as an iris diaphragm, instead of the electrical shunt), providing means to deal with the received signals in the resonating air column electrically, and so on. The practicability of using the same line for a number of different signalling points without confusion is an important feature of the system.

Mr. Roberts may be addressed c/o Messrs. Spencer & Son, 56A, Highbury Grove, London, N.

Electrically-Heated Linotype Metal Pots.

A comparatively new application of electric heating is that of keeping in a molten condition the metal in the pots of linotype machines from which the slugs bearing the characters are cast. The printer finds the electrical method free from the disadvantages of gas and gasoline heating, and the slugs produced are practically perfect owing to the close and accurate regulation of temperature. An electric linotype pot is made by the Cutler-Hammer Manufacturing Co., Milwaukee, Wis. Each unit consists of a series of resister ribbons of metal alloy encased first in mica, then in metal ducts, and sealed by autogenous welding inside a steel casing. The two main units are immersed directly in the metal in the pot, while two more are disposed about the throat and mouthpiece of the pot to ensure proper temperature at these points. The circuit is initially closed by an ordinary snap switch. Thereafter the circuit is automatically controlled by a special thermometer, set to maintain the temperature desired, which limits the range within 10° either way from the predetermined point. This special thermometer consists of an air-tight metal tube filled with mercury, the enlarged end of which rests in the pot. The other end of the tube is formed into a spiral and attached to a lever. As the temperature rises and falls the mercury in the tube expands and contracts, causing the spiral to open and close and the lever to move back and forth between two contact points. This makes and breaks a relay circuit, in turn controlling the current in the heating elements. In first heating the pot from a cold condition the input is 1,600 watts, and is maintained for about 50 minutes. When the proper temperature point is reached the thermometer cuts it down to the operating rate of 550 watts. As the peak load comes from midnight until morning, the electric linotype pot makes a very attractive addition to central station lines.—*Electrical World*.

LEGAL.

MONOMETER MANUFACTURING CO. *v.* ELECTRIC AND ORDNANCE ACCESSORIES CO., LTD.

MR. MUIR MACKENZIE, one of the High Courts Official Referees, on June 27th, concluded the hearing, at the Royal Courts of Justice, of an action, part heard at Birmingham, in which the Monometer Manufacturing Co. sought to recover from the Electric and Ordnance Accessories Co., Ltd., of Birmingham, the cost of a certain specially constructed and designed installation, consisting of furnaces for melting aluminium and other metals, together with the necessary plant for drawing off and carrying away the metals so melted.

Mr. Colam, K.C., appeared for the plaintiffs, and Mr. Hugo Young, K.C., for the defendants.

By a contract made on January 7th, 1915 between the parties, the plaintiffs agreed to manufacture for the defendants three furnaces for melting aluminium, each with a melting capacity of 1,000 lb., fitted with from 8 to 10 burners each, and with the necessary parts for drawing off the metal into certain smaller furnaces, such parts to consist of a suitable base to bring the outlet pipe over the orifice of the smaller furnaces, which had a melting capacity of 140 lb., so that the metal might be drawn direct from the larger furnaces into the smaller. The plaintiffs agreed to supply these for £230 each, less 2½ per cent. discount, one furnace to be delivered at the Ward End Works within four weeks from the date of the contract. Plaintiffs also agreed to supply 12 furnaces, to be used in conjunction with the three larger ones, each with a melting capacity of 140 lb., without parts for pouring, but each to have three burners with a specially-designed top. These were to be supplied for £52 each, and four of them were to be delivered at the works within four weeks from the date of the contract. Next, there were to be two other furnaces to be used in conjunction with the others, with a capacity of 140 each, to be fitted with pouring spouts and valves, for which the charge was to be £62 each. There were also three furnaces for melting aluminium swarf, each with a capacity of 600 lb., fitted with water-cooled chills, for casting ingots of aluminium, which were to be supplied complete for £248 each. The burners were to consume only about 60 ft. of gas per burner per hour, and it was also agreed that all

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the furnaces should be bricked with special silica bricks, to cut down the consumption of gas per burner by about 40 per cent., and to reduce the consumption to a point lower than that of any other system of furnace heating. All the furnaces were to be fitted with special burners, described as Monometer low-pressure gas burners, Monometer patented gas chamber, and all the latest improvements.

The DEFENDANTS said that the furnaces were not according to contract, and would not satisfactorily do the work for which they were required, and they counterclaimed for damages and for the return of money paid. They said that the plaintiffs contracted that the furnaces should be reasonably fit for melting aluminium to be cast in chilled moulds for fuses, for producing a molten product of pure aluminium absolutely free from particles of iron or other foreign matter, and free from porosity and other flaws and defects, and that the pots forming parts of the plant should not produce scale, but should produce castings suitable for pressing and machining all over. Another condition was that the specified number of burners would produce such a temperature as would be required satisfactorily to melt aluminium for the production of castings. These conditions the defendants said were not complied with by the furnaces supplied. The defendants stated that they required the furnaces and plant for the purpose of melting aluminium for castings in chilled moulds for the purpose of manufacturing fuses, for which manufacture they had prepared plans of a proposed new foundry for an estimated output of between 50 and 60 tons of castings per week. The defendants further alleged that the delivery was not made to time, and that when delivered the furnaces did not work satisfactorily, and that they were not reasonably suitable for the work.

The plaintiffs' case was completed at the hearing at Birmingham, where the evidence of Prof. Arnold and other expert witnesses was taken, in support of the plaintiffs' contention that the furnaces were capable of carrying out the work for which they were intended.

Further evidence was called for the defence at the resumed hearing in London to prove that the specified number of burners did not produce such a temperature as was required sufficiently to melt the aluminium for the castings, and that the necessary degree of liquidity could not be produced with the consumption of gas indicated, and that in fact a much larger consumption of gas was used in attempting to obtain the liquidity. It was said that although attempts were made to make the furnaces comply with the contract conditions they had not been successful.

MR. WILMOT, the works manager for the defendants, was recalled, and further cross-examined by Mr. Colam, when he said that the scum in the ladling pots was sometimes half an inch in thickness. The cold metal was put in at the top as the molten metal was drawn off at the bottom, and in this way the accumulation of scum might have been assisted. He had all through complained of the excessive oxidation. The Monometer furnaces had been offered as being capable of minimising the oxidation, but practice had proved, in his opinion, that they did not. His view was that the principal cause of oxidation was the long time it took to melt the metal. The quicker the melting the less the oxidation. The average heating power was not sufficient, and consequeatly they could not get their output. When he complained the plaintiffs expressed their astonishment and made certain alterations, but they did it on their own responsibility, and not in consequence of any request from him. In making the contract, he wanted to get furnaces without compressed air or other forced draught and the plaintiffs represented that their furnaces met this requirement.

In re-examination, the WITNESS said that to supply the shops he had to have a certain output from the foundry, and he wanted the quickest and best way of getting the metal down, but the plaintiffs' furnaces took a much longer time to get it down than had been represented, and that necessarily affected the output.

MR. NUTHALL, head foreman at the defendants' works, also gave evidence as to alleged shortcomings of the Monometer furnaces.

MR. THOS. TURNER, Professor of Metallurgy at Birmingham University, who said he had been interested for more than 30 years in the production of aluminium and was acquainted with the practice in the chief Birmingham aluminium foundries, gave evidence as to what was meant in the trade by the term "aluminium" and aluminium castings. The term to a chemist would mean pure metal, but in the trade it meant an aluminium alloy consisting of a percentage of zinc or copper. The melting of ordinary aluminium in an iron pot would have very little effect upon the pot, but in the case of an alloy of zinc the iron pot would be affected by the zinc, which would make a distinct crystallised compound. The zinc would take up the iron which was attacked very shortly after the melting point of the zinc was reached, and for practical purposes the iron pot ceased to be an iron pot. He attributed the accumulation of scum to excessive heat or to a longer time being taken in the melting. If the metal was a long time melting, there would be oxidation. The scum on the top of the ladling pot would affect the molten metal underneath, because there would be a certain amount of oxidation distributed below any large amount of scum, and the effect upon the castings would be that they would be less sound and harder to machine.

In cross-examination, the Witness said that if he ordered aluminium articles, he would expect to get an alloy; but if he ordered aluminium from a metal merchant, he would expect to get aluminium of 99 per cent. pure. Sometimes a little magnesium was present in aluminium castings, and sometimes he found a little iron. Pure aluminium would not attack the pots, but when there was a mixture of zinc with it, the zinc would do so. Zinc always attacked iron, and would do so even though there was aluminium with it. It was a common thing to coat iron pots, but he objected to say what the coating was, as it was a secret process.

Pressed to say what the process was, Witness said that it was a French secret brought over by a Frenchman. It was in the form of a wash, and had to be renewed from time to time. It was largely composed of chalk or whiting, and was mixed with something which made it stick.

Other witnesses said that in consequence of the Monometer plant failing to do its work properly, there was delay in the defendants' output, and they had to place some of their work in other hands. One witness (Mr. Monroe, their accountant) said that up to the end of July the furnaces produced 1,300,000 castings, which represented about 20 tons a week, instead of 50 tons required. There was necessity for an even larger output than 50 tons required. Up to the end of July there was no intention to get rid of the Monometer furnaces; on the contrary, they were endeavouring to get the Monometer people to work them.

After further evidence had been given for the defence, the Official Referee reserved judgment.

D. DAVIS & SONS, LTD., *v.* THE ASSESSMENT COMMITTEE OF PONTYPRIDD UNION, OVERSEERS OF RHONDDA AND THE RHONDDA URBAN DISTRICT COUNCIL.

THIS case came before the Court of Appeal, composed of Lords Justices Swinfen Eady, Phillimore and Bankes, on June 21st, upon the appeal of the respondent Assessment Committee, Overseers and Urban District Council, from a judgment of a Divisional Court, consisting of Justices Ridley, Lush and Low.

The short facts appeared to be these:—

D. Davis & Sons, Ltd., are the owners and occupiers of certain mines and their appurtenances, and in 1904 they made with the Assessment Committee an agreement by which, for the purposes of rates, the assessment of the property was to be calculated on the output of coal, the agreement being determinable by one year's notice. Some small electric stations were attached to the appellants' pits, and for some years they purchased a large amount of power from an electric power company, but in 1907 they erected an electric power station of their own, and from that time the small stations went out of use, and the company reduced the amount of power that they purchased. Down to April, 1913, the assessments on the company's property were made in accordance with the agreement, the electric power station not being assessed separately from the rest of the colliery. In April, 1913, the Assessment Committee, having given previous notice determining the agreement, assessed the electric power station separately from the rest of the colliery; but they still assessed the latter in accordance with the agreement. The Divisional Court held upon the question of the company's appeal against the poor rate that although the Assessment Committee of 1904 had no power to bind subsequent Assessment Committees, yet as the Assessment Committee of 1913 could not repudiate the agreement so far as concerned the power station, since they had affirmed it as regarded the rest of the company's property, there was no power to rate the power station separately as long as the rest of the property was rated in accordance with the agreement. The Court, therefore, held that the rate was bad and remitted the matter back to Quarter Sessions, with an intimation to that effect. Hence the present appeal.

At the conclusion of the arguments of Counsel, their Lordships affirmed the decision of the Divisional Court, and dismissed the appeal with costs.

POWER *v.* PRINCE OF WALES DRY DOCK CO.

AN unusual claim under the Employers' Liability Act, for personal injuries, came before his Honour Judge Bryn Roberts, at the Swansea County Court, the other day, when Wm. Power, boilermaker, of Cardiff, sued the defendant company, of Swansea, for £47 odd for damages sustained through the alleged negligence of the defendants, by which he received a severe electric shock that rendered him incapable of work for over a fortnight. The plaintiff was in the employ of the Oxy-Acetylene Welding Co., who were sub-contractors to the Dry Dock Co. in carrying out certain work on the steamship *Lille* at Swansea, in March last. Plaintiff was engaged in trundling some gas cylinders from the stokehole into the engine room, and at the same time some of the defendants' men were engaged with an electric drill, for which purpose an electric cable was conveyed from the quayside to the engine room. The cable trailed along the floor of the engine room, and as the plaintiff brought in the third gas cylinder he received an electric shock that rendered him insensible for some time. It was afterwards discovered that the insulation of one of the electric wires had been cut in several places, presumably by the collar of the cylinder, and it was supposed that by this means the current escaped along the iron floor of the engine room. For the defence it was urged that there was no negligence, and that if there were any, it could easily have been obviated.

MR. DAVID FULTON, the chief electrician to the Swansea Harbour Trust, who supplied the current, and other witnesses, deposed that they had experimented with a cable under the same conditions, and not more than 175 volts was possible to go through the body. They suffered no ill-effects whatever from the shock. Mr. Fulton added that the biggest shock he ever sustained in his life was of 1,500 volts; but he admitted that less than 100 volts had been known to kill. The latter, however, was alternating current.

HIS HONOUR said there was negligence in allowing the cable to trail along the floor when if might easily have been hung up out of danger, and he awarded the plaintiff £23 and costs.

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Stealing Electricity.

A fine of 40s. was imposed at Llanhilleth upon Esau Protheroe, a local collier, for fraudulently consuming electricity, the property of the Abertillery U.D.C., between March and April. Defendant pleaded guilty. Mr. A. H. Dolman, Abertillery, diverted the current from the meter by means of a pin, and conveyed it direct to the lamp.—*South Wales Daily News.*

BUSINESS NOTES.

South African Electrical Requirements.—The *South African Mining Journal* for May 27th says:—"All the municipalities are quietly in the market for switches, copper, and everything connected with electrical power driving machinery. As regards household goods, under this heading, the recent frosts have created a brisk demand for radiators, and in this respect it is pleasing to record that the complete framework of these have been made in Johannesburg for several seasons past, and those now presented are an improvement over last season's. A large dealer thinks that the local makers will oust the imported article, as any metal worker can make them in his spare time, &c. However, they are about 15 per cent. dearer than the imported goods. It must not be omitted to mention that the higher voltage lamps are getting scarce, as it is very difficult to obtain 2,000 candle-powers for the mines, and not easy to get the 1,000 kind."

Wolverhampton Electrical Trade.—In the annual report of the Wolverhampton Chamber of Commerce, the following reference is made to the electrical engineering trade:—"Throughout the year the demand made by the Allied Governments for electrical plant of all descriptions has been exceedingly heavy, many innovations having been introduced for special electrical requirements. Local factories have been, and are still, working day and night to meet the requirements. There is a distinct indication of an increase of trade with the Colonies, due to the supplies from enemy countries having been cut off."

Nottingham as an Industrial Centre.—A well-organised effort is being made to popularise the advantages possessed by Nottingham as a centre for new manufacturing industries. A glance at the map shows the ample nature of the railway connections between the city and the great seaports, also the excellence of the waterway connections. Powers have been secured by the Corporation under which they will spend £160,000 for increasing navigational facilities, but, unfortunately, this work is inevitably held up until a year after the war. At a time when new industries are being established, or when existing companies and firms are contemplating the building of new works, the claims of the district, with its ample fuel supplies, the cheapness of raw materials, &c., are well worthy of consideration. A Special Committee has been appointed to undertake the commercial development of the city, and an Industrial Development Officer has been appointed to devote his whole time and energies to the department. Communications may be addressed to him at the Guildhall, Nottingham.

New T.L.A. Lamp Discount Scheme. — Messrs. Siemens Bros. Dynamo Works, Ltd., of 38 and 39, Upper Thames Street, E.C., have sent us two booklets explaining the new lamp discount scheme that has just been inaugurated. One of the booklets deals with the scheme from the point of view of the trade reseller, and the other from the point of view of the trade user. They have already been distributed to a number of their customers, and copies will be supplied to any of our readers who are interested in the purchase of Wotan or other makes of T.L.A. lamps. In order that the scheme may be thoroughly and generally understood, we may say that it is based on the quantity of lamps purchased and delivered during 12 months, and the discounts are regulated in accordance with certain stipulated minimum quantities or equivalent net money values. The money values are introduced to cover half-watt type lamps, which, of course, are higher in initial cost. The total annual turnover in all makes of Association lamps will, therefore, regulate the terms at which Wotan, half-watt type, or tantalum lamps can be supplied. The booklets give an example of the method of procedure. A new customer will commence to buy lamps at 20 per cent., but immediately his total purchases of T.L.A. lamps amount to 500 he will automatically become entitled to buy at 22 per cent. In order to avail himself of these terms he must notify the secretary of the T.L.A., and, in addition, he will receive from his supplier, or suppliers, a credit note for the difference between 20 per cent. and 22 per cent. on the original lamps purchased. As each succeeding step is reached the increased discount will be obtained by means of the same procedure. There are, of course, a number of customers who were graded at a definite figure under the previous arrangement, and they will now receive the terms specified for a quantity of lamps based on their past purchases. This will bring them into the new scheme at, approximately, the discount to which they are entitled in accordance with their established turnover, and increased discount will be allowed should they improve on their previous figures. The terms for the trade user have been somewhat revised, and if lamps are purchased in quantities of less than 50, a discount of 15 per cent. only is allowed. Providing the lamps are ordered in quantities of 50 and over for delivery at one time, the standard schedule of discounts are applicable. It is therefore claimed that the scheme is absolutely equitable, and ensures to each trade buyer a discount directly in proportion to his turnover. As the discounts increase in a succession of easy steps the scheme should be an incentive to business extension. All invoices will be subject to one discount (*i.e.*, the one corresponding to the minimum quantity taken), plus the usual 2½ per cent. (cash) approved monthly account. This obviates the multiplicity of discounts, which are sometimes confusing, and often cause inconvenience and misunderstanding.

Australian Insulators.—According to the *Melbourne Age*, the assurance was given by the Postmaster-General to Mr. Fenton (V.), in the House of Representatives, on May 11th, that the Postal Department was encouraging the manufacture of insulators in Australia, with a view to becoming independent of importations. The following comparative statement shows the extent of the Australian orders, as against importations:—

Year.	Australian.	Imported.
1911	£800	£12,747
1912	421	11,190
1913	329	17,115
1914	4,490	14,444
1915	9,359	5,063

Bankruptcy Proceedings.—The Colston Electrical Works, Ltd., 9, Denmark Street, Bristol.—The winding-up order in this matter was made on the petition of a creditor. The liabilities amount to £1,573, to meet which there are net assets of £991, the estate disclosing a deficiency of £582 as regards unsecured creditors, whilst as regards contributories there is a deficiency of £2,234. The company was registered in December, 1913, with a nominal capital of £3,500, to acquire, as a going concern, the business of electrical engineers promoted by G. J. T. J. Parfitt and W. J. Webber, trading as Parfitt, Webber & Co., at 9 and 10, Denmark Street, Bristol. By an agreement of January, 1914, the vendors agreed to sell to the company the goodwill, plant, machinery, stock-in-trade, implements, utensils, book debts, and contracts, &c., which the vendors were entitled to in connection with the business, for 1,600 fully paid-up shares, the company to discharge all the trade liabilities of the said business, and the liability of the vendors' firm to the Capital and Counties Bank, Ltd. The business was taken over from July, 1913, and from that date down to January, 1914, the date fixed for completion, the vendors were deemed to have been carrying on the business on behalf of the company. The directors appointed were Miss H. L. W. Parfitt, Bath; A. E. Finch, Weston-super-Mare, electrical engineer; and E. W. Brock, Keynsham, glass tile manufacturer. At a meeting of directors, A. E. Finch was appointed chairman. An agreement was entered into in January, 1914, whereby A. E. Finch was to act as manager at a weekly salary of £3, and on the same day E. W. Brock was appointed secretary. The company was registered as a private company, and no capital was offered to the public for subscription, and no prospectus was issued. A meeting of the six largest creditors was convened by E. W. Brock in May, and an offer was made of a composition of 12s. 6d. in the £, payable as to 2s. 6d. forthwith, 5s. in one month, 2s. 6d. in two months, and 2s. 6d. in three months. Mr. Brock also issued a notice, signed by him as secretary, without consulting the other directors, convening an extraordinary general meeting of the company for the purpose of submitting an extraordinary resolution for voluntary liquidation and the appointment of a liquidator. Three shareholders apparently attended this meeting, the resolution was passed, and on May 30th, notwithstanding that the hearing of the petition for a winding-up order was to be heard by the Court on the following day, the liquidator purported to have been appointed sent out a notice convening a meeting of the creditors of the company to be held for the purpose of confirming his appointment as liquidator. In these circumstances the meeting was abortive. The failure was said to be due to loss of £725 through bad debts in 1914, and want of capital. From its inception the company has never had sufficient capital, and in 1914 it lost £650 through the failure of the Bristol International Exhibition, Ltd., and £75 through the failure of G. J. T. J. Parfitt in February, 1915. The usual books of account have been kept, but the cash book has not been balanced, and the books in general have not been properly posted. The following are creditors:—

British Ever-Ready Co. ...	£194	Hodge, Jacques & Co.	£11
Bristol Corporation Electricity Department	14	Joyner, C., & Co.	10
		National Telephone Service ..	14
Callender's Cable & Construction Co.	48	Metallic Seamless Tube Co. ..	22
		Premier Accumulator Co. ..	20
Cryselco, Ltd.	28	Willey & Co.	20
Drake & Gorham, Ltd... ..	15	Wilesmith, John, & Co. ..	12
Edison & Swan United Electric Light Co.	133	Wright, Harland	17
		Parfitt, Webber & Co.	731
Haslam & Stretton, Ltd. ..	77		

R. E. Connold, late electrician, now R.N.A.S., late 6A, The Parade, Canterbury.—The public examination of this debtor was fixed for June 17th, at Canterbury. Debtor was unable to obtain leave to attend the Court. The case was, therefore, adjourned.

South American Trade.—The Hon. R. C. Parsons, chairman of the King's College Delegacy, presided at a lecture given by Colonel Don Pedro Suarez, Consul-General for Bolivia, at King's College last week, on the subject of "Bolivia, its Geography and Industries," and said that the greatest bar to British trade in South America was the refusal of the British merchants to adopt the metric system, and their unwillingness to make goods to suit other peoples' necessities. This refusal had sent great quantities of trade into German hands.—*Morning Post.*

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Dissolutions and Liquidations.—READER'S PATENTS AND ENGINEERING CO., LTD.—A meeting is called for July 26th, at 3, Portland Street, Southampton, to hear an account of the winding up from the liquidator, Mr. E. W. C. Whittaker.

STANDARD CABLE MANUFACTURING CO., LTD.—Creditors should send particulars of debts, &c., to the controller, Mr. J. S. Feather, 35, Great Tower Street, E.C., by July 31st.

SHIP CARBONS, LTD.—Creditors should send particulars of debts, &c., to the controller, Mr. W. Hancock, 90, Queen Street, E.C., by August 7th.

BLEICHERT'S AERIAL TRANSPORTERS, LTD.—Creditors should send particulars of their debts, &c., to the controller, Mr. W. Hancock, 90, Queen Street, E.C., by August 7th.

ECONOMISERS, LTD.—A meeting is called for July 28th, at 18, Theobald's Road, to hear an account of the winding up from the liquidator, Mr. W. F. Johnson.

HOBART ELECTRIC TRAMWAY CO., LTD.—A meeting is called for August 3rd, at 5, Bucklersbury, E.C., to hear an account of the winding up from the liquidator, Mr. F. J. Warner.

JOHN ROBERTS & SON, boiler coverers, Salt Street, Manningham, Bradford.—Messrs. J. W. Roberts and S. Haigh have dissolved partnership. Mr. Roberts will attend to debts, and carry on the business at 29, Princes Crescent, Bare, Morecambe, under the same style.

Book Notices.—"Trade as a Science." By Ernest J. P. Benn. London: Jarrold & Sons. Price 2s. 6d. net.

"Large Electric Power Stations." By G. Klingenberg. London: Crosby Lockwood & Co. Price 25s. net.

"Electrical Engineering." By E. J. Berg and W. L. Upson. London: Hill Publishing Co. Price 17s. net.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXV. No. 6. June, 1916. New York: The Institute.

"Science Abstracts," A and B. Vol. XIX. No. 222. June 26th, 1916. London: E. & F. N. Spon, Ltd. Price 1s. 6d. each net.

"Scientific Paper of the Bureau of Standards," No. 276, "Protected Thermo Elements." Washington: Government Printing Office.

The *Magazine* of the Finsbury Technical College and Old Students' Association for May contains a portrait and obituary notice of the late Prof. R. Meldola, F.R.S., the continuation of a paper on "Humphrey Pumps," by J. G. Bulger, and a further Roll of Honour of remarkable length.

Board of Trade Inquiry.—The Commercial Intelligence Branch of the Board of Trade has the name and address of a firm of agents and importers of electrical material at Brescia, Italy, which wishes to secure the agencies of United Kingdom manufacturers of electrical plant and machinery, measuring instruments and gauges, apparatus and material for electrical plant, and porcelain and insulating material in general. Reference No. 202.

The Commercial Intelligence Branch of the Board of Trade has received inquiries from Home firms for makers or producers of manganese dioxide for Leclanché batteries, and electrical novelties.

Catalogues and Lists.—THE BONECOURT WASTE HEAT BOILER CO., LTD., Parliament Mansions, Victoria Street, S.W.—New catalogue dealing with gas-fired boilers and waste-heat boilers, describing the Bonecourt surface-combustion system; in view of the increasing importance of economising fuel and recovering the by-products from coal, the contents of this brochure are exceptionally interesting. Tables are given showing the standard sizes of the boilers, the performance of each tube with different kinds of gas, and the draught required, with illustrations of the details of the plant and the lay-out recommended. The results of a test by an independent expert are included, showing the efficiency of an unlagged Bonecourt boiler and feed-water heater to be 92·7 per cent. It is claimed that an evaporation up to 20 lb. of steam per sq. ft. of heating surface per hour is obtainable, and that 48,000 lb. of steam per hour can be generated on a floor space of 225 sq. ft. A battery of boilers for 12,000 H.P. occupies a space of only 48 ft. by 33 ft., and a CO_2 content of 18·1 per cent. in the flue gases is recorded. The boiler can be utilised for recovering heat from the exhaust gases of gas engines, coke ovens, steel furnaces, &c. A new method of mixing the air and gas has prevented back-firing, and the refractory material is now made on a greatly improved system, so that over 3,000 cb. ft. of producer gas can be burnt per hour in one tube 6 in. in diameter and 15 ft. long.

MESSRS. MOSSAY & CO., LTD., 41, Tothill Street, Westminster, S.W.—Illustrated pamphlet (20 pages), describing the "Orwell" electric vehicle of 1½, 2½ and 3½-ton sizes. A number of improvements and additions to the equipment of the vehicles are included.

THE BRITISH THOMSON-HOUSTON CO., LTD, Rugby.—Price list No. 4,310, describing and illustrating their type EK, form B, iron-clad switch fuses.

MESSRS. BRUCE PEEBLES & CO., LTD., Edinburgh.—Twenty-page illustrated pamphlet (No. 21 C), in their standard form and size, containing full illustrated specification, detailed tabulated data, output ratings, weights and dimensions, of the Peebles self-contained continuous-current dynamos and motors. Sixteen frame sizes, which are listed, can be manufactured in any of the usual types.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD., Ponder's End.—Two illustrated and priced leaflets of Ediswan electric fans of various types. The company has also issued a very handy pocket book in a distinctive red cover, containing "Ediswan discount tables" from ⅛ to 50 per cent. The book is issued for the convenience of the members of the trade, and it contains various tables not to be found in the ordinary discount books, but useful in making up discount on T.L.A. lamp prices, such as 22 per cent., 24 per cent., 27 per cent., 28 per cent., 32 per cent., 34 per cent., 36 per cent, 39 per cent., &c.

MESSRS. BELLING & CO., Derby Road, Edmonton, London, N.—Two-fold circular, containing description of their electric immersion heaters, with diagrams showing the methods of their application, also giving dimensions and prices.

Trade Announcements.—MESSRS. MARBRO, LTD., have removed to larger premises at Palace Wharf, Rainville Road, Fulham, S.W. Telephone No.: "Hammersmith 1215."

The electrical and engineering advertising business of Mr. A. J. GREENLY will in future be conducted as A. J. Greenly & Co., and will have additional offices at 37 and 38, Strand, W.C.

THE GENERAL ELECTRIC CO., LTD., announce that the address of their Cork branch, from whence all orders from the South of Ireland are attended to, has now been altered to 76, Grand Parade.

For Sale.—MESSRS. PERCY HUDDLESTON & CO. will sell by auction, on July 11th, at Dalling Road, Hammersmith, a quantity of electrical apparatus, &c. Full particulars are given in our advertising pages to-day.

Copper Prices.—THE WEEK'S CHANGES.—F. SMITH AND CO. report, Wednesday, June 28th:—Electrolytic bars drop from £139 to £130; ditto sheets, £157 to £150; ditto rods, £146 to £137; ditto H.C. wire, 1s. 5½d. to 1s. 4½d.

JAMES & SHAKESPEARE report, Wednesday, June 28th:—Copper bars, sheet and rod (best selected), drop from £160 to £152.

LIGHTING AND POWER NOTES.

Aberdeen.—ENGINEER'S REPORT.—Mr. Bell, the Corporation electrical engineer, in a report regarding new generating plant, says:—"The Council's decision not to proceed with the additional installation suggested in November last precludes the installing of plant for the winter of 1916, and the question now to be considered is the provision of new generating plant before the winter of 1917. The output for the 10 months ending May 31st is 2,030,360 units above the previous corresponding period, being an increase of 19·1 per cent. The remaining two months will, at a conservative estimate, add a further half million units increase, which would make a 23 per cent. increase for the year—a figure only once exceeded in the history of the undertaking. Additional motors of 2,027 H.P. have been coupled up since July 31st last, and applications for a further 1,291 H.P. have been received. No. 1 turbine has now generated 28½ million units, being 19 millions in 22 months and 9½ millions in the last seven months. A further 500-KW. converter has been ordered since the last report, and, therefore, the 1,000-KW. set recommended in November last can meantime stand over. A 5,000-KW. turbine alternator, if ordered now, can be delivered for next summer, and will, I estimate, cost £18,000."

Australia.—POWER STATION PLANT.—For the power station plant and equipment for the Commonwealth naval dockyard at Cockatoo Island, one tender only for engines of Australian manufacture was submitted—viz., for reciprocating engines; the tenders had been originally invited under the heading of four alternative schemes—viz., geared turbo-generators, reciprocating sets with exhaust turbines, reciprocating sets and exhaust geared turbo-generators, and Diesel engine sets. Acting on the advice of the British Admiralty, who endorsed the recommendation of local experts, the Naval Board has adopted the first alternative scheme, and orders have been placed for Parsons-Crompton geared turbo-generator sets. It is stated that for reciprocating engines the price quoted by the Australian manufacturers and that submitted from abroad showed a difference of something like 70 per cent.—*Sydney Morning Herald.*

Barnsley.—PRICE INCREASE.—Having considered the report of the borough electrical engineer on the working of the department for the past year, and in view of the loss thereon, the Electricity and Lighting Committee has decided that the price of energy be increased by ½d. per unit for lighting, and 10 per cent. for power consumers.

Beckenham.—PRICE INCREASE.—The D.C. has decided that the charge for electricity for lighting shall be raised to 7d. per unit, to take effect from Saturday last.

Bedford.—The R.D.C. has given consent for the T.C. to supply current to the new works of Messrs. W. H. Allen, Son and Co., to be erected in the rural district.

Bolton.—Despite the Summer Time Act, the electrical engineer reports no appreciable decrease in the consumption of electricity. Lighting restrictions had already considerably reduced the quantity used for lighting purposes.

Colwyn Bay.—PRICE INCREASE.—Owing to the heavy increase in the price of fuel, the U.D.C. has decided, from the close of the present quarter, to advance the price of energy from 5d. to 5½d. per unit.

Coventry.—PRICE INCREASE.—The Electric Light Committee recommends an increase of the scale of charges for the supply of energy for power proportionately to the increased cost of coal.

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Darwen.—Fire broke out, on Monday, at the Darwen electricity works, and the man in charge of the engine room, Joseph Munroe, was burned about the face in a plucky attempt to stop an engine. The fire brigade extinguished the flames.

Dundee.—Year's Working.—The total units sold last year amounted to almost 18½ millions, an increase over the previous year of 3¼ millions; the net income, which showed an increase of fully £12,700, was £78,295. The costs also showed a large increase, being £10,000 in excess of the previous year. The coal account itself practically represented the entire increase, this item being £9,800 more than in the previous year. The accounts closed with a net profit of £409.

Gosport.—Restriction of Output.—The Gosport and Alverstoke Electric Supply Corporation has notified its consumers that owing to the difficulties in obtaining skilled labour, it is feared that it may be necessary in the near future to restrict, if not entirely cancel, the supply of electricity for power, heating, and lighting, and also for the service of the tramways.—*Portsmouth News.*

Heston and Isleworth.—Year's Working.—The engineer reports that, as the result of the "Summer Time" Act, the output has fallen 200 units per day. He estimates the approximate loss during the summer at £400 to £450. The Electricity Committee reports that there was a deficit on last year's working, after taking into account expenditure on new plant and the previous year's deficit of £1,049, which arose mainly from the high price of coal. Each unit sold cost for coal ·55d. against ·38d. in the previous year. The total number of units sold was 1,288,371 against 1,162,995 in the previous year, and the increase of expenditure—due entirely to the rise in the price of coal—after allowing for the reduction in consumption per unit due to the larger amount generated, was well over £900. The prices of coal showed an increase on last year, and the Committee had no other course open to it but to raise the charges by 12½ per cent. In his annual report, the engineer, Mr. P. E. Rycroft, states that the income was £11,246, an increase of £751, and the working expenses £7,031, giving a profit of £4,214; but interest and loan charges were £4,927, which caused a deficit of £712. The main cause of the deficit was the cost of coal, which was £1,088 in excess of the previous year. The total units generated were 1,564,473, an increase of 55,246, but the units sold increased by 125,376. The works costs had risen from 1·03d. to 1·23d. per unit, and new business had been very difficult to obtain.

Hornsey.—Year's Working.—There is a deficit of £2,789 on the net revenue account of the electricity undertaking for the year ended March 31st last. The total expenditure for the 12 months, including the purchase of meters, amounted to £11,035, an increase of £470 compared with a year ago. On the other hand, the total receipts showed a falling-off of £1,720, the respective figures being £20,570 and £22,290. The balance, transferred to net revenue account, shows a reduction on the previous 12 months of £2,189. The balance to the credit of this account is now £3,984. The Council has again found it necessary to increase the prices for energy and meter rent, this time by a further 15 per cent., provided they do not exceed the authorised maximum rates.

Hull.—Year's Working.—The annual report to the T.C. on the working of the electricity undertaking states that the revenue from all sources amounted to £89,208, and the total working expenses, exclusive of special charges, to £47,178, leaving a balance of £42,030. Of this amount, interest and sinking fund absorbed £33,950, income-tax £2,106, and special charges £1,727, leaving a net balance to be carried to the reserve fund of £4,247. The revenue from lighting showed a decrease of £5,000 on the figures for the year 1914-15. On the other hand, the increase in revenue from power amounted to £9,517, approximately 22 per cent. over last year's figures. The units sold for all purposes increased from 12,969,776 to 14,795,426, being an addition of 14 per cent., and the additional income under this head was £4,207. The revenue from power supplies more than compensated for the decrease on the lighting side. The works costs and total cost were the lowest recorded by the undertaking. The total connections to the mains were:—Power, 20,470 KW.; and lighting, 8,320 KW. The city accountant stated that the income for the year increased by £6,908 on the previous year's working. During the year capital outlay amounting to £2,476 was met out of revenue, and £6,760 out of loans. The total capital expenditure on the undertaking was £540,099.

The town clerk has been instructed to take the preliminary steps towards getting an order to authorise the Corporation to supply electricity to the new sanatorium at Cottingham.

India.—Electric Lighting.—It is stated that the Mukhis and the leading Sind merchants of Hyderabad are forming a company on the lines of the Karachi Electric Corporation to supply electricity to the town of Hyderabad. The preliminary details have been settled. The firm of Messrs. Mukhi Hiranand Tarachand are to be managing agents for the company. The engineers of Messrs. Tata & Sons' electric works near Bombay are to be consulted. It is proposed to utilise the River Indus for the supply of power.—*Indian Engineering.*

Kingstown.—The U.D.C. has made an arrangement with the Munster and Leinster Bank for a loan of £6,000 at 4½ per cent., for three years, to cover the preliminary expenses in connection with the electric lighting scheme.—*Irish Builder,*

London.—Hampstead.—Price Increase.—The B.C. has decided, owing to the cost of coal, to increase the charges for electricity by 23½ per cent. from January 1st, making, with the 10 per cent. then made, a total advance of 33½ per cent. on the pre-war charges.

St. Pancras.—Price Increase, &c.—The Electricity Committee has had under consideration the question of revising the charges for energy, in view of the serious financial loss falling upon the undertaking, and having due regard to the continuance of the 10 per cent. at present added to all accounts, recommends the following increased charges, which are estimated to produce an additional income of £18,000 during the year:—(1) Present charge of 1d. per unit for power, heating and cooking to be increased to 1½d.; (2) present rebate of 20 per cent. allowed for "factory" lighting (exclusive of offices, showrooms, &c.) to be abolished, and a flat rate of 3d. per unit charged in lieu thereof; (3) present two-rate system of 6d. per unit between the hours of 4.30 p.m. and 8.30 p.m., and 1d. per unit afterwards, to be abolished; (4) present maximum-demand tariff of 6d. and 1½d. per unit to be increased to 6d. and 2d., and the introduction of a flat rate of 3d. per unit for kinema theatre supplies; (5) KW. demand system of charging of £4 per annum, plus ½d. per unit, to be abolished; (6) meter rents to be charged on a sliding scale in regard to all supplies, instead of only, as at present, where a factory lighting rebate is allowed, and for cooking and heating purposes, &c., and where the maximum-demand indicator is used. The Finance Committee is in full agreement with the above proposals, and in view of the fact that, as a result of the agreement come to with the L.C.C. to accelerate the periods of repayment of loans, an additional sum of £1,454 a year will have to be paid from revenue during the next three years, has recommended that the interest of about £1,500 a year earned by the reserve fund account should be taken into revenue, instead of accruing to the reserve fund as heretofore. Arrangements have been made for laying an E.H.T. main in Gray's Inn Road to supply current for power purposes; this work will necessitate the re-arrangement of the switchboard at the Tavistock Place sub-station, at a cost of about £462. The Committee has received a reply from the Board of Trade in reference to representations made as to the necessity of an adequate supply of coal for the undertaking, suggesting that in any case in which the Council is unable to renew a contract, it should communicate with the Coal Supply Committee for the district in which the colliery concerned is situated, and that immediate steps be taken to renew contracts which will shortly expire. The Committee has also received a reply from the Admiralty Coasting Trade Office, stating that every effort will be made to assist the Council to secure supplies.

Poplar.—Year's Working.—The annual report of the electrical engineer and manager, Mr. J. H. Bowden, shows that the energy sold amounted to 21½ million units, an increase of 4½ millions, or 27½ per cent.; the net income from the sale of energy was £88,490, an increase of 20½ per cent.; and the working expenditure was £52,179, an increase of 45 per cent. The gross profit was £36,311, a slight decrease on the previous year; and after deducting interest £11,530, repayment of loans £12,860, and sundry charges £563, there remained a surplus of £11,814, a decrease of 20 per cent. With the unappropriated balance of £10,220 from last year, there was a total surplus of £22,035; a sum of £3,500 was transferred to the rates, about £8,000 was applied to sundry items of capital expenditure, alterations, &c., £1,000 to the staff as a bonus, and £617 was transferred to the superannuation and pensions fund, leaving an unappropriated balance amounting, with other items, to £11,667. The Council has decided that after providing a working balance of 10 per cent. of the total income, 40 per cent. of any available surplus shall be carried to the general fund for relief of rates; 20 per cent. up to an amount of £6,000, and 10 per cent. above that figure, as bonus to the staff; and the balance to meet capital expenditure. The agreement between Poplar and Stepney enables an output of 25 million units per annum to be attained before extensions at Poplar are necessary. The average price of coal rose from 12s. 5½d. per ton in the previous record year to 17s. 11½d. last year; but the working costs have only risen from 0·51d. to 0·58d. per unit, which is claimed as the record for the metropolitan area for the past year. The average price of 0·988d. per unit is also stated to be a record; deducting the supply to Stepney, the price for the Poplar area becomes 1·087d., which is claimed as a record to date. The capital employed per KW. of plant installed (£30·7) is believed to be the lowest in the country, and the output is said to be the largest yet published in connection with any metropolitan municipal undertaking. The load factor was 30·2 per cent., compared with 28·8 per cent. in the previous year. The sale of energy for private lighting was 1,125,005 units; for domestic supply (fixed charge + ½d. per unit), 935,414; for power, 16,647,703; for bulk supply, 2,556,946; and for public lighting, 241,546 units. The accounts are published in a remarkably complete and detailed form.

St. Marylebone.—A.C. Plant.—In recommending payment of the final instalment on the extra-high-pressure three-phase generating plant installed on the recommendation of the general manager, Mr. A. H. Seabrook, the Committee reported on the results of the whole scheme. During the year ended March 31st, 1914, 24 per cent. of the total energy generated at the station was supplied from this plant; to March 31st, 1915, it generated 94 per cent., and for the year ended March 31st, 1916, 96 per cent. The turbo-generators, although contracted for to work at 3,000 KW. each, actually give 4,200 KW. continuously, and have done 5,000 KW. as a maximum. The steam consumption of the plant during the 2½ years has been at least up to the contract guarantee. The steam consumption per unit generated (including all losses) has been reduced from 21·17 lb. with the old plant to 16·34 lb.

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with the new; the coal consumption has been reduced from 3·49 lb. (10 per cent. slack) to 2·87 lb. (42 per cent. slack) per unit. The saving in coal last year by the new plant was £6,534. Though the station and mains staff had no previous experience with this system of generation and transmission, no breakdowns had occurred. The actual expenditure amounted to £32,981 for plant and mains.

The Electricity Committee reports that women have been engaged to replace men wherever possible. One is employed as storekeeper at the generating station stores; with the exception of the chief technical clerk, all clerical work at the station is done by girls, and girls are now being engaged for the switchboard galleries at the generating and sub-stations. The Committee has appointed a lady as district representative in the sales department, and arrangements are being made for the employment of women as lamplighters, meter testers, and in any other capacity where they can replace men.

Luton.—Extensions.—The electrical engineer hopes shortly to be in a position to submit tenders for the additional boiler, economiser, and ash and soot-handling plant required in connection with the generating station extensions. The demand has increased 36 per cent. over the corresponding period last year. Applications in hand include 5,125 8-c.p. lamps for lighting; 376-h.p. motors, and 513 kw. for heating.

Manchester.—Summer Time.—After a month's experience of conditions under "Summer Time," the electricity department anticipates a reduction of 550,000 units of energy at the Stuart Street station from May 21st until the end of September, equal to 1 per cent. of the total output of the station, and a reduction of 600 tons in the consumption of coal; at the city stations the reduction in output is estimated at 200,000 units, or 2 per cent., with a reduction in coal consumption of 300 tons.

Nelson.—The electrical engineer having reported on the engines at the electricity works, it was decided that no repairs be undertaken to the engine now disabled, and that a Sub-Committee be appointed to deal with any emergency that may arise in connection with the generating station.

Newton Abbot.—The U.D.C. has accepted an offer from the E.L. Co., of a reduction of £55 for discontinued lighting during June, July, August and September, the period of the contract to be extended for the time the lamps are not used.

Norway.—According to a recent official return, the number of electricity generating plants in Norway at the end of the fiscal year, 1915, amounted to 1,515, with a capacity of 649,127 kw., these figures comparing with 1,427 and 560,406 respectively at the end of the preceding twelve months.

Perth.—The balance on the year's work is fully £330 to the good, and there will be no increase in the charges.

Rawtenstall.—Price Increase.—The Electricity Committee has decided that the price of electricity to power consumers other than those under an agreement containing a coal clause shall be increased 5 per cent.

Ripon.—Prov. Order.—The City Council has decided to apply for a provisional order for the supply of electricity to the city.

Rochdale. — Arbitration. — Tyre Yarns, Ltd., of Castleton, have asked that a dispute between the firm and the electricity department respecting the interpretation of certain clauses in their agreement for the supply of electricity shall be submitted to the arbitration of the Board of Trade, and the T.C. has instructed the town clerk to take the necessary steps to this end.

Southend-on-Sea.—For some months past the Electric Lighting Committee has been in communication with the various contractors for the plant ordered for the proposed sub-stations at Leigh and Thorpe Bay, with the object of effecting an amicable arrangement to meet the difficulty which arose in consequence of the action of the L.G.B. in prohibiting the raising of loans by local authorities during the war. The plant ordered included five Diesel oil engines manufactured by Messrs. Belliss and Morcom, Ltd., three 200-kw. dynamos manufactured by the Phœnix Dynamo Manufacturing Co., Ltd., and two 180-kw. dynamos manufactured by the British Thomson-Houston Co., Ltd., the amount of the accepted tenders totalling £16,359. With the exception of two six-crank engines, all the machines mentioned were ready for delivery last summer. The Committee has now succeeded in provisionally effecting an arrangement.

It was reported at the last meeting of the Lighting Committee, that a tradesman who carried out the work of cleaning the interior of various houses and also furniture by means of a vacuum cleaner, had, for the purpose of operating the machine, used the current supplied under the contract rate to such premises. The Committee resolved to charge the tradesman in question at the rate of 6d. for a period not exceeding three hours, or 1s. per day in respect of the current used for the purpose referred to, and that this rate be charged for all current used in vacuum cleaners where the consumption thereof does not exceed one quarter unit per hour.

The Committee appointed to consider the question of effecting economies in public expenditure expresses the opinion that it would be impracticable, at the present time, to reduce the amount of the estimate (£3,900) for street lighting during the current financial year. With the view, however, of lessening the future outgoings, it has advised the Corporation to request the Highways Committee to consider the question of substituting electricity for gas in the streets at present lighted by the latter.

Stalybridge.—Plant Extensions.—L.G.B. sanction has been received by the Stalybridge, Hyde, Dukinfield and Mossley Tramways and Electricity Board, for the borrowing of £30,000 for extensions, and the work is to be put in hand at once.

Walthamstow.—The Lighting Committee of the U.D.C. has given instructions for the whole of the street lighting to be discontinued until the end of August. The Committee has recommended the purchase of automatic switches for the public lamps at a cost of about £450. The Finance Committee has approved of the expenditure, and recommends application for borrowing powers.

West Ham.—The electrical engineer has been authorised to proceed with the work of extending the supply of electricity to the works of the India-Rubber, Gutta-Percha and Telegraph Co., Ltd.

Westleigh.—Electrical plant to serve a variety of purposes is to be put down at the Parsonage Collieries, Westleigh, Lancs., belonging to the Wigan Coal and Iron Co., Ltd., who are sinking extensive new mines there. Additional electrical power is to be introduced at other collieries in the same neighbourhood.

TRAMWAY and RAILWAY NOTES.

Birmingham.—Car Derailed.—A serious accident occurred at Handsworth, on Thursday last week, 39 persons being injured, four of them somewhat seriously. The car was making the journey from Darlaston to the city with a full complement of passengers and had reached a point opposite Soho Road Station when, through an accident to the brakes, it left the rails, ran into the pavement, smashing the stones for many yards, and finally fell over on its side in the roadway. The passengers both inside and outside were thrown violently against each other, many being pressed downwards against splintered glass. Most of the injured, who were suffering from shock and bruises, were taken on ambulances to the general hospital. The majority were sent to their homes after receiving treatment.—*Morning Post.*

Blackpool.—Despite the abandonment of the Whitsuntide holiday, Mr. C. Furness, general manager of the Corporation tramways, reported on June 22nd that the tramway traffic practically held its own compared with last year. This he considers a very good result, for he was prepared to see a decline of about £1,500.

Brentford.—Track Repair.—The D.C. has decided to call the attention of the B. of T. and the Commissioner of Police to the noise made by the cars owing to the worn-out state of the track, with a view to pressure being brought to bear on the company to carry out repair work.

Huddersfield.—The Tramways Committee has agreed to a further amendment to the existing agreements to allow of their continuance until the conclusion of the war. The Committee has decided that men who are called up for military service before their holidays are due shall receive holiday pay, this applying to temporary men where they have been in the employment of the department for the necessary period.

Keighley.—After allowing for interest and sinking fund charges, the net revenue accounts for the tramways show a deficit of £168 for the year, and for railless trolley vehicles a surplus of £51.

Newcastle-on-Tyne.—Year's Working.—The financial statement of the working of the Corporation tramways shows that for the past year the traffic expenses were £93,831, as compared with £79,328 for the preceding year. The increase of £14,503 was made up principally by increased wages and war bonuses to the traffic staff. Of the total traffic expenses, 87.40 per cent. represented wages. General expenses totalled £34,745, an increase of £9,165, of which rates alone accounted for £6,000. General repairs and maintenance had cost £38,055 against £31,120, an increase of £6,935. Power expenses at £17,436 showed an increase of £3,496, due to the higher prices of fuel and an increased consumption. On the maintenance of power and sub-stations £3,087 had been spent, as against £3,969. Public lighting, £4,320, showed a decrease of £760, attributable to the fact that in recent years new lamps had gradually been installed to supersede less efficient types. The total working expenses were £192,649, an increase of £32,191. The total income was £324,695, as against £293,264, an increase of £31,431. The traffic income of the undertaking was £314,732. The gross profit on the year's working was £132,046, which was increased by interest to £135,764. Out of this sum there had been paid £10,834 for income-tax (an increase of nearly 100 per cent.), £75,000 for interest and redemption of loans, £8,164 contribution to the rates out of profits, £13,144 allowances to men on active service and their dependents, and other smaller items, which left a net profit of £23,389 as against £24,822 in the previous year to be appropriated for the reserve and renewals fund, which now totals £77,000. During the past year there had been spent on renewals to the permanent way,

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additions to plant and cable, and in the purchase of land £21,052, so that almost the whole of the surplus of the undertaking for the past year had been absorbed, and there was a net £2,000 in round figures to carry to the reserve and renewals fund.

Preston.—FARES.—The T.C. is to be recommended by the Tramways Committee to sanction the discontinuance of the issue of transfer tickets, and to agree to the issue of ½d. tickets on the present transfer stages.

Swansea.—The B.C. has approved of the recommendations of the Tramways and Electric Lighting Committee that the Council accept the Tramway Co.'s offer to convey the freehold of the power station, instead of the leasehold interest, and that the necessary steps be taken to carry the matter to completion.

Walthamstow.—The D.C. is recommended to put in hand at once the work of repairing the tramway track in Chingford Road.

West Ham.—FARES AND STAGES.—The Tramways Committee has reconsidered a recommendation, referred back at the last Council meeting, with reference to the adoption of a revised list of ½d. stages, and the substitution of 1½d. workmen's return tickets for the existing 1d. returns, together with certain resolutions adopted by the Leyton Tramways Committee, with reference to the revision of ½d. fares and the overlapping stages, or their abolition, and the revision of workmen's fares, which are considered to be too low. The Committee now recommends that in lieu of the previous recommendation, the following be adopted and carried into effect:—(1) A universal 1d. fare for a continuous journey on any one car within the borough; (2) children's stages to remain in force as at present; (3) a 1½d. workmen's return fare for a continuous journey on any one car within the borough—return tickets to be issued on all cars scheduled to arrive at a terminus before, and up to, 8 a.m.; (4) existing through fares, where necessary, to be adjusted to comply with the above scheme.

LOAN APPLICATION.—The T.C. is recommended to apply to the B. of T. for sanction to a loan of £1,000 to cover the cost of doubling the track at the Connaught Road terminus, and to advise the Board, in reply to their letter with regard to the possibility of postponing the whole, or a portion, of the scheme, that the matter is one of extreme urgency at the present time, due to heavy traffic from the docks and Arsenal, and should be completed as early as possible.

TELEGRAPH and TELEPHONE NOTES.

Hull.—The Corporation having applied for sanction to borrow £4,000, the L.G.B. stated that in the present circumstances it was undesirable to have recourse to borrowing. The telephone engineer explained that this was capital expenditure by the Post Office before the Council took over the telephones, and recommended that all capital expenditure from January 1st last should be met out of the reserve fund, and that in connection with all future new installations the subscribers be requested to defray the expense. The recommendation was adopted.

Argentina.—*La Electricidad y la Maquinaria* states that Alexander Schwimmer, the representative of a North American Syndicate, has applied to the Municipal administration for leave to set up an automatic telephone system in Buenos Ayres. The tariff which the promoters offer is 10 to 15 per cent. lower than the prices now charged by the Union Telefonico for the existing service.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—U.D.C. Cable. See "Official Notices" June 23rd.

Aberdeen.—July 7th. Corporation. One 5,000-KW. turbo-alternator with surface condenser and auxiliaries, for the Electricity Department. See "Official Notices" June 23rd.

Australia.—PERTH.—July 19th. P.M.G. Supply of insulators (Schedule 510). See "Official Notices" June 9th.

August 16th. P.M.G. Distilling apparatus (Schedule 502), telegraph and measuring instruments (Schedule 498). See "Official Notices" June 16th.

MELBOURNE.—July 26th. Victorian Railway Commissioners. 400 signal lighting transformers.*

August 8th. Deputy P.M.G. Standard battery material:—Porous pots, jars, zinc and carbon rods, and chemicals. Sched. 1,327. High Commissioner's Office, 72, Victoria Street, S.W.

SYDNEY.—August 17th. Portable internal-combustion engine and dynamo (2½ KW.) for the Departmental Stores, Sydney, for P.M.G.*

August 24th. P.M.G. Automatic switchboard and apparatus for North Sydney Exchange. Schedule No. 511.*

BRISBANE.—July 31st. P.M.G. Power board and accumulators. Schedule No. 381.

Barrowford.—July 8th. U.D.C. Automatic control electric screen-cleaning gear for the sewage disposal works. Mr. F. Sutcliffe, Surveyor to the Council.

Bradford.—Guardians' Union House Committee. Installing an adequate telephone system at Bowling Park Colony.

Leeds.—July 3rd. Electricity Department. Two overground transformer chambers at Holbeck, and one underground transformer chamber at Hunslet. Mr. C. N. Hefford, Manager.

Manchester.—July 11th. Electricity Committee. (*a*) Electric or hydraulic coal-wagon lift and turntable; (*b*) saddle tank steam locomotive. Specification, &c., 21s. (returnable), from Mr. F. E. Hughes, Secretary, Electricity Dept., Town Hall.

New Zealand.—INVERCARGILL.—September 28th. Borough Council. Steam turbo-alternator, condensing plant, and switchgear. Specifications from the Tramway Office.

Plymouth.—July 20th. Corporation. Rotary steam boiler feed pump for the Electricity Department. See "Official Notices" to-day.

Rochdale.—July 12th. Electricity Committee. Paper-insulated cables for 12 months. Mr. C. C. Atchison, Engineer and Manager, Dane Street.

Rotherham.—July 3rd. Corporation. Twelve months' supply of tramway stores and materials, coal, cable, meters, &c. See "Official Notices" June 16th.

Spain.—July 14th. The municipal authorities of Sollana (Province of Valencia). Concession for the electric lighting of the town during a period of five years.

Warrington.—July 11th. Electricity Department. 7,000 tons of slack coal for six months, or alternatively 12,000 tons during 12 months. Mr. F. V. L. Mathias, Borough Electrical Engineer.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Barnsley.—Electricity Committee. Contracts for coal: 4,000 tons, Wilby & Sons; 4,000 tons, Williams.

Bolton.—Electricity Committee:—

J. B. Scholes & Sons.—15,000 tons of Ellerbeck and rough Arley slack, and 2,500 tons of Roscow's (Peel Hall Colliery) rough slack, with option of further 2,500 tons.
Earl of Ellesmere.—5,000 tons of slack.

Brentford.—District Council. Automatic starters for the pumping station: Igranic Electric Co., Ltd.

Brighton.—Board of Guardians. Electrical fittings: H. J. Galliers, £35.

London.—Included in the tenders which have been accepted by the Metropolitan Asylums Board for the supply of general stores, &c., during the period ending June, 1917, is one from the General Electric Co., Ltd., for three items of the schedule.

ST. PANCRAS.—Borough Council. Tenders received for 1,000 yards of E.H.T. three-core cable, required for the supply of power to industrial works:—

Union Cable Co., Ltd.	£564
Western Electric Co., Ltd. (accepted)	568
Pirelli-General Cable Works, Ltd.	579
Johnson & Phillips, Ltd.	590
B.I. & Helsby Cables, Ltd.	590
Siemens Bros. & Co., Ltd.	594
W. T. Henley's Telegraph Works Co., Ltd.	597
W. T. Glover & Co., Ltd.	608
Callender's Cable, &c., Co., Ltd.	632
Macintosh Cable Co., Ltd.	690

Subject to satisfactory sureties, the tender of Messrs. Beattie and Co., Ltd., for coal to the generating stations for one year has been accepted. The approximate estimated quantities for the respective works given in the schedule were 16,125 tons beans, 5,375 tons nuts, and 3,600 tons large hard steam. Messrs. Beattie's prices (£1 6s. 5d. for hard steam, £1 4s. 5d. for beans, and £1 5s. 8d. for nuts) are subject to any advance or reduction authorised under any alteration of the Price of Coal (Limitation) Act, to the Coal Exchange Strike, &c., Clauses, the Official Government Clause, and to the increase or reduction in railway rates and charges.

Rawtenstall.—2,000-KW. turbo-generator (G.E.C.), James Howden & Co., Ltd.; condenser plant, Mirrlees, Watson and Co., Ltd.

Southampton.—Messrs. Walton & Clough, contractors for the coal conveyors for the electricity works, have been authorised by the Ministry of Munitions to treat this contract as war work, provided it does not interfere with the output of munitions. Accordingly, two of the conveyors may be delivered in July.

Electricity Committee. Accepted tender:—A coal breaker, £148, Jenkins & Co.

Watford.—The Electricity Committee recommends the D.C. to enter into an agreement with Messrs. E. Foster & Co. for the supply of 45 tons a week of Kingsbury slack coal at 20s. 2d. per ton for a period of 12 months. The Committee also recommends the acceptance of the offer of the Tudor Accumulator Co. to renew their contract for a period of 10 years on the same terms as before.

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FORTHCOMING EVENTS.

Tramways and Light Railways Association.—To-day (Friday). At 2.30 p.m. See "Notes" to-day.

Physical Society of London.—To-day (Friday). At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Ordinary meeting.

NOTES.

Electric Vehicle Committee.—A meeting of the Electric Vehicle Committee was held in London on June 16th, Mr. A. C. Cramb presiding, in the absence of Mr. R. A. Chattock. It was announced that for the present year the following had been nominated by their respective Associations to act as their representatives on the Committee:—

The Society of Motor Manufacturers and Traders.—Mr. T. C. Pullinger, of Arrol-Johnston, Ltd., Heathhall, Dumfries.

The Tramway and Light Railways Association.—Mr. W. T. Robson, general manager, Corporation Tramways, Southampton.

The Incorporated Association of Electric Power Companies.—Mr. J. S. Highfield, chief engineer, Metropolitan Electric Supply Co.

A Sub-Committee consisting of Mr. E. S. Shrapnell-Smith, Mr. E. W. Curtis, and the hon. secretary was appointed to draft a letter to the Board of Trade, with a view to getting electrical commercial vehicles excluded from any declaration that might be made prohibiting the import of foreign-made commercial motor vehicles.

The Committee's attention had been drawn to the fact that industrial electric trucks imported into the country were not being provided with the standard charging plug. The Committee was unanimously of the opinion that these trucks ought to be provided with the standard fitting, and the secretary was instructed to write to the manufacturers to this effect.

The date of the next meeting was fixed for Friday, July 28th, at 2.45 p.m.

Allied Labour Conference.—An important conference of Allied Labour Federations will take place at Leeds on July 5th and 6th to consider a lengthy programme on general Labour subjects affecting trade unions in the Allied countries. Representatives of the General French Confederation of Labour, and the Italian, Russian, and Portuguese confederations, will attend as the guests of the British General Federation of Trade Unions, whose annual conference will be held during the same week. Among the subjects to be discussed are:—An international eight-hour day, a general Saturday half-holiday, the Sunday cessation of labour, the industrial protection of women and labour, and an international approximation of laws relating to Labour. There will also be considered the question of stopping immigration from enemy countries, and the appointment of a Government Committee representing all sections of industry and Government departments.—*Daily Telegraph.*

Institution and Lecture Notes.—Diesel Engine Users' Association.—The June meeting of the Diesel Engine Users' Association was held at the Institution of Electrical Engineers last week.

Mr. A. J. C. De Renzi (Newcastle-under-Lyme) made a suggestion that the Association should hold one meeting in each year in an important centre outside London.

A motion by Mr. H. Leslie Dixon (Leatherhead), seconded by Mr. C. O. Milton (Maidenhead), that the Association should support the application of the Suffolk Electricity Supply Co., Ltd., to the Board of Trade for the voiding or suspension during the war of the German patent in regard to "Improvements in Internal-combustion Engines" to enable tar oils to be used as fuel, was discussed, and carried unanimously.

A paper was read by Mr. Geoffrey Porter (president) on "Oil Engines and Steam Engines in Combination," in which he discussed the problems met with in extending a comparatively inefficient steam-driven generating station of about 1,500 kw. capacity, of which there are large numbers in various parts of the country. He dealt with the subject from the point of view of capital costs and working costs, and produced tables showing comparisons of actual results obtained by the introduction of Diesel engine plant at various works. All the examples of generating stations in which Diesel engine plant had been put down as an extension to the steam plant showed a remarkable diminution in working costs. An important advantage of the Diesel engine over steam plant was that any irregularity or inefficiency in working became obvious at once, and could receive prompt attention, and the author was convinced that a Diesel-engine plant could much more readily be kept in good economical working condition than the average steam plant. The question of fuel oil supplies was one of the greatest importance, and the present war had opened their eyes to the manner in which this country had become dependent on others for absolute necessities. The fuel oil question could be, and would be, solved by their own chemists and engineers. Continental users and manufacturers of Diesel engines had used tars and tar-oils with success for many years, and they should do so too. In working their coal deposits they were living on their capital; the greater the reason, therefore, to use it to the best advantage.

The next meeting of the Association will be held on Wednesday, July 12th.

The Tramway Congress in London.—To-day the eighth annual Congress of the Tramways and Light Railways Association is being held in the Westminster Palace Hotel (Room 1). The annual general meeting takes place at 2.30 p.m. At 3 o'clock, Mr. W. Tuke Robson (general manager, Southampton Corporation tramways) will read a paper on "Tramway Transit and Comfort: a Plea for the Passenger." After this has been discussed, there will, at 4 o'clock, be a visit by motor-'bus to the L.G.O. training school at Milman Street, Chelsea, where members will be received by Mr. H. E. Blain, operating manager of the L.G.O. and the Underground Railways. The class rooms, &c., will be inspected, and in the kinematograph hall special films will be exhibited showing London traffic schemes, with special reference to rules of the road for tramcars, 'buses, and other traffic, methods of training, &c. After tea Mr. Blain will give a short address on "The Safety Movement"; and in the evening the members' dinner will be held at the Trocadero Restaurant, at 7.30 for 7.45. Evening dress is optional.

Volunteer Notes.—1st London Engineer Volunteers.—Orders for the week by Lieut.-Col. C. B. Clay, V.D., Commanding.

Monday, July 3rd.—Technical for Platoon No. 9, 46, Regency Street, S.W.; Squad and Platoon Drill, Platoon No. 10; Signalling Class and Recruits.

Tuesday, July 4th.—Officers' Training Class, 6 to 7; Recruits, 7; lecture, 7.15, "Constitution and Duties of a Field Company," Company Commander Bentley.

Wednesday, July 5th.—Platoon Drill, No. 2 Platoon.

Thursday, July 6th.—Platoon Drill, No. 6 Platoon; Recruits, 5.45 to 7.45; Instructional Class, 5.45.

Friday, July 7th.—Technical for No. 10 Platoon, 46, Regency Street, S.W.; Squad and Platoon Drill, No. 9 Platoon.

Saturday, July 8th.—Instruction Class, 2.30, Company Commander Fleming.

Sunday, July 9th.—Entrenching duties: Parade, Victoria (S.E. and C. Railway Booking Office), 8.35 a.m.

Macleod Yearsley, *Adjutant.*

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, June 29th, 1916:—

Week-End Parades.—Saturday.—The Battalion will Parade at Wembley Park at 3 p.m., under the Commandant. The Examination, Officers' Instruction Class, which was postponed from last Saturday, will take place on this Parade.

A party, as strong as possible, is required for Entrenching work on Saturday, July 1st. This party will Parade at Liverpool Street Station (Low-Level entrance, G.E.R.), at 8.40 a.m., and return to London by the 5.20 p.m. train.

Sunday.—The Battalion will Parade at Liverpool Street Station (Low-Level entrance, G.E.R.), at 9.30 a.m., and proceed by train for Entrenching duties, returning to town about 6 p.m.

Public Regimental Recruiting Meeting at the Guildhall on Friday, 30th inst., at 12.30 p.m., presided over by the Lord Mayor.

Musketry.—Competitors for the "Holland Cup" who have sent in their names to shoot at Bisley on Sunday, July 2nd, will report in uniform to Sergeant J. W. S. Burmester, at 9.45 a.m., at No. 8 Platform, Waterloo Station.

All members who took part in the competition for the Cup presented by Brigadier-General the Hon. F. C. Bridgeman are requested to attend Saturday's Parade at Wembley Park.

G. H. F. Duncan, *Acting Adjutant*, O.B.C.

Professional Classes and the War.—A meeting was held at the Mansion House last week in furtherance of the objects of the Professional Classes War Relief Council, the Lord Mayor presiding. Cardinal Bourne placed under three heads the professional people who required temporary assistance: (1) Those dependent for their livelihood upon fixed salaries despite rising prices: (2) those who were not dependent upon fixed incomes, but were becoming increasingly prosperous before the war, and (3) those whose whole means of subsistence had been practically brought to an end owing to the war. Mr. Marshall Hall, K.C., M.P., was of opinion that among the classes concerned collective assistance was far preferable to individual aid. Dr. (Mrs.) Scharlieb dealt with the work of the Maternity Committee, and Sir William McClure explained the educational and musical work. Lord Justice Phillimore pointed out that the professional classes had done much for the country by enlistment and other national service, and were the greatest sufferers from the war. The Council had already relieved 7,000 cases, and most of the money had been subscribed by professional people less severely affected by the present economic conditions. A donation of £100 from Lord Loreburn was announced.—*Morning Post.*

Engineer Examiners.—It is announced by the Secretary of the War Office that 250 examiners of engineers' work are urgently required for service at home. The rates of pay are 50s. to 60s. weekly, plus allowance of 21s. weekly up to three months at one station; also a special war increase of 4s. a week, and overtime at common-time rates after 48 hours per week. Applications should be addressed, "Room 268, A. G. 2 B, War Office," enclosing credentials.

Appointments Vacant.—Junior engineers-in-charge, for the Newport electricity department (45s.); assistant, with experience of suction gas plant and overhead wiring, for the Holmfirth U.D.C. electricity works; chief assistant engineer and manager of the electricity undertaking (£160), for the Leek U.D.C. For particulars, see our advertisement pages to-day.

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London P.O. Engineering Department.—On Thursday last week the Postmaster-General opened new offices which have been erected in Denman Street, London Bridge, to accommodate the headquarter staff of the Post Office Engineering Department, London District, which numbers 350 members. At a meeting that was held on the premises, Mr. A. Moir, superintending engineer of the district, presided. Sir W. Slingo, engineer-in-chief, welcomed Mr. Pease and the secretary, Mr. G. E. P. Murray, and stated that the total expenditure of the department last year reached over 6½ millions sterling. The architect, Mr. E. Cropper, said the site covered 8,000 sq. ft., and the building consisted of seven floors, with a total area of 45,000 sq. ft. It was designed by his predecessor, Mr. Rutherford, and cost £26,000. The Postmaster-General said that the staff had been depleted by the war, and consisted of 160 men and 40 women; the old building now provided for three district engineers and assistants. The number of women employed on the engineering staff in the Metropolitan district had risen from 13 before the war to 141. The total number of all ranks in the district in July, 1914, was 5,541, of whom 2,132 voluntarily joined the Colours, 25 obtaining commissions; 58 had fallen in the war, and 68 had been invalided home. Seven had received the D.C.M. Since taking over the National Telephone Co.'s system the department had opened four large new exchanges and five smaller ones, and arranged for 19 others; 14,000 miles of O.H. wire had been removed, and 36,000 subscribers had been added. The staff now maintained 53 telephone exchanges and 12,000 private branch exchanges, and 251,142 telephones—one-third of the whole telephone service of the United Kingdom. Over 300 million calls originated in the area last year. There were in London over 600 telegraph offices, and the Central Telegraph Office dealt with one-third of the 91 million messages that were dispatched per annum. The total length of cables in the district was 70,849 miles, and the single-wire mileage was 1,037,790 miles. The cost of new construction and maintenance was over a million a year. The number of complaints received from the public had diminished from 1·25 per diem per 1,000 direct lines to 0·5. About 7,000 additional telephones had been installed for the War Office during the year, and 1,500 for the Ministry of Munitions. The work of the Post Office engineers had been accorded the highest praise during the war.

The secretary expressed appreciation of the work of the staff, and Mr. Moir replied, pointing out the advantages of the concentration of the staff, and presented Mr. Pease with a key with which he proceeded to open the new building.

Accident.—Whilst James Lancaster, an electrician, of Shipley, was engaged last week in filing a nut at the rear of a switchboard on the electrical equipment at Briar Field Mills, Shipley, the file came into contact with a live wire, which fused. Lancaster's clothes caught fire, and he was severely burnt about the face and hands, and suffered from shock. After first aid had been rendered he was taken to hospital and detained there.

Foreign Languages.—The Senate of the University of London has elected a Professor of the Spanish language.

Sir James Roberts, Bart., has offered £10,000 to the Leeds University for the establishment of a Professorship of Russian language and literature, and the offer has been accepted.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with th technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—Having been offered, and accepted, another appointment, Mr. W. H. ALLEN has resigned the post of engineer and manager of the Loughborough Corporation electricity department, which he has held since the inception of the undertaking, some 12 years ago.

A Yorkshire paper states that Mr. A. B. MOUNTAIN, the borough electrical engineer of Huddersfield, has resigned his position, and, on the recommendation of the Electricity Committee, the Huddersfield Town Council has decided that the following arrangements shall come into operation on September 1st:—Mr. Mountain to be consulting engineer, up to December 31st, 1919, at £300 per annum and expenses; Mr. J. W. Turner to be borough electrical engineer at £400 per annum (his present salary is £250); Mr. E. Lunn, station superintendent, to have his salary increased from £240 to £265; Mr. J. A. Swift, commercial assistant, to have his salary increased from £200 to £225; and Mr. Phillips to be appointed mains foreman at £182 per annum.

Nuneaton T.C. has granted a war bonus of £40 a year to the acting electrical engineer during the absence of the electrical engineer on military service.

Huddersfield T.C. has advanced the salary of its tramway manager, Mr. R. H. WILKINSON, from £400 to £500 per annum.

Mr. C. L. E. STEWART, borough electrical engineer of Rawtenstall, is laid up, but it was stated at the Council meeting last week that he was much better.

On the occasion of his marriage, Mr. JOHN DOWNIE, chief clerk of the Aberdeen Corporation electricity works, was last week met by the staff and employés and presented with a barometer and clock. Mr. Bell made the presentation, and Mr. Downie suitably replied.

General.—In May, Prof. J. H. DOBSON, general manager of the gas, electric supply and tramways department of the Johannesburg Municipality, left on active service with the Forces for the German East African campaign. He has been appointed officer commanding, South African Pioneer Battalion, with the rank of major.

At Blackpool, on June 21st, the marriage took place of Mr. WM. H. MILLER, A.M.I.E.E., of Belfast and Fleetwood, and Mrs. F. Browne, widow of Mr. Frank Browne, of St. Helens and Liverpool.

The marriage took place at Wellington, New Zealand, on June 10th, of Mr. WILSON ORMROD, A.M.I.E.E., and Miss E. B. Bean, only daughter of Capt. Fredk. T. Bean, of the Bedfordshire Regiment, of Clapham Common, S.W.

The *Times* states that "an engagement is announced between Mr. GEORGE VERITY, J.P., hon. colonel, R.E. (T.), of 7, Basil Street, S.W., and Mrs. Charles Hamilton Walter, of 35, Hyde Park Gate, S.W." Mr. Verity is, of course, the chairman of the well-known firm of Veritys, Ltd.

Mr. J. J. LIGHTFOOT (secretarial department), County of London Electric Supply Co., has been gazetted as second-lieutenant, Royal Engineers (T.), Wireless Section.

Mr. H. G. PRICE has resigned his position as secretary of the Nottingham Society of Engineers, and a successor is being advertised for at £25 per annum.

Roll of Honour.—Amongst those mentioned in dispatches for gallant and distinguished conduct in the field is the late Private W. R. JENKINSON, of the 13th Cheshire Regiment, who, before the war, was an electrician at Port Sunlight, Birkenhead. He fell in action last January.

Private WALTER ASHCROFT, of the Loyal North Lancashire Regiment, formerly employed at the Bolton electricity works, has been killed while on sentry duty.

Sergeant S. LEVEY, of the Rifle Brigade, formerly employed by Messrs. Hans Renolds, Ltd., Manchester, has been killed in action, aged 25.

Private J. A. WARREN, of the King's (Liverpool) Regiment, formerly employed at the Chloride Electrical Storage Co., Clifton, has died from wounds, aged 29.

Lance-Corporal E. W. ICKE, of the Manchester Regiment, formerly employed at the British Westinghouse Works, Trafford Park, has been wounded by a rifle grenade.

Private J. BOND, of the Royal Canadian Highlanders, who has died of wounds, was formerly employed as an electrician by the Lancashire & Yorkshire Railway Co.

Private T. BULLOCK, of the Highland Light Infantry, formerly with Messrs. Taylor, Tunnicliffe & Co., electrical china manufacturers, of Eastwood, Hanley, has been killed in action.

Private J. MILLINGTON, formerly on the staff of the Potteries Electric Traction Co., has been killed in action. He served through the South African war.

Seaman ROBERT CHANT, of *H.M.S. Invincible*, who lost his life in the North Sea fight, had been in the employ of the Lancashire Dynamo Co., Trafford Park.

Corporal ARTHUR DAVY, of Urmston, previously reported missing at Gallipoli, and now officially reported killed, was 25 years of age, and, prior to the war, was assistant secretary to the general manager of the British Westinghouse Works, at Trafford Park.

HIRAM HART, an electrical fitter, formerly in the employ of Bolton Electricity Committee, has been killed on active service.

HAROLD WILLSHER, wireless telegraphist on the *Tipperary*, who was presumed lost in the North Sea battle, is a prisoner in Germany.

Second-Lieutenant WALTER J. CRIDGE, of the 15th Sherwood Foresters, was wounded in the face recently in France, and he is now at the 4th Northern General Hospital, Lincoln, where he is going on well.

Sergeant-Major O. LAING, 21st County of London Regiment, 1st Surrey Rifles, has been awarded the Military Cross for an act of great gallantry in saving a wounded comrade. Sergeant-Major Laing was on the staff of Messrs. M. Bateman and Co., of Brooke Street, Holborn, and was known to many houses in the lighting industry.

The following casualties among men of the County of London Electric Supply Co., Ltd., with the Forces are reported:—Private H. BEAZLEY, 9th Battalion (Buffs) East Kent Regiment, killed in action; Lance-Corporal E. CAPON, 5th Royal Berkshire Regiment, wounded, March 11th; Chief Petty Officer A. GARDEN, Royal Navy, died of injuries (North Sea); Private T. HYAM, 9th Battalion (Buffs) East Kent Regiment, killed in action; Private R. REEVES, 9th Battalion (Buffs) East Kent Regiment, killed in action.

Private H. F. GILL, Royal Engineers, Wireless Section, secretarial department, County of London Electric Supply Co., has been awarded the Military Medal for services in the field.

Obituary.—MR. W. TODHUNTER.—Mr. W. Todhunter, a member of the electrical staff of the Telegraph Construction and Maintenance Co., Ltd., who, as stated in our last issue, passed away on June 19th at the comparatively early age of 59, was born at Emsworth, Hants. He was educated at Blackheath, and, like most of the Todhunters, showed an

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aptitude for mathematics. He joined the company's service on board the *Great Eastern* in 1873, and remained with them up to the time of his death. His first submarine cable expedition was in 1874, when he assisted in the laying of the Anglo-American cables. He has also been principal assistant on cable expeditions to all parts of the world until 1907, when he took charge of the electrical department in repairing and renewing the Eastern Telegraph Co.'s Bombay-Aden, Durban-Mozambique cables and numerous repair expeditions for various telegraph companies. His last expedition was laying the duplicate New York-Guantanamo-Colon cables for the Central & South American Telegraph Co. With his experience of over 43 years, his death is a severe loss to the electrical department of the company. He was much admired as a genial companion, and respected by all whom he met in the course of his career. He has been a member of the Telegraph Cable Masonic Lodge since 1903. The funeral took place on Saturday last at Shooter's Hill Cemetery.

Mr. W. J. Cockram.—The death has taken place, from pneumonia, of Mr. Wm. James Cockram, electrical engineer, of Barnstaple, aged 53 years. Deceased was for some years in business in the town.

Miss Isabella Faraday.—The *Times* records that Miss Isabella Faraday, a descendant of Michael Faraday, has died at Kirkby Stephen. Miss Faraday founded the Michael Faraday Homes near Warlingham, Surrey, where over 100 old people are housed.

Mr. Mark Brown.—The funeral took place at Blackpool Cemetery, on June 21st, of Mr. Mark Brown, foreman arc lamp trimmer at Blackpool Corporation electricity works, where he had been employed for 22 years. Mr. Chas. Furness, electrical engineer, and a number of fellow workmen attended.

Mr. William Hanning.—According to the daily Press, Mr. William Hanning, a former president of the British Chamber of Commerce in Paris, who was well known in engineering circles both in England and in France, died in Paris on Sunday.

CITY NOTES.

Marconi's Wireless Telegraph Co., Ltd.

The report for the year ended December, 1915, states that there was a gross profit of £581,125 for the year, and that the net profit was £377,818, which is better by £145,101 than for 1914. Including £69,497 brought forward, the amount is £447,315. There is still no agreement with the Government as to the basis of remuneration and compensation for the use of the company's high-power stations since the beginning of the war and for other services rendered in connection therewith. It has, therefore, again been impossible to include in the accounts any sum in respect of these matters. A large number of contracts have, however, been entered into with Government departments, for all of which payments have been regularly received. It is stated that sums are payable by the Government to the company under the following four heads:—

1. The Post Office, for remuneration and compensation in respect of the use of the company's high-power stations since the beginning of the war, the staffing and management of those stations, and other services in connection therewith. (It is hoped that a substantial payment on account may be received shortly.)
2. The Admiralty, for the use of the company's patents since the expiration, on March 31st, 1914, of the Admiralty agreement of 1903, no new agreement having yet been concluded. (There have been difficulties in arriving at a settlement of this matter and delay has been unavoidable. We have, therefore, received an assurance that every dispatch will be given to deal with the matter as quickly as possible.)
3. The War Office, in respect of the use of the company's patents, without agreement, during the whole time wireless telegraphy has been used by the War Office. (This matter is about to be referred to the Treasury for settlement under the Patents and Designs Act, 1907.)
4. The Post Office, for compensation in respect of their withdrawal from the contract for the Imperial chain of stations, with regard to which no agreement has been arrived at, and the company has therefore been obliged to leave the amount of compensation to which it is entitled to be settled by a court of law.

Shares in associated companies and patents are taken at their cost price, viz., £1,383,658, which shows an increase of £22,532. The company's holdings in associated companies, except for some additions, have undergone no change during the past year. The par value of the shares held in associated companies now stands at £2,484,370, exclusive of shares which have no capital denomination. After crediting £100,000 allocated from profit and loss account of the preceding year, the general reserve account now stands at £967,530.

The Marconi International Marine Communication Co. has continued to show substantial development of its business and a further increase in profits. Dividends for the past year amounting to 12½ per cent. have been declared, and £33,842 has been carried forward.

The Russian company, Société Russe de Télégraphes et Téléphones sans Fil, has continued to do a large business. A dividend at the rate of 15 per cent. for the year 1915 has been declared.

The French company, La Compagnie Française Maritime et Coloniale de Télégraphie sans Fil, has declared a dividend for the year 1915 at the rate of 10 per cent. on the ordinary shares and 31.25 francs on the founders' shares.

The Amalgamated Wireless (Australasia), Ltd., has paid a dividend of 6 per cent. for the year.

The Wireless Press, Ltd., has paid a dividend of 25 per cent. in respect of the year.

The Marconi Wireless Telegraph Co., of America, has again earned increased profits for the past year, but its principal revenue is expected to be derived from the trans-Atlantic service, which, in consequence of this company's stations being in Government service, has been obliged to remain idle. It is apprehended that the compensation to be received in respect of this company's Carnarvon stations will also embrace the loss incurred by the enforced idleness of the American stations.

Owing to the unfavourable rates of exchange, large sums of money have had to be placed on deposit with foreign banks, principally in allied countries, until such time as the exchanges become normal. Had these moneys been remitted on December 31st last there would have been a loss in exchange of £25,757. Temporary investments at the end of the year showed a depreciation of £27,606. It has, therefore, been deemed right to debit to profit and loss account both these sums, which amount to £53,363. There have since been substantial improvements, and it is contemplated that if held until hostilities cease the loss will be completely recovered. In the event of eventual realisation without loss, the amount so written off will appear as profit in another year. In view of the state of war, and having regard to the large sums of money abroad, and to the uncertainty as to when any of the moneys due to the company from the Government will be received, the directors deem it prudent to husband their resources, and recommend the declaration of a final dividend upon the ordinary shares at the rate of 5 per cent., which, together with the 5 per cent. interim dividend paid on February 1st, 1916, will make 10 per cent. for the year. They will, however, further recommend that a substantial bonus shall be declared and paid out of the moneys due from the Government as soon as they are received.

Annual meeting: To-day.

Aluminium Corporation, Ltd.

Mr. S. G. Bibby presided, on June 22nd, at the annual meeting. He said that the difficulties referred to at the last meeting were eventually successfully overcome, although the first six months of the year were better, as regarded output and profits, than the following half, due to the drought and shortness of their water supply. This was not likely to occur again now that they had been successful in tapping the Dulyn water. The boring of the tunnel was completed in April last, and they were now reaping the benefit of the Dulyn water, and already it was making all the difference as regards output, this having increased by approximately 30 per cent. during the five months of the current year as compared with the same period of 1915. The more water they could control the greater the output; the Dulyn tunnel had amply justified its construction. As the shareholders only gave a meagre response to the offer of debentures, they had to arrange for temporary loans. Loans appeared at £28,000 in the accounts, but they had been reduced since the close of the year to £15,000. Loans to subsidiary companies had increased by £6,442, these advances being made to enable the subsidiary companies to increase their output, so as to cope with this company's increased consumption. An Act of Parliament would be applied for shortly for simplifying the capital account. Having regard to their present position and prospects, they recommended that a start be made to reduce the accumulating preference stock dividend by paying 7 per cent., less income-tax. Their faith in the company has justified itself, and during the past year it had proved itself to be a national asset. Conditions were extremely abnormal in consequence of the demand for aluminium. That need not worry them, however, as recent developments of new uses would have the effect of increasing the demand and consumption when they returned to normal peaceful times. The abnormal demand had created a much higher selling price than before the war, but the cost of production had very considerably increased. There had been serious difficulties as to their supplies of raw materials, labour, freights, &c., and all these had told heavily again them, and they were likely to be still further increased as long as the war lasted. The Treasury had approved of their increasing the debenture issue, and they were now negotiating for the placing of a further £100,000 6 per cent. debentures to rank *pari passu* with the existing issue. This would give the funds for proceeding with the erection of the Cowlyd and Trasbwll dams, which were essential to increased output, and would treble the water storage. An additional pipe line was absolutely necessary, and would be proceeded with as soon as practicable. Arrangements had been made for the installation of a new generator, and work had been commenced upon a bridge over the River Conway, enabling them to bring the L. & N.W.R. direct into the works. They were doing their best towards placing the company upon a sound and substantial dividend-earning basis, and the present year promised to be one of considerable progress.

James Keith & Blackman Co., Ltd.

Mr. T. W. Alsop, presiding at the annual meeting recently, said that the balance sheet was not an unsatisfactory one. The business done was a record, 18 per cent. more than in 1915, notwithstanding the decrease in lighting, which was an important part of their business. The dividend was 10 per cent. free of income-tax—practically 12 per cent., and they were wiping goodwill and patents out altogether. They were increasing the reserve to £40,000. In the carry-forward of £12,056 they had provided for excess profits tax. Orders were being maintained; the works were now ready for anything of a profitable nature which might come along; and they looked forward with hope

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and confidence to a steady, successful, and secure future. Mr. James Keith, the managing director, who followed, said that while the lighting department of the business diminished at home, owing to the Government restrictions, the turnover had largely increased in other directions. They began the current year well. They had had to get a lot of new and special machinery for urgent Government requirements, but they had been careful only to obtain such machinery as would be necessary for their regular and special work long after the war would be over. Their present principal trouble was in getting and retaining skilled workmen. All in the Empire must now and henceforth so organise as to effectively bar business relations with, and unfair competition from, the Huns and their relations.

Lancashire Power Construction Co., Ltd.

Dr. H. F. Parshall, presiding at the annual meeting on June 22nd, said that the progress of the Lancashire Electric Power Co., in which they held all the shares and debentures, had been very satisfactory, with a substantial increase in the profit on trading. As to the first five months of the present year, the results were appreciably better than those for 1915, and if progress was maintained during the whole of 1916 the trading profit would be substantially better. From an engineering point of view, the progress had been comparatively uneventful. No addition had been made to the power plant, which had worked economically and well throughout the year. With regard to mains, they had extended them, and the system generally had been reinforced and consolidated, and therefore there was no large capital expenditure for them to face in order to keep up a sufficient supply. The outlook for future business was good, and on terms more consistent with the advantages given by the company and than those which had so far been obtained. It was not necessary for him to mention specific contracts, but there were several of importance. The units sold during the year showed a substantial increase over those sold in 1914, as did also the revenue. The growth of business with local orders showed an increase, but not as great as might have been anticipated, owing to the restricted lighting regulations. Still, the increase showed that their investment in those local orders would ultimately be a profitable one. The cost for fuel per unit sold was greater than in 1914, the increase being due to the higher price of fuel, but the total operating costs had been reduced, although there had been an increase in the rates. While on the subject of generation, he desired to point out that the Government appeared to be favourable now to a central supply system. In the past they had certainly not been given much consideration in that connection, and local authorities which could not generate as cheaply as the company had been allowed to go on with generating systems when, in the interests of the public or of economy, they should have come to the company for a supply. They had most pleasing and satisfactory relations with some of their larger neighbours, but some of their smaller neighbours had been very anxious to go on with their own undertakings, even at a loss. It was satisfactory to know that the principle of centralisation, after all these years, was now being recognised in a practical way by the Government, for he thought it could be said without fear of dispute that generation in England was more wastefully carried on than in any country in the world; that was to say, the relative cost of fuel per unit generated was vastly greater than in any other country. That was due to the fact that almost every local authority had been allowed to set up its own undertaking. In London half a million tons of coal were wasted yearly. If the principle of centralisation became generally adopted, their Lancashire undertaking would become a very important one, because they were in the centre of the district, with every facility for extension and generating on the most economical lines—and they could attain to very much lower generating figures than smaller undertakings less favourably situated. Owing to the handicap of not being, he feared, as favoured as the local authorities, they had had to feel their way, going on with small generating units, and, as a result, their fuel economy had not been as low as it might have been if they could have gone ahead at full speed from the beginning. Their fuel consumption, however, was lower, considering the class of fuel they were using, than of most other similar undertakings in the kingdom. Although they might have been in a better position had they been allowed to go ahead with bigger units, yet, as they stood to-day, they were very favourably situated to give a proper supply if they became the nucleus for giving a general supply in their district. They were proposing to extend their power station by the addition of another large generating unit to meet the general growth of their business and to give a safe margin for the continuity of the supply. The expenditure had been approved by the Government authorities, who had also approved the ordering of this machinery, and they were able to carry out the extension without asking for any new capital. When this unit was in working order they might expect an improvement in their cost of generation—at least, in their coal consumption; and they could also safely say that on the present basis of working, this unit would take them up to the point where they would be earning their fixed charges something like three times over. They had a considerable issue of profit-sharing notes. He thought that a dividend on them would be forthcoming when the new unit was fully employed, because they could then pay a fair dividend and, at the same time, have a sufficient margin over for carrying on the business. Having regard to the present general financial situation, he thought they must provide for necessary extensions out of earnings.

Globe Telegraph & Trust Co., Ltd.

The net revenue for the year ended May, 1916, after deduction of expenses, amounted to £226,086, plus £27,655 brought forward. £122,932 has been distributed in interim dividends, leaving £130,808. A final dividend of 3s. per share, less income-tax, on the preference shares makes 6 per cent. for the year; 8s. per share is to be paid, free of income-tax, on the ordinary shares, making 7 per cent., free of tax, for the year. The balance to carry forward will be £36,849. It is proposed that the directors' fees shall be paid free of income-tax. Annual meeting: July 4th.

Waygood-Otis, Ltd.

Mr. H. C. Walker, presiding at the annual meeting, said that one part of their works was occupied for the Government, to the detriment of operations in the other part. They had met with loss on a number of contracts, some of large amounts, which were placed at pre-war prices, but which, owing to the delay in building work generally, were hung up, or had had to be completed at the advanced costs of labour and material due to the war. They were obliged to carry out their undertakings though involving considerable loss. The speaker said that he did not regard the present state of affairs with any apprehension. When they were able to resume normal business they would be able to do it with conspicuous success, and he hoped that they would soon be able to pay the arrears in the preference dividend.

Hart Accumulator Co., Ltd.

The report for 1915, presented at the annual meeting held at Stratford on June 22nd, stated that the profit was £10,331, plus £11,394 brought forward. The dividend on the preference shares requires £423, and a dividend of 5 per cent., free of income-tax, on the ordinary shares absorbs £4,353, leaving £16,949 to be carried forward. Buildings, plant, tools, &c., have been augmented by £1,285, which has been charged to capital, and due depreciation on same has been made. The maintenance of the works, plant, &c., has been kept up at a cost of £1,697, which has been paid for out of revenue.

Anglo-Argentine Tramways Co., Ltd.—With reference to our paragraph of last year, the circular issued to the second preference shareholders reads:—"The directors regret that owing to increased expenditure, due to the abnormally high cost of fuel, it would be inexpedient at present to declare an interim dividend on the 5½ per cent. cumulative second preference shares for the half-year ending June 30th. The board entertains no doubt that when normal conditions again prevail regular payment of dividends on these shares will be resumed and arrears paid."

J. Stone & Co., Ltd.—The report for the year ended December 31st shows a profit, after full allowance for depreciation and provision for special Government taxes, &c., of £133,157, plus the balance brought forward of £189,039, making a total of £322,197. The directors recommend a dividend of 10 per cent. per annum and a bonus of 3s. per share on the ordinary shares, leaving £207,147 to be carried forward. —*Financial Times.*

Consolidated Electrical Co., Ltd.—A dividend of 2½ per cent. on the ordinary shares for the year is announced. The income for the year ended March, 1916, was £5,437, as compared with £5,344 for the previous year. The general charges were £1,215, compared with £1,191. The directors record the death of Mr. T. Taunton, who had been secretary from the company's formation.

Shawinigan Water & Power Co.—There is to be offered to shareholders $1,361,250 of new stock, the Treasury having given permission.

Stock Exchange Notice.—The following have been ordered to be quoted in the Official List:—

Barcelona Traction, Light & Power Co., Ltd.—£436,700 7 per cent. 50-year prion lien "A" bonds, Nos. 1 to 4,367, of £100 each, in lieu of the scrip.

STOCKS AND SHARES.

Tuesday Evening.

Investment markets in the Stock Exchange have come to something of a halt in the matter of business. This is partly due to the difficulty that there is in obtaining stock, and also to the inclination on the part of investors to await further developments from the various war theatres. Everyone has heard some of the highly interesting rumours which have been current in the City during the past few days, but of the truth of these no confirmation has been received. Expectation, however, stands on tip-toe; and, meanwhile, Stock

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Exchange interests must be content to look after themselves to a large extent. The price of Consols shows a tendency to rise once more; and the industrial market of the Stock Exchange attracts more interest than any other part. A gratifying feature is a respectable series of advances in price amongst electricity supply shares.

More than half the shares in our list of electricity companies show rises, the improvements ranging from 1s. 3d. to 5s. From this, it might have been supposed that there was an active business being done in them. In point of fact, however, the number of shares changing hands is very small. Proprietors decline to sell, and, at the same time, there is a steady demand from investors who have noticed that this is one of the few sections which has hitherto failed to respond to the investment movement. Jobbers complain that there are no shares about, and that they have only buyers.

We reminded holders of the convertible debenture stock of the Consolidated Gas, Electric Light & Power, of Baltimore, last week that they should observe that the time for converting their debenture stock into common shares expires to-morrow (July 1st). Since then, the price of the stock has risen from 90 to 95, while the shares spurted from 110 to 120, there having been some little reaction from these prices. The shares, it need scarcely be said, are of the semi-speculative order, while the debenture stock is a first-class security of its kind, so that its holders may feel that they would prefer to retain this rather than exchange into shares of a more volatile description.

The price of the debenture stock has been run up on the conversion rights, and, when these expire, probably the price of the debenture will gracefully decline. Therefore the holders of the debenture stock, though they should feel disinclined to convert into common shares of the company, may be advised, even at this eleventh hour, to realise their stock, with a view to re-investing the money in something of the still more gilt-edged variety, which also stands a good chance of improving in price.

The Shawinigan new issue is now out, and the Treasury has given consent for holders on this side to subscribe for their proportion, which is one new share for every 10 now held, to be paid for at 115. A distinct novelty is introduced into this issue by the company's giving option certificates whereby those holders who do not wish to take up their shares now, may defer doing so until next April, when they will have to pay 120 if they elect to take up the shares at that time. Last year's dividend was 6½ per cent., and the company is doing well. These American utility companies, by the way, are considerably to the fore at the present time, a jump of about 75 points within less than a fortnight in Cities Services shares having attracted mild interest and attention to the group as a whole.

Brazilian Tractions are a disappointing market, the price having given way 1½ points to 61½, notwithstanding the fact that the Rio exchange is well maintained in the neighbourhood of 1s. 0½d. Other Brazilian stocks are mostly firm, so that the decline in Tractions is taken to suggest that there may be something of a tap on hand, and that until it is turned off the price of the shares will remain depressed.

The Mexican group is weak. Few suppose that there will be open war between the States and Mexico, but events are moving rather rapidly now, and the situation is obviously very strained. The revolutionaries—or whatever Carranza and his friends style themselves—appear to be respecting private property, as, indeed, they have done hitherto. But it is quite comprehensible that holders of Mexican securities should feel anything but happy at the unexpected and uncomfortable turn which affairs have taken.

Anglo-Argentine Trams keep steady, despite the directors' decision to postpone payment of the interim dividend on the second preference shares. This is rendered advisable by reason of the increased expenditure due to the abnormal cost of fuel.

The Marconi report came out at the end of last week. The directors have decided to repeat last year's dividend payment of 10 per cent., but they hold out hopes of a substantial bonus at the end of the year. The immediate effect was a fall in the price of the shares to 2⅜. Profit-takers hurried in to scalp their gains while they could. Directly this bout of selling was over, a sharp rally occurred, the price being taken up to 2¾, so that on the week there is a net improvement of 3s. 9d. The other shares of the Marconi group are also higher, with the exception of Marines, which, after touching £2, eased off to 37s. 6d.

The Home Railway market has fallen upon quiet days, though to-day's rise in Consols helped prices considerably. Metropolitans fell ¾, Underground income shares ⅛, and others in this division were similarly dull. Central London stocks are still wanted, and the prices well maintained, the assented ordinary again exhibiting an improvement.

This remark applies also to the prior-charge issues of the various lines, steam and electric both. The best-class debentures have been forced up to a level at which the return is barely 4¼ per cent. on the money, or ¼ per cent. less than the Government is now offering on Exchequer Bonds. The inference obviously is that there are people looking for such a drop in the value of money after the war as shall justify them in taking a lower rate nowadays upon an irredeemable security, than they can get from a Government bond terminable within a few years. As to which, of course, he who lives longest will see most—or his children will.

Babcock & Wilcox have risen 5s. to 3. Castner-Kellners are ¼ higher, following upon their rise of 3/16 last week, at 3¼. British Aluminium lost sixpence, but British Westinghouse preference are 1s. 6d. better, while other things in the manufacturing list are decidedly hard in tone. India-Rubber shares are 15s. up, and Electric Constructions are 9d. to the good. General Electric preference hardened to 9¾.

The Telegraph market pursues the even tenour of its rising way. There was a slight reaction towards the end of last week, but what little stock came to market was avidly snapped up, and every change which we record is again in the upward direction. Eastern ordinary has gained 3 points, and Eastern Extensions at 14¾ are 7s. 6d. higher. Globe ordinary and preference have moved with the rest of the market; and were it not for the difficulty of supplying the requirements of the buyers, there would be a free and good market in the whole list.

This week dealings have started in the new stocks of the British Electric Traction Co. The common is quoted at 37-39, and the 6 per cent. preference stock at 79-80. The latter looks quite a fair stock of its kind, and the yield at the present price comes to 7½ per cent. on the money, so that there would appear to be scope for appreciation. The debenture stocks, of course, remain the same as before, and the quotation for the Firsts is 81, while that for the Seconds is about 10 points lower.

The rubber share market is slightly better than it has been lately. For this the issue of another batch of excellent reports and good dividends is responsible, because the price of the raw material continues to afford little stimulus to purchases. Further weakness has occurred in copper shares in consequence of the dulness in the metal; but the armament group is sympathetically strong with most of the shares in the iron and steel market.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price June 27, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6¾	+ ½	£7 18 2
Charing Cross Ordinary	5	5	8⅛	—	7 2 10
do. do. do. 4½ Pref.	4½	4½	8½	—	6 18 6
Chelsea	5	4	8	—	6 18 4
City of London	9	8	12⅛	+ ⅛	6 12 8
do. do. 6 per cent. Pref.	6	6	10⅛	—	5 14 8
County of London	7	7	10¾	+ ¼	6 13 4
do. 6 per cent. Pref.	6	6	10⅛	—	5 15 8
Kensington Ordinary	9	7	5⅛	+ ⅛	6 16 7
London Electric	4	3	1 7/16	—	7 11 0
do. do. 6 per cent. Pref.	6	6	4¼	+ ¼	6 13 4
Metropolitan	3½	3	2⅜	—	6 6 4
do. 4½ per cent. Pref.	4½	4½	3⅛	+ ⅛	7 4 0
St. James' and Pall Mall	10	8	6	+ ⅛	6 13 4
South London	5	5	2¾	—	8 13 10
South Metropolitan Pref.	7	7	1⅛	+ 1/16	6 4 4
Westminster Ordinary	9	7	6⅛	+ ⅛	5 14 8
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	106	+2	5 13 2
do. Def.	80/-	83/6	28	—	7 10 9
Chile Telephone	8	8	6⅛	+ ⅛	6 8 1
Cuba Sub. Ord.	5	5	7⅛	—	6 13 4
Eastern Extension	7	8	14¾	+ ⅜	*5 8 4
Eastern Tel. Ord.	7	8	149	+3	*5 7 7
Globe Tel. and T. Ord.	6	7	12⅜	+ ⅛	*5 10 0
do. Pref.	6	6	10¾	+ ¼	5 11 7
Great Northern Tel.	22	22	37	—	5 19 0
Indo-European	13	13	49	—	6 13 8
Marconi	10	10	2⅜	+ 3/16	8 7 6
New York Tel. 4½	4½	4½	102⅜	—	4 7 10
Oriental Telephone Ord.	10	10	2	+ 1/16	5 0 0
United R. Plate Tel.	8	8	6¼ xd	+ ⅛	*6 3 1
West India and Pan.	1	N	20/-	—	9 6 1
Western Telegraph	7	8	15⅛	+ ⅛	*5 5 8
Home Rails.					
Central London, Ord. Assented	4	4	78	+1	5 9 7
Metropolitan	1¼	1	26¾	— ¾	8 14 9
do. District	Nil	Nil	19¼	— ¼	Nil
Underground Electric Ordinary	Nil	Nil	1 1/16	— ⅛	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	6	6	87⅛	+ ⅛	*6 17 0
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4¾	+ ⅛	6 8 1
Anglo-Arg. Trams, First Pref.	5⅛	5⅛	8 1/16	—	7 9 2
do. 2nd Pref.	5⅛	5⅛	8½	—	8 9 2
do. 5 Deb.	5	5	77⅛	— ½	6 9 0
Brazil Tractions	4	4	61⅛	— 1⅛	6 10 0
Bombay Electric Pref.	6	6	10⅜	—	5 15 8
British Columbia Elec. Rly. Pfce.	5	5	60	+ 1	8 6 8
do. do. Preferred	—	Nil	40	—	Nil
do. do. Deferred	—	Nil	39	—	Nil
do. do. Deb.	4½	4½	62	—	6 17 1
Mexico Trams 5 per cent. Bonds	—	Nil	40	—2	Nil
do. 6 per cent. Bonds	—	Nil	34	—1	Nil
Mexican Light Common	Nil	Nil	20	—	Nil
do. Pref.	Nil	Nil	32	—	Nil
do. 1st Bonds	Nil	Nil	41	—1	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	8	+ ½	8 0 0
British Aluminium Ord.	5	7	26/-	—6d.	5 7 8
British Insulated Ord.	15	17½	10½	—	7 2 10
British Westinghouse Pref.	7⅛	7⅛	48/-	+1/6	6 5 0
Callenders	15	20	12⅛	—	8 0 0
do. 5 Pref.	5	5	4⅜	—	5 17 8
Castner-Kellner	20	—	8¾	+ ¼	6 6 8
Edison & Swan, £8 paid	Nil	—	10/6	—	Nil
do. do. fully paid	Nil	—	1⅛	—	Nil
do. do. 5 per cent. Deb.	5	5	57	—	8 15 8
Electric Construction	6	7½	15/8	+9d.	9 16 8
Gen. Elec. Pref.	6	6	9¾	+ ⅛	6 3 1
Henley	20	25	15	—	8 6 8
do. ½ Pref.	4½	4½	4	—	5 11 6
India-Rubber	10	10	12½	+ ½	*8 3 4
Telegraph Con.	20	20	39	—	*6 4 6

* Dividends paid free of income-tax.

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EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING MAY, 1916.

In comparison with the returns for the preceding month, the May figures for electrical exports and imports show markedly increased values in nearly all sections of the table.

The exports reached the respectable total of £499,384, as compared with £353,266 in April; the imports were valued at £302,583, as against £256,099 in the previous month; while the re-exports were considerably in advance of the April figures.

The increased value of the exports was due principally to improved business in the machinery and cable sections, cable exports showing an increase of £57,000, and machinery £46,000: arc lamp parts and carbons were the only sections to show a reduction as compared with April.

The imports reached the highest recorded total this year, the machinery, cable, goods, and telephonic and telegraphic sections showing increased values.

The re-exports reached £20,889, as compared with £15,391 for the previous month.

India, New South Wales, Russia, and France were our best customers during the month, and to Victoria, Argentina, New Zealand, and Holland also we supplied considerable quantities of material.

The total value of electrical material received from the United States of America during the month showed an advance of £43,000 on the April figures.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	2,077	12,657	13	1,140	193	1,692	21,650	60	89	24	439	1,121	41,155
Netherlands, Java and Dutch Indies ...	1,079	10,822	1,727	...	...	155	1,331	...	1,076	54	8,105	1,197	25,546
Belgian Congo	...	...	...	...	...	...	...	...	27	...	369	4,590	4,986
France	3,983	2,744	778	160	55	142	14,221	10,355	871	492	18,458	9,020	61,279
Portugal	50	1,665	...	12	...	59	44	80	13	...	440	30	2,393
Spain, Canary Isles and Spanish N. Africa...	27	44	52	...	...	759	2,281	...	64	57	19	172	3,475
Switzerland, Italy and Austria-Hungary ...	242	286	506	...	...	530	3,729	...	...	25	79	3,905	9,302
Greece, Roumania, Turkey and Bulgaria ...	3	275	124	20	...	...	116	...	...	...	...	...	538
Channel Isles, Gibraltar, Malta and Cyprus...	112	230	97	175	...	13	25	53	13	25	30	10,504	11,277
U.S.A., Philippines and Cuba	692	19	193	...	...	864	197	229	20	...	...	298	2,512
Canada and Newfoundland	637	...	40	510	...	172	1,666	55	180	...	...	66	3,326
British West Indies and British Guiana ...	249	...	23	139	38	...	12	14	34	...	...	18	527
Mexico and Central America	29	207	...	...	...	320	183	...	...	...	100	10	849
Peru and Uruguay	249	195	...	...	...	173	214	...	124	...	78	4	1,037
Chile	466	219	62	...	58	10	1,368	239	237	11	105	285	3,060
Brazil	131	540	40	132	...	...	2,103	247	28	125	...	47	3,393
Argentina	2,752	10,836	279	1,561	43	525	1,948	1,399	1,390	13	1,464	518	22,728
Colombia, Venezuela Ecuador and Bolivia...	108	65	11	12	...	225	33	...	12	5	...	169	640
Egypt, Tunis and Morocco	310	1,037	115	502	...	37	1,146	117	643	120	127	8,259	12,413
British West Africa	12	10	...	14	...	16	60	...	...	66	...	40	218
Rhodesia, O.R.C. and Transvaal	1,423	10,085	276	858	...	643	1,357	29	872	...	21	...	15,564
Cape of Good Hope	121	2,194	1,274	1,460	30	267	2,192	117	453	8	148	121	8,385
Natal	469	2,573	594	176	...	398	1,878	...	...	...	14	202	6,304
Zanzibar, Brit. E. Africa, Mauritius & Aden	...	31	...	217	...	48	827	...	35	...	...	...	1,158
Azores, Madeira and Portuguese Africa ...	31	180	5	119	...	...	117	...	15	...	...	37	504
French African Colonies and Madagascar...	...	37	...	...	...	...	107	500	...	...	...	...	644
Persia	47	116	10	82	...	...	10	...	17	...	19	...	301
China and Siam	430	3,376	353	1,194	...	1,746	4,855	156	666	30	221	862	13,889
Japan and Korea	529	...	...	21	...	2,602	...	...	2,815	50	20	476	6,513
India	2,573	23 721	2,832	4,613	547	842	16,748	2,420	6,917	157	1,497	1,054	63,921
Ceylon	117	1,814	155	236	...	182	150	36	185	18	162	121	3,176
Straits Settlements, Fed. Malay States and Sarawak	184	774	584	510	...	41	784	691	144	55	674	324	4,765
Hong Kong	352	379	260	404	...	393	471	...	104	...	144	111	2,618
West Australia	483	3,452	99	502	12	791	3,281	282	136	...	143	...	9,181
South Australia	345	1,966	165	360	...	...	695	...	...	...	626	...	4,157
Victoria	5,382	20,866	2,855	1,232	65	487	13,155	238	1,212	167	950	823	47,432
New South Wales	1,853	20,530	442	1,994	295	1,524	8,016	11,245	4,201	295	12,348	919	63,662
Queensland	149	5,420	112	243	...	...	2,825	...	4,983	...	20	229	13,981
Tasmania	18	3,200	11	81	...	...	22	...	17	...	...	...	3,349
New Zealand and Fiji Islands	442	6,550	384	908	23	1,455	3,880	1,744	1,238	...	2,324	278	19,226
Total, £	28,156	149,115	14,471	19,587	1,359	17,111	113,697	30,306	28,831	1,797	49,144	45,810	499,384

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	...	...	...	...	447	...	9,691	...	1,825	721	3,257	15,941
Germany	...	...	...	...	...	...	...	...	...	...	...	...
Holland...	26	1,195	63	23,328	3,243	16	105	...	37	...	...	28,013
France	1,395	38	352	10	501	1,029	393	200	8,357	2,104	581	14,960
Switzerland	1,571	...	50	92	...	1,532	4,062	...	581	1,259	414	9,561
Italy	979	8,514	...	...	...	...	30	885	...	...	...	10,408
United States	9,641	4,386	451	5,323	2,327	596	14,091	92,754	4,884	12,131	71,455	218,039
Total, £	13,612	14,133	916	28,753	6,518	3,173	28,372	93,839	15,684	16,215	75,707	296,922

Additional imports.—Spain, carbons, £1,202; China, lamp parts, £317; Japan, electrical goods, £20, glow lamps, £354, arc lamps and parts, £2,005, telegraph wires and cables, £15; Channel Islands, machinery, £20; N.S. Wales, goods, £5; Canada, electrical goods, £135, wires and cables, £1,308, glow lamps, £5, machinery, £275.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above	1,550	3,995	...	3,255	333	5,118	4,172	...	383	274	1,809	20,889

TOTAL EXPORTS: £499,384 TOTAL RE-EXPORTS: £20,889 TOTAL IMPORTS: £302,583

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

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CONTROL GEAR FOR DIRECT-CURRENT MOTORS.

By E. F. BUTLER.

(*Concluded from page* 699.)

In larger sizes, and for heavier work, the contacts on the slate should be reinforced by carbon rollers, to take any arc away from the contacts. A skate on the arm makes contact with these rollers when passing from one segment to another. Such an arm will usually have a square hole in which contact-blocks can slide freely. Adjustment of pressure is effected by means of a suitable spring acting on a short arm pressing on the top of the contact. It is best to have two contact blocks, as they can bed independently, and the block which first makes contact should be of carbon.

Flexible pigtails are often fitted to shunt the current from the tension spring. The fitting of these is often a source of weakness. The usual arrangement is to drill a hole in the carbon, push in a short piece of brass rod, to which the pigtail is fixed, and hope for the best. Owing to unequal expansion, these pieces of brass often work loose and fail to make good contact. Furthermore, when renewing the carbons it is easy to split them in attempting to fit the pigtails. A way of getting over the difficulty is shown in Fig. 3. A

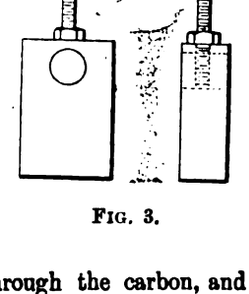

Fig. 3.

hole is drilled through the carbon, and another at right angles into this hole. A piece of round brass is tapped out and inserted. A set-screw is fitted to this, and two nuts at the top serve to hold the pigtail.

In the full-on position a laminated contact on the side of the arm presses against brass pillars on the slate and takes the full-load current. The pressure of this is usually taken against the pull of the no-volt coil, which in a good many cases is not sufficient to make a firm and reliable contact.

The next thing to consider is the resistance. Resistance elements in the form of wire or strip are most common. The construction is usually carried out in such a way that the maximum length of wire is got into as small a space as possible, and the usual form is a spiral, either with or without a core.

When no core is used, it is a good plan to provide separators or distance pieces to prevent the possibility of the coils touching or short-circuiting one another, either from vibration or sagging. This separator may take the form of a substantial sheet of uralite, having holes drilled and spaced correctly, which is slipped over the coils before they are connected up.

Coils wound on a core or former should have plenty of room to expand without buckling; if made of hygroscopic material, earthenware ends should be fitted. It would be an advantage if any coil could be removed independently for renewal or repair. In any case, all the side covers should be easily removable for inspection, and in small and medium sizes the resistances might well be arranged so that they could be removed bodily with the slate.

In order to keep down the sizes and numbers of resistance coils as much as possible, makers sometimes connect a number of coils in parallel to get the required resistance, and while this is often satisfactory, it means extra joints; furthermore, the wires, having a much smaller cross-sectional area, very easily get eaten through in damp locations.

The latest development of resistances in the form of coils is the enamel embedded type, and it seems very likely that these will be very largely used in the future. When properly made they are electrically and mechanically sound. In one form, largely used for Admiralty and dockyard work, a steel tube is covered with a coating of enamel, which will not soften at any ordinary working temperature. The resistance wire is wound over this, and to hold the wire in position a current is passed through it of sufficient strength to soften the enamel; the turns of wire sink in, and are held in place. A second coating of enamel is applied, which serves to preserve the wire from atmospheric influence, and also prevents any surface leakage. Previously to being dipped, suitable tappings are connected in where necessary, and the whole forms a robust self-contained unit. It is impossible to repair a burnt-out coil, but, on the other hand, burnt-out coils are very rare.

The metals available for resistances are somewhat few; iron is very much used, and also the nickel alloys. The latter are characterised by a very low temperature coefficient, which makes them of special value for use in regulating resistances, where it is desirable that a resistance, when once adjusted, shall keep its value permanently.

The most common alloys are nickelin, constantin, manganin, and eureka. Iron is most useful in the form of grids, and when so used, the following points may be noted:—

The formation of rust should be prevented as much as possible, the use of aluminium paint being the most common way.

Only mica insulation should be used; fibre is not uncommon, but very quickly perishes. Grids should be placed vertically, to facilitate cooling. When used on cranes, it will often be found preferable to bolt them up to the roof of the cab. If placed on the floor, which appears to be the usual method, the covers will get dented in, and short-circuit the grids, or there will be trouble due to irregular notching, which will quite likely be found due to the presence of spanners, screw-drivers, and miscellaneous ironmongery in general.

A three-point suspension is useful to prevent sagging, and it may be noted that stamped grids are much stronger and less liable to break than cast ones. An offspring from the grid is the mat or sieve resistance, which, in its usual form, consists of a woven asbestos mat, with the resistance wire threaded backwards and forwards through it. These mats are cheap, and a very fine grading of resistance can be obtained by their use.

The weakest point is in the connection; the mats are usually of very fine wire, and often connected several in parallel, and it seems difficult to make a sound connection to carry the current. This type of resistance has not been found satisfactory for controllers or regulators where it is necessary to keep the resistance continuously in circuit. When so used, the asbestos perishes and the wires short-circuit; furthermore, it is necessary to renew the whole resistance when one portion gives out, as the mats fall to pieces when taking them apart.

Materials of which the resistance decreases when heated up by the passage of the current are not in very general use. Messrs. Reyrolles, Ltd., are probably the leading makers of this type of control gear, and use this class of material to advantage. Its reliability is shown by at least one installation with which the author is familiar. The firm in question is one of the largest colour and poster printers. The starters have been in daily use since 1903, and have given no trouble. The makers of these starters also fit a magnetic blow-out to break the current at the first contact, as did the B.T.H. some years ago, and this seems such a simple and efficacious device that it is a wonder that it is not more widely adopted.

A few more details concerning the ordinary type of starter may be given. The buffer on which the arm rests when in the off position usually consists of a spindle passing through the slate and fixed by a nut, the other end carrying a disk of poor-quality rubber. The most common troubles with this arrangement are the breaking-up of the rubber and the working loose of the spindle in the slate. The usual result in either case is that the arm hits the end of the slot in the cover when the motor is stopped, and gets smashed, or else hits the spindle and knocks a piece out of the slate. It is good practice to use two buffers placed

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close together, so that the arm hits them both. Alternatively, a cast socket with lugs, bolted through the slate and using a spring in place of a rubber buffer, can be used. There is a point with regard to the starter arm which is worthy of notice, and that is the design of the end through which the spindle passes. A very common design is shown in fig. 4 at A. This has the fault that a very small

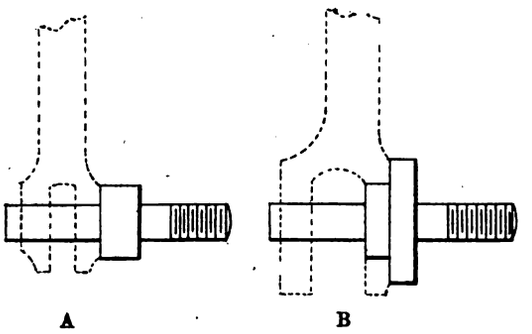

Fig. 4.

amount of wear is sufficient to throw the top end of the arm away from the slate. This often happens to such an extent as to cause sparking and heating of the contacts. A better arrangement is shown at B; the greater length of the spindle, together with the much larger facing and the addition of a shoulder, makes a much more mechanical job, and has a longer life.

The greater part of the foregoing remarks applies, to a very large extent, to starters and regulators used for series motors. In the case of small motors, regulators are often of the plain type, with no automatic features. Of course, this affords no protection to the motor in the event of the failure of the supply, and so it is usual to incorporate some more or less protective devices. In one form, ratchet teeth are cut round the bottom of the starter-arm, and the keeper of the no-volt release is made sufficiently long to engage with them, the end being turned up for the purpose. This arrangement suffers from the defect that the tension of the spring varies with the position of the arm; it is often too strong to hold the arm on the last contacts, and too weak to release when on the first contacts, the trouble being aggravated when the teeth begin to wear. In the most suitable form two arms are used, one acting as a switch, the other as the regulator, the resistance being cut out from right to left. The insulated handle is fixed to the regulator arm, and on moving this hard over, the switch arm is carried on to a contact button, which passes current round the motor, energising a coil which acts both as a no-volt and overload coil, and holds the switch arm on. The backward movement of the regulator arm cuts out the resistances, and so increases the speed of the motor. A somewhat similar arrangement can be used for varying the speed of a shunt motor by altering the strength of the field. In this case the insulated handle is fixed to the regulator arm. When this arm is moved, it pushes in front of it the arm which cuts out the armature resistance and runs the motor up to speed, the shunt resistance being short-circuited until the last stop is reached. The regulator arm can then be moved backwards, and the resistance inserted in the field in so doing. When the current is interrupted, both arms are returned to the off position and the shunt resistance is short-circuited.

A very common fault, and one which has done much to prejudice electric driving, is the abominable and inexcusable practice of having the starter and shunt regulator independent of each other, thus making it possible to start up the motor with a weakened field. In printing works especially, attempts to "inch" under such conditions have been, and still are, a source of trouble. Whenever shunt regulation is desired, it should be made impossible to start up except on a full field. This can be accomplished by means of the double-arm starter just described; or, if a separate regulator is desired, as in the case of an existing starter, or of some type of push-button control, then an electrically-interlocked regulator should be provided. A simple and reliable interlock (Igranic Co.) is shown in fig. 5. It will be seen that the essential part consists of a small coil C, similar to a no-volt coil, connected in series with the shunt fields, having a soft-iron keeper K, and a pair of contacts, A B.

Assuming that the motor were stopped by simply opening the double-pole switch, then the spring S would pull the keeper away from the iron cheeks, and so short-circuit the shunt resistance. The spring is strong enough to prevent the keeper from being attracted, but not strong enough to pull it away once it is attracted. When the motor is started, or re-started, the shunt resistance remains short-circuited until the regulator handle is moved to the "all out" position, pushes the keeper from the face of the magnet, and so unshort-circuits the shunt resistance, and enables it to be inserted in the field circuit.

Although speed regulation by means of resistance inserted in the armature circuit is not much used, as it is wasteful, and the speed varies with the load, it is sometimes convenient. Shunt regulation can be used in addition if required. The connections are as shown in the diagram, fig. 6.

One modification of the ordinary type of starter may be mentioned in passing, and that is the retarded or slow-motion type, which ensures that the resistance is cut out steadily and not too quickly.

The simplest way is to have a starter-arm with teeth cut round the lower end. A small worm-wheel is mounted underneath, free to rock through a short arc, and having a spindle with a crank at one end. The crank is pulled down until the worm engages with the teeth on the starter-arm, and is held down whilst being revolved. When the resistance is all cut out, the crank is released and the worm drops out of gear.

The troubles inseparable from the use of the ordinary type of starter—namely, flashing on the contacts, making

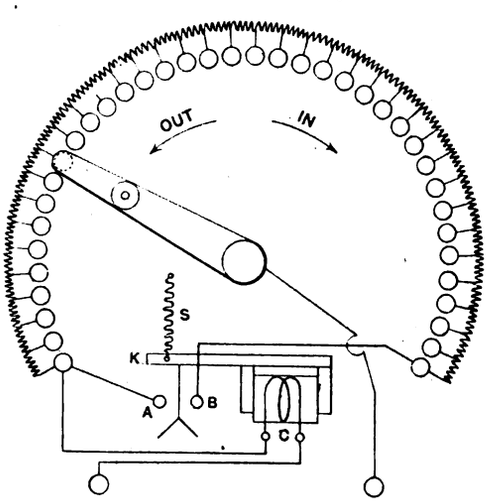

Fig. 5.

and breaking the circuit on the first stud, and the uncertain rate of cutting out the resistance—led makers to try and devise a starter which, without having any great complications, would get over these defects. Some makers are still trying to design a fitting or find out something which will not cost much (this is important), but when added to the ordinary starter will give it interlocking, non-arcing features, automatic acceleration, and dynamic braking. They usually give up the idea, or end by evolving a totally different class of apparatus.

The first step towards the evolution of a better type of control gear followed upon the realisation of the fact that the proper place to make and break a circuit carrying current is at a switch. A starter is not intended to do so, and will not do so. When the starting current of a motor, together with the self-induction of the fields, is to be broken, suitable arrangements must be made to deal with it, namely, auxiliary carbon contacts, operating in an arc-resisting chamber, a magnetic blow-out—in fact, all the essentials of a circuit-breaker, excepting that to avoid excessive pressure rises the break may be arranged to take place more slowly. A piece of apparatus which fills these requirements, and has stood the test of experience, may be described.

Briefly, this type of starter comprises a double-pole breaker which takes the place of switch and fuses, a no-volt and overload release, and a device for preventing too rapid

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acceleration. The starter itself looks very much like an ordinary one, but has the addition of a concentric ring on its base.

A contact on the starter-arm consists of a wheel, part of the periphery being an insulator and part metal, which engages with this ring.

On moving the handle forward, this wheel rotates until the brass portion makes contact with the ring, completes the "pull-in" circuit, and closes the double-pole breaker, which consists of two clapper switches. Moving the handle further forward puts an economy resistance in series with the holding-up coils of these switches. If the handle be moved

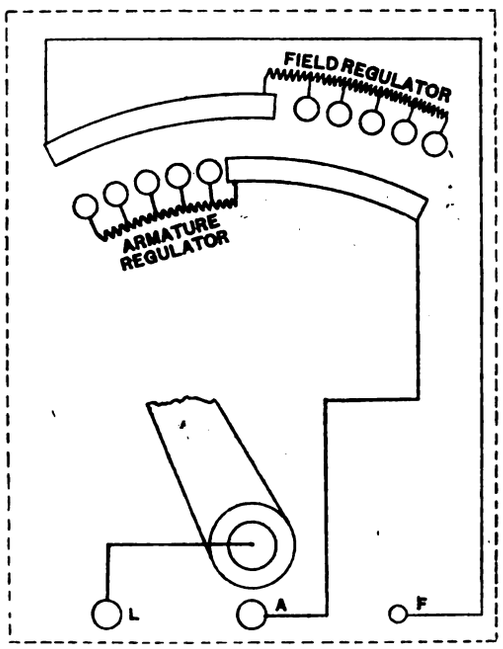

FIG. 6.

over too fast, the overload operates and opens the circuit of the clapper switches, and as the economy resistances are still in circuit, there is not enough current passing to pull them in again and so the handle must be put back to the "off" position.

If the handle be moved backwards while starting up, the roller turns round slightly and the insulating portion touches the brass quadrant; again, the clapper switches open and the arm must be moved right "off."

This type of apparatus also has the advantage that push-buttons can be connected up in series and operate by breaking the "hold-up" circuit. This makes it of particular value for such purposes as printing works and saw-mills.

Having dealt with a number of types of starters largely from the standpoint of design, this article may be fittingly concluded by a few words, more in sorrow than in anger, to the user and the wiring contractor.

The fixing-up of control gear is often done in a slipshod and unworkmanlike manner, probably more often than not. It is a far too common sight to see the double-pole switch and fuses, starter, and sometimes speed regulator and ammeter, fixed to any convenient part of the wall, which may have to be plugged in four places for each item, with cables festooned from one fitting to another, possibly held together at intervals with tape. Sometimes battens are fixed, and the control gear is screwed on to them, attempts at earthing being made by trying to tighten a stranded cable under a countersunk screwhead without washers. It is much more satisfactory to make a sound job, both mechanically and electrically, by mounting the whole of the control gear on steel bars or channels. These should be spaced to take the widest fitting, usually the starter; the other portions can be mounted on ironwork carried across between the uprights, and preferably riveted to them. The whole can be fixed to the wall by means of bolts cemented in, or run in, with lead. To facilitate subsequent repairs, it is advisable to crank the ends of the uprights, or to pack them out from the wall, so that it is possible to work behind the panel.

IRON CONDUCTORS FOR HOUSE WIRING.

A CONTRIBUTOR to the *Elektrotechnische Zeitschrift*, obviously desirous of making a virtue of necessity, has drawn up what is probably the best case possible for iron as a house-wiring material. The author states that after overcoming his initial natural prejudice against iron wiring, he realised speedily its numerous advantages, and is now prepared to recommend its use after, as well as during, the war (!). His premises and conclusions are certainly worth consideration, since the exhaustion of the world's copper supplies is due at a much earlier date than the exhaustion of its coalfields. From the notes and examples given below, it will be clear that iron as a house-wiring material is a much more feasible proposition than the use of that metal for transmission and distribution cables and for the windings of electrical machinery.

When there was no more efficient filament lamp than the carbon type, and when electric lighting was a luxury accessible only to the rich, so that the problem was to supply large installations of inefficient lamps, the use of copper as a wiring material was practically essential, and relatively enormous sections of even that good conductor were frequently required. Now, however, the use of tungsten lamps is universal, and there are thousands of small lighting installations having only a few metal-filament lamps supplied through copper wiring, which is rarely worked at anywhere near the permissible voltage drop. For example, the I.E.E. rules specify that the minimum cross-section of any house-wiring conductor (except fittings wires), must be not less than that of an 18 S.W.G. conductor. Such a conductor, rubber insulated, may be worked at 7·2 amperes so far as concerns heating. Taking an average lighting load of 350 watts for a suburban villa, this corresponds to 1·75 amperes at 200 volts, and assuming the whole load to be concentrated at the end of a single pair of leads (which it is not), the length of run might be about 105 yards for a pressure drop of 5 volts (2 per cent. plus 1 volt, as allowed by I.E.E. Rule 40). In other words, the smallest permissible size of copper conductor is unnecessarily large, both from the standpoint of conductivity and temperature rise, in such an installation, and there is a *prima facie* case for a wiring material of lower conductivity.

The permissible voltage drop in house lighting installations being 2 per cent., plus a constant allowance of 1 volt (*i.e.*, 3 per cent. total in 100 volts, and 2½ per cent. in 200-volt circuits), the C.P. variation in metal-filament lamps is about 10 per cent., as against 15 per cent. in carbon-filament lamps, and it must be remembered that the actual voltage drop is very rarely the maximum possible, and then only for the lamps at the far end of the circuit; further, the full 10 per cent. change in C.P. will only occur if all intervening lamps be switched on, and then off. Usually only 15 to 30 per cent., and rarely 50 per cent., of the lamps in a private house are in use at any one time, so that the maximum pressure drop is very rarely more than half the possible value, and the variations in pressure are yet smaller. Arguing on these lines, a number of German electricity supply stations which took 1·5 per cent. voltage drop as the basis for designing house-wiring installations prior to the war have decided to allow 5 to 6 per cent. maximum drop in future.

In order to see what can be done with iron wiring on this basis, let us assume conductors of 1½ and 2½ sq. mm. section (approximately Nos. 17 and 15 S.W.G. respectively) supplying, say, five, and ten, 30-watt lamps (in turn) grouped at the end of a single pair of leads. The length of run of these leads, corresponding to 5 per cent. voltage drop at the terminals of the lamps, will give a very fair indication of the utility or otherwise of iron conductors of the above sizes. Taking the specific resistance of iron as 0·143 ohm per metre per sq. mm., the results may be thus tabulated:—

		110 volts.		220 volts.	
Supply pressure					
No. of 30-w. lamps		5	10	5	10
Permissible run (single length) of circuit for 5% pressure drop; using iron wires.	Lamps grouped:	Yd.	Yd.	Yd.	Yd.
	17 S.W.G. wire	23	11½	92	46
	15 S.W.G. wire	38½	19	154	77
	Circuit branched:				
	17 S.W.G. wire	35	17½	139	69
	15 S.W.G. wire	58	29	232	116

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The two lower lines in this table show the probable run permissible in the same cases as before, but assuming the circuit to be branched, as is invariably the case in actual house-wiring. The exact increase in run permitted by this branching depends on the distribution of the lamps, but it is safe to assume that the most distant lamp may be 1½ times as far from the service point as when all the lamps are supposed grouped at the end of two wires.

There are many thousands of small lighting consumers having, say, eight 30-watt lamps, or their equivalent, installed, and it is obvious from the above table that No. 16 S.W.G. iron wiring could be used in such cases without any fear concerning voltage drop, the effective length of the branch circuits in such houses being less (generally much less) than corresponds to the 5 per cent. maximum pressure drop held to be permissible. By using larger iron conductors (say, up to 7/16 S.W.G.), and by using copper or zinc for the heavily loaded portions of more extensive wiring installations, the possibilities of economy in wiring are greatly extended. An immense amount of copper at present used only for mechanical reasons would be saved. Electrolytic troubles at the junction of dissimilar conductors could be avoided by the use of suitable junction-boxes, and the prevention of rusting on the exposed portions of iron wiring at connecting points does not appear to offer insuperable difficulties, so far as concerns ordinary house wiring. German reports concerning the ease of installing iron wiring are not very favourable, but, on the other hand, it is pointed out that practically no skilled labour is available for the work; and, further, that installation would be much facilitated were rubber-insulated wires available, so that the conductors could be drawn into conduit—but rubber is as scarce as copper in Germany! There seems good ground for the belief that German manufacturers will continue to use iron as a substitute for copper in many electrical applications after the war, and it certainly seems that house wiring is not merely one of the least objectionable of these applications, but one which is distinctly worth closer investigation, even by those to whom the copper markets of the world are still open.

A NEW RÖNTGEN RAY TUBE.

At a recent meeting of the Dresden Electrotechnical Association, Prof. F. J. Koch discussed the latest developments in X-ray equipment, and described a new tube construction due to Lilienfeld. According to Koch, the inconstancy of vacuum in a Röntgen tube operating on a high-pressure rectifier may be attributed to sudden fall in the potential of the electrodes, after attaining the potential difference required to break down the initial resistance of the tube, permitting energy stored in the capacity of the starting-transformer windings to set up oscillatory discharges through the tube. The vacuum is also affected by release of occluded gas on the one hand and by consumption of residual gases in the tube on the other hand. The higher the vacuum the "harder" the tube, but once a steady state has been attained, a skilled operator can maintain practically constant "hardness" for a long time by choosing a suitable current strength.

Lilienfeld has discovered that the nature of the discharge is independent of degree of vacuum, up to a certain point, if an incandescent cathode be employed in the vacuum tube. This principle is applied in the Coolidge tube by using a glowing tungsten spiral as cathode; diffuse cathode rays are sent off in all directions, and generate Röntgen rays where they impinge. The efficiency of the tube decreases rapidly with load, so that control of effect is not easy. With a view to overcoming this difficulty, Lilienfeld adds to the ordinary Röntgen ray tube a special ignition tube containing an incandescent cathode in the shape of an ordinary metal lamp filament. The main and ignition tubes may be excited by two tranformers working in phase, or a single transformer (T, fig. 1), may be used for both purposes. In fig. 1, G represents the incandescent cathode, K the main cathode, and A the anticathode. A variable high resistance R is shunted between K and A, and adds considerably to the homogeneity of the rays. The cathode G is made incandescent by an auxiliary transformer H, and when T develops the breakdown pressure, ignition current flows between G and K. The latter being tubular, cathode rays pass into the Röntgen tube itself, break down its high cathode resistance, and establish discharge between K and A. As compared with R, the internal resistance of the tube is so small that most of the current passes through it, and only a small part through the high-pressure resistance.

As regards general construction, the anticathode is water-cooled, and since the glass shows no fluorescence (electrons being produced artificially), a fluorescent screen is mounted inside the tube to indicate its working. It is claimed that this tube gives constant radiation at all loads, that the hardness or penetrating power of the rays can be varied easily and accurately either by altering the ignition current or by varying the setting of R, and the hardest or softest rays can be obtained at a moment's notice (irrespective of previous conditions) and maintained indefinitely in greater intensity than is possible with other tubes. The quantity of rays varies directly with the current strength, and the radiation is relatively homogeneous. Since no reflected cathode rays fall on the glass, the latter does not become hot in working; also no guard screen is necessary on account of Röntgen-rays from the glass. Sharp negatives are obtained; and the life of the tube is practically equal to that of an

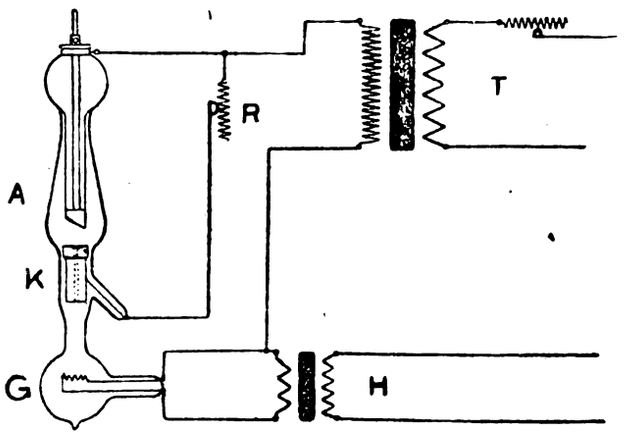

Fig. 1.

ordinary glow lamp (so long as the anticathode is not prematurely damaged by overload), *i.e.*, the life is determined by the incandescent cathode instead of by consumption of residual gas by the cathode rays. The new tube is made with as high a vacuum as possible.

A valve-tube with incandescent cathode is claimed to give excellent results, and to render unnecessary rectification of the high-pressure transformer current. In order to keep the field stress in the spark transformer approximately symmetrical, Koch places a "directional resistance" (porcelain-sheathed aluminium rod in electrolyte contained by an iron vessel), in parallel with the transformer primary.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

NETHERLANDS.—In virtue of a Ministerial Resolution dated April 27th, iron moulds used for the construction of concrete ducts for electric cables are classed as machinery in the Dutch Customs Tariff, and will be admitted free of import duty.

MEXICO.—The Board of Trade have received information to the effect that, in virtue of a Mexican Decree published on May 24th, the fee to be charged by Mexican Consular officers for the certification of invoices of goods shipped to Mexico has been fixed at 3 per cent. of the value of the goods covered by the invoice. It is understood that this new rate was to come into force on June 15th as regards shipments from the United States or Cuba, and on July 1st as regards shipments from other countries.

SOUTH AFRICA.—According to a decision, dated April 17th, by the Commissioner of Customs, incandescent bulbs for pocket electric torches are dutiable under No. 114 (b) of the Union Tariff at the rate of 3 per cent. under the General Tariff, with a rebate of 3 per cent. on goods manufactured in the United Kingdom or reciprocating British Colonies.

ITALY.—A Decree, dated May 21st, has been issued by the Lieutenant-General authorising the competent Italian Ministries to prohibit, during the period of the war, the importation into Italy of bulky goods and articles of luxury. The Decree came into force on June 4th.

UNITED STATES—HAYTI.—Ratifications were exchanged on May 3rd of a Treaty which was signed in September last between the United States and Hayti, having for its objects, *inter alia*, the remedying of the present condition of the revenues and finances of Hayti and the carrying out of plans for its economic development and prosperity. The Treaty is to remain in force for 10 years from May 3rd, 1916. It provides for the appointment, upon nomination by the President of the United States, of a General Receiver to collect, receive, and apply all Customs duties on imports and exports; and, further, that the Customs duties shall not be modified in a manner to reduce the revenues therefrom without a previous agreement with the President of the United States.

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NEW PATENTS APPLIED FOR, 1916.
(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

8,278. "Electric incandescent lamps." T. H. BENYON. June 12th.

8,285. "Portable electric lighters for gas." R. W. SANDERS. June 12th.

8,291. "Recording and reproducing audible and visual indications." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.). June 12th.

8,303. "Transforming motion into electrical waves and impulses." T. B. DIXON. June 12th. (U.S.A., July 19th, 1915.)

8,305. "Telephone transmitter." S. C. PORTER. June 12th. (U.S.A., June 12th, 1915.)

8,310. "Electric meters or relays." BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING Co. (Westinghouse Electric & Manufacturing Co.). June 12th.

8,320. "Electrical regulators, or rheostats." E. D. RODWAY AND SWITCHGEAR & COWANS, LTD. June 13th.

8,321. "Holders for electric lamps." W. TRENTHAM. June 13th.

8,334. "Electric detonators or fuses." F. S. DENNISON. June 13th.

8,359. "Electric arc lamps." BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING Co. (Westinghouse Electric & Manufacturing Co.). June 13th.

8,360. "Control systems for electric motors." BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING Co. (Westinghouse Electric & Manufacturing Co.). June 13th.

8,393. "Electrolytic cells." H. C. JENKINS, H. F. PATTINSON & R. WELLESLEY. June 14th.

8,394. "Electrical keyboard transmitting apparatus." H. K. HARRIS. June 14th.

8,416. "Electrical resistances." H. SNOWDON. June 14th.

8,422. "Cutting-out fluid wave transmission lines." G. CONSTANTINESCO AND W. HADDON. June 14th.

8,430. "Field magnets for magnetos, &c." H. B. STOCKS. June 15th.

8,433. "Electric heaters." CABLE ACCESSORIES Co. & F. H. REEVES. June 15th.

8,436. "Ammeters and voltmeters." V. DEEBECQUE & WALSALL ELECTRIC Co. June 15th.

8,453. "Glass-working machines." BRITISH THOMSON-HOUSTON Co. (General Electric Co.). June 15th.

8,457. "Magneto electric machines." A. E. BENNETT. June 15th.

8,458. "Electrical make-and-break devices." A. E. BENNETT. June 15th.

8,467. "Attachment for electric torches." J. F. BARR. June 15th.

8,470. "Device for attachment to sparking plugs of petrol, &c., engines for automatically cleaning and cooling sparking points of such plugs." A. E. LAMKIN. June 15th.

8,473. "Machine switching telephone exchange systems." L. POLINKOWSKY & WESTERN ELECTRIC Co. June 15th.

8,474. "Electric and steam power-generating systems." J. C. RUTHS. June 15th. (Germany, June 14th, 1915.)

8,476. "Electric and steam power-generating systems." J. C. RUTHS. June 15th. (Germany, June 14th, 1915.)

8,499. "Electrical turning gear for starting internal-combustion engines." ROLLS-ROYCE, LTD., & F. H. ROYCE. June 16th.

8,509. "Secondary electric batteries or accumulators." CHLORIDE ELECTRIC STORAGE Co. & H. DEAN. June 16th.

8,521. "Fittings for preventing theft of electric incandescent lamps." J. HARRINGTON. June 16th.

8,533. "Electric furnaces, &c." T. BALMFORTH & Co. AND H. J. KITCHEN. June 16th.

8,536. "Electric bell actuated by sound waves." T. W. A. COMBEN. June 17th.

8,550. "Field telephone equipment." A. E. CARR. June 17th.

8,551. "Electric lamps, &c." J. CLEGG & J. COOK. June 17th.

8,558. "Variable-rate electricity meters with two counters." LANDIS AND GYR SOC. ANON. June 17th. (Switzerland, June 22nd, 1915.)

8,574. "Electrical motors." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.). June 17th.

8,581. "Rotary motors actuated by alternating fluid currents." G. CONSTANTINESCO & W. HADDON. June 17th.

8,584. "Ignition dynamos." C. T. MASON. June 17th. (U.S.A., June 19th, 1915.)

PUBLISHED SPECIFICATIONS.

1914.

4,808. SPARKING PLUGS, AND THE MANUFACTURE OF SAME. Thomas Crosbee and Sons, Ltd., & W. J. Spicer. March 29th. (Cognate applications, 11,123/15 and 12,240/15.)

6,197. CONTROLLING MECHANISM FOR AUTOMOBILES. British Thomson-Houston Co. (General Electric Co., U.S.A.). April 20th.

6,340. ELECTRIC RESISTANCE REGULATING ARRANGEMENTS. J. H. Woolliscroft. April 28th.

7,909. BATTERY CASES FOR ELECTRIC CYCLE LAMPS. F. Westwood. May 28th.

8,004. INSULATING MATERIAL AND METHOD OF PRODUCING SAME. H. B. MacFarland & R. J. Shoemaker. May 29th.

8,106. PROTECTIVE ARRANGEMENTS FOR ALTERNATING-CURRENT APPARATUS. F. E. Berry. June 1st.

8,305. METHOD OF AND MEANS FOR SEPARATING METALS BY ELECTROLYSIS. A. Walker. June 4th.

8,318. MECHANISM FOR OPERATING ELECTRICALLY-WORKED TRAMWAY AND RAILWAY TRACK POINTS. J. Murray. June 4th.

8,327. COMPOSITE METAL BODIES. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 4th.

8,417. CASING FOR THE STATORS OF DYNAMO-ELECTRICAL MACHINES. Maschinenfabrik Oerlikon. June 7th. (June 30th, 1914).

9,408. CASES FOR AMMETERS AND VOLTMETERS. A. Chinn & H. Butler. June 28th.

11,224. MAGNETOS APPLICABLE FOR THE LIGHTING OF VEHICLES. J. Bethenod. August 3rd. (June 27th, 1914.)

11,473. ALTERNATING-CURRENT MOTORS. British Thomson-Houston Co. (General Electric Co., U.S.A.). August 9th.

11,684. CONTROLLING MECHANISM FOR PRINTING PRESSES OPERATED BY ELECTRIC MOTORS. Goss Printing Press Co., of England (Goss Printing Press Co.). August 12th.

12,702. ELECTRICAL HEATING ELEMENTS. H. Cheshire (trading as Cranmer and Cheshire). September 4th.

12,772. ELECTRICAL SWITCHES. A. C. Wynne. September 7th.

12,772. ELECTRIC RESISTANCES. J. Collinson. October 6th.

14,164. ELECT[illegible]

14,273. PROCESS FOR THE ELECTROLYSIS AND TREATMENT OF SULPHATE LIQUORS. E. J. Hunt & W. T. Gidden. October 8th. (Addition to 11,634/13.)

14,499. GUARDS FOR THE CORDS OR WIRES OF TELEPHONE SETS. O. Yates, Sen., H. Gambling & L. F. Parker. October 13th.

15,563. CONSTRUCTION OF ELECTRIC SWITCH. G. Markt. November 4th.

16,452. ELECTRIC SOLDERING IRONS. J. G. Clemens. November 22nd. (November 21st, 1914.)

1916.

801. SHADEHOLDERS FOR GAS OR ELECTRIC LIGHT FITTINGS. R. W. McLachlan. January 18th, 1916. Patent No. 100,525.

955. ELECTRIC CONDENSERS. H. R. van Deventer. February 15th, 1915. (Patent No. 100,081.)

3,389. ALTERNATING-CURRENT ELECTROMAGNETS. Waygood-Otis, Ltd. (Otis Elevator Co.). March 7th, 1916. Patent No. 100,519.

3,533. MULTIPLE-CONTACT MICROPHONES. Signal Gen. January 19th, 1915. Patent No. 100,156.

3,658. STARTING MECHANISM FOR INTERNAL-COMBUSTION ENGINES. British Westinghouse Electric & Manufacturing Co. April 6th, 1915. Patent No. 100,246.

3,659. STARTING MECHANISMS FOR INTERNAL-COMBUSTION ENGINES. British Westinghouse Electric & Manufacturing Co. March 24th, 1915. Patent No. 100,197.

4,109. JOINT FOR AN ELECTRIC CABLE. A. E. Tanner & E. A. Claremont. March 20th, 1916. (Addition to 6,980/15.) Patent No. 100,511.

LIST OF BRITISH PATENTS EXPIRING DURING 1916.

(*Continued from page 720.*)

9,488. April 24th, 1902. A. W. Beuttell. Electric lamps.

9,803. April 28th, 1902. M. Wildermann. Electrolysis.

10,181. May 2nd, 1902. O. J. Lodge & A. Muirhead. Syntonic telegraphy.

10,204. May 3rd, 1902. J. Hargreaves, J. W. Stubbs & J. Kearsley. Electrolysis.

10,452. May 6th, 1902. J. E. Evans-Jackson. Wireless telegraphy.

11,085. May 14th, 1902. Stothert & Pitt and E. Evans. Electric cranes.

11,500. May 20th, 1902. G. C. Marks. Electric switches.

11,698. May 22nd, 1902. W. D. Kilroy. Time indicators for stokers, &c.

12,159. May 28th, 1902. C. D. Abel. Electric lamps.

12,554. June 2nd, 1902. Siemens Bros. & Co. Telephone systems.

12,706. June 3rd, 1902. C. D. Ehret. Electric telegraphs.

13,287. June 11th, 1902. H. H. Lake. Signals, marine; locating sounds.

13,521. June 14th, 1902. Sir O. J. Lodge, A. Muirhead & E. E. Robinson. Wireless telegraphy.

14,133. June 21st, 1902. H. Baker & Castner-Kellner Alkali Co. Electrodes; couplings.

14,135. June 21st, 1902. H. Baker & A. T. Smith and Castner-Kellner Alkali Co. Electrolysis.

14,136. June 21st, 1902. W. A. Gorman & A. Graham. Telephones for divers, &c.

14,228. June 23rd, 1902. W. Schuster. Clutches.

14,269. June 24th, 1902. E. W. Smith. Controlling traffic on railways.

14,286. June 24th, 1902. T. A. Hearson. Electric vehicles.

14,308. June 24th, 1902. J. P. O'Donnell & E. C. Irving. Railway signals.

14,373. June 25th, 1902. Lancashire Dynamo & Motor Co. and R. S. McLeod. Electric distribution.

14,430. June 25th, 1902. F. H. W. Higgins. Telegraphs; gearing.

14,732. July 2nd, 1902. T. B. Murray & N. O. Fulton. Magneto-electric machines; dynamos.

14,774. July 2nd, 1902. Vickers, Sons & Maxim, A. D. Williamson and C. L. Sumpter. Electric motors; planing machines, &c.

14,790. July 2nd, 1902. Johnson-Lundell Electric Traction Co. Dynamo-electric machines.

14,851. July 3rd, 1902. L. Lohner & F. Porsche. Dynamos and motors, controlling; systems of electric lighting.

15,095. July 7th, 1902. F. Conrad. Electric testing.

16,034. July 18th, 1902. G. S. Baker. Toothed gearing.

16,041. July 18th, 1902. A. C. Reyrolle. Electric resistances and heaters.

16,495. July 24th, 1902. J. E. Bousfield. Welding chain links.

16,529. July 25th, 1902. M. I. Pupin. Telephone and telegraph cables and conductors.

16,923. July 30th, 1902. H. H. Lake. Incandescent electric lamps; moulding glass.

17,406. August 7th, 1902. A. Blondel. Electric lamps.

17,703. August 12th, 1902. R. A. Fessenden. Wireless signalling, &c.

17,705. August 12th, 1902. R. A. Fessenden. Wireless signalling.

17,706. August 12th, 1902. R. A. Fessenden. Wireless signalling.

17,708. August 12th, 1902. R. A. Fessenden. Wireless signalling.

18,328. August 20th, 1902. British Thomson-Houston Co. Electric switches; motors, controlling.

18,747. August 26th, 1902. R. Haddan. Telephone systems.

18,786.* August 26th, 1902. H. Bremer. Electric lamps.

18,817. August 27th, 1902. British [illegible]nson-Houston Co. Electric motors.

18,821. August 27th, 1902. British Thomson-Houston Co. Electric motors.

(*To be concluded.*)

A Fire Without a Flame.—The strangest freak fire in the history of the Dayton fire department occurred recently at the Paris Store. An electric iron left on a table burned its way through the table, through the flooring, through a 10-in. joist that supported the floor, and was dangling by its wires from the ceiling of the storeroom below when discovered. The fire department investigated, but did not throw any water, for the iron had not fired the building. The only repairs necessary will be to reinforce the burned joist and close the hole in the ceiling and floor.—*Electrical World.*

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